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EDITORIAL

Essential Pain Medicine A Clinical and Ethical Imperative for Healthcare Professionals

Amjad Iqbal

Pain is not just a symptom; it is a signal, a story, and often, a silent cry for help and is one of the most common reasons patients seek medical care, yet its management remains one of the most neglected areas in clinical practice. Millions suffer unnecessarily due to under-recognition and under-treatment of pain. The ability to recognize, assess, and effectively manage pain is not merely a clinical skill — it is a moral imperative. Whether acute or chronic, its management directly impacts recovery, quality of life, and trust in the healthcare system. For healthcare professionals, especially in South-East Asia and Pakistan, the integration of essential pain medicine into routine care is not just a clinical necessity — it is a moral obligation.

The Scope of the Problem

Chronic pain affects more people than diabetes, heart disease, and cancer combined. In Pakistan, the burden of chronic pain is substantial, with studies indicating that it surpasses the prevalence of commonly encountered disorders such as diabetes mellitus and hypertension. Despite this, pain management services are limited, and access to essential medications — particularly opioids for severe pain — remains restricted due to regulatory, logistical, and educational barriers.

Gaps in Access and Education

- **Essential Medicine Lists**:
- While Pakistan has a National Essential Medicine List, the availability of essential pain medicines, especially opioids for severe pain and palliative care is inconsistent across healthcare facilities due to regulatory, economic, or educational barriers.
- **Training Deficits**.
- Medical curricula at the undergraduate as well as post graduate level in the country lacks even basic training in pain assessment and management, leaving doctors ill-equipped to address this critical aspect of patient care.
- **Regulatory Challenges**:
- WHO reports highlight that access to essential opioids in South-East Asia is hindered by overly restrictive drug policies, despite their necessity for palliative and cancer care.

The Role of Healthcare Professionals

- Doctors are uniquely positioned in health care system and they must lead the transformation in pain care by:
- **Advocating for Policy Reform**: Supporting balanced regulations that ensure access and affordability of essential pain medicines while preventing misuse.
- **Integrating Pain Education**: Encouraging medical institutions to include pain medicine as a core component of undergraduate and postgraduate training.
- **Expanding Services**: Promoting multidisciplinary pain clinics and rehabilitation services, as exemplified by emerging interventional pain management practices in Pakistan.

A Call to Action

- Pain relief is a human right. The World Health Organization emphasizes that essential medicines should be available at all times, in adequate amounts, and at prices individuals and communities can afford. For doctors in Pakistan and across South-East Asia, embracing pain medicine is not just about improving outcomes — it's about restoring dignity to those who suffer.
- Let us ensure that pain is no longer invisible in our healthcare systems. Let us treat it with the urgency, compassion, and expertise it demands.

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REFERENCES

1. Akhlaque, U., Razaq, S., Gunduz, H., & Rathore, F. A. (2024).
2. *Interventional pain management practices in Pakistan: The role of Physical Medicine and Rehabilitation*. Journal of the Pakistan Medical Association.
3. Drug Regulatory Authority of Pakistan. (2022). *National Essential Medicine Lists*. WHO South-East Asia Regional Office. (2018). *Access to pain relief and essential opioids in the WHO South-East Asia Region.*

CONFLICT OF INTEREST

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ORIGINAL ARTICLE

Risk of Premature Atherosclerosis in Patients with Transfusion Dependent Beta-Thalassemia Major

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ABSTRACT

Objective: To assess the risk of premature atherosclerosis in transfusion-dependent beta thalassemia major patients using Atherogenic Index of plasma.

Study Design: Comparative Cross-sectional study.

Place and Duration of the Study: Pathology Department, Fauji Foundation Hospital Rawalpindi, from 1st March 2024 to 31st August 2024.

Materials and Methods: Total 120 participants were included in our study comprising of 64 β-Thalassemia major patients and 56 healthy subjects. Patients with poor compliance for blood transfusions or iron-chelating therapy; individuals with age <3 years, having history of familial hyperlipidaemia, diabetes mellitus, hypothyroidism, liver or renal disease were excluded. Consent was obtained and anthropometric along with clinical details were recorded. Fasting blood samples were analyzed for serum lipid profile, serum Ferritin and plasma hemoglobin. Atherogenic index of plasma was calculated by the formula: log TG/HDL-C. Data was analyzed on SPSS 23.

Results: Sixty-four β-Thalassemia major patients with mean age 13.2±4 years and 56 healthy subjects with mean age 12.6±5 years participated in our study. Elevated serum triglyceride level while reduced serum total cholesterol, low density lipoprotein and high-density lipoprotein cholesterol levels were found among β-Thalassemia major patients than healthy individuals (p <0.001). Atherogenic Index of Plasma was markedly elevated among β-Thalassemia patients than their healthy counterparts; 0.27(0.08-0.38) vs. 0.06(0.03-0.08) (p <0.001), indicating high propensity of premature atherosclerosis in them. Plasma Atherogenic Index exhibited positive correlation with serum Ferritin (r= 0.41, p = 0.001) and negative correlation with plasma Hemoglobin (r= -0.65, p < 0.001).

Conclusion: β-Thalassemia major patients have elevated Plasma Atherogenic Index value than age-matched healthy subjects, implying high risk of premature atherosclerosis and future cardiovascular events in this vulnerable group.

Keywords: *Beta-Thalassemia, Lipid Profile, Premature Atherosclerosis.*

Introduction

Beta-Thalassemia major (βTM) is among the most common genetic disorders characterized by abnormal or decreased production of β-globin chains of hemoglobin leading to hemolysis, chronic anemia in these patients and the need for repeated blood transfusions for their entire life.[1] High prevalence of βTM has been documented in the Indian subcontinent, with the estimated carrier rate of 5-7% in Pakistan.[2]

Cardiovascular complications, particularly those secondary to chronic iron overload, are recognized as the leading cause of mortality in patients with βTM.[3] There is strong evidence that these patients are prone to develop premature atherosclerosis[4]; a condition that is subclinical and has been attributed to iron overload, oxidative stress, chronic hemolysis, dyslipidemia and several other factors.[5] Metabolic lipid derangements commonly observed among βTM patients include reduced levels of total cholesterol (TC), low density lipoprotein cholesterol

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(LDL-C), high density lipoprotein cholesterol (HDL-C) while elevated levels of serum triglyceride (TG).[6, 7] Exact pathogenesis of dyslipidemia is not clear but iron overload and oxidative stress have been mainly attributed for these changes.[8]

Owing to ineffective erythropoiesis, ongoing hemolysis and frequent transfusions, iron overload that is commonly seen in these patients causes oxidative stress and poses the risk of various complications including dyslipidemia.[3] Other factors contributing towards dyslipidemia in βTM patients include plasma dilution secondary to hemolysis and anaemia altering the distribution of the lipids, increased cholesterol uptake by reticulo-endothelial system due to increased erythropoiesis triggered by ongoing hemolysis, altered liver function secondary to iron deposition, and endocrine disorders like hypothyroidism and diabetes mellitus.[9]

These lipid derangements and vascular changes if not detected early can lead to atherosclerotic cardiovascular disease (ASCVD) and even cerebrovascular disease in these patients. To evaluate the risk of atherogenicity in patients with βTM, various investigative tools have been utilized including carotid artery intima media thickness (CAIMT), serum Osteoprotegerin, fasting lipid levels and atherogenic index of plasma (AIP).[10] AIP is an emerging biomarker that has been considered useful for atherosclerosis risk assessment in obese, diabetic, hypertensive, hypothyroid, vitamin D-deficient and other high-risk groups,[11, 12,13] however, its use for risk assessment and stratification in βTM patients has not been studied much. AIP is a lipid-derived index calculated from logarithmic transformation of ratio of serum triglyceride and HDL-c, both of which have strong association with atherogenesis.[14] AIP has been suggested as a better predictor of ASCVD than the standard lipid testing and other atherogenic indices[15,16,17] since AIP is less cumbersome, inexpensive and outperforms than the predictive ability of the individual lipid values.[17,18] High risk of atherogenicity reported in βTM patients by previous studies prompts close monitoring of lipid derangements for early detection and timely management of potential contributors of atherogenesis in order to avoid progression towards cardiovascular complications. Data regarding biochemical assessment of atherosclerosis risk in βTM patients are scarce in our region; therefore, we designed this study to evaluate the risk of premature atherosclerosis in transfusion dependent βTM patients by using Atherogenic Index of Plasma.

Materials and Methods

This was a cross-sectional study executed at Department of Pathology, Fauji Foundation Hospital Rawalpindi from 1st March 2024 to 31st August 2024 after getting permission from the Institutional Ethical Review Board (No. 702/RC/FFH/RWP). Sample size of the study was determined through WHO sample size calculator with the prevalence of βTM in Pakistan 7%, [2] confidence level 95% and margin of error 5%.

Our study comprised of total 120 participants selected through non-probability consecutive sampling. Sixty-four Beta thalassemia major patients > 3 years age, diagnosed on the basis of hemoglobin electrophoresis or high-performance liquid chromatography (HPLC) and registered in the Hospital Blood Bank for receiving regular blood transfusions were included in the study. Fifty-six apparently healthy, age and gender-matched individuals were included for comparison. βTM patients having poor compliance for blood transfusions or iron-chelating therapy, participants with age <3 years, history of other hemoglobinopathies, hereditary hyperlipidemia, diabetes mellitus, hypertension, hypothyroidism, liver disease, renal disease, cardiac disease, acute inflammation, smoking and those taking lipid lowering medication or steroids were excluded.

After getting informed consent, demographic information including gender, age of the subjects, age of βTM diagnosis, frequency of blood transfusions, medical history, drug history, dietary history and family history were recorded on a questionnaire. Anthropometric parameters including weight and height were measured by using calibrated digital weighing scale and stadiometer (Kern MPE, Germany). Fasting blood specimens were collected and analyzed for blood complete picture on fully automated hematology analyzer (Beckman Coulter, USA), serum lipid profile on fully automated chemistry analyzer (Atellica CH by Siemens, Germany) and serum Ferritin on Chemiluminescence immunoassay (Atellica IM by Siemens, Germany).

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Body Mass Index (BMI) and BMI percentile scores were determined by using CDC BMI calculator and BMI-for-Age growth charts respectively. Subjects were categorized into underweight (BMI <5th percentile), healthy weight (BMI between 5th and 84th percentile), overweight (BMI between 85th and 94th percentile) and obese (≥95th percentile) according to CDC guidelines. Serum Ferritin in the range of 15-150 ng/ml for females and 15-200 ng/ml for males was used for reference according to WHO recommendations. For comparison of Hemoglobin level between healthy and βTM subjects, WHO recommended age-specific cutoff values were used. Plasma Atherogenic index was derived by calculating logarithm of ratio of TG (mmol/L) and HDL (mmol/L), as explained by Dobiasova and Frohlich.[14] Based on AIP results, subjects were stratified into three categories of atherosclerosis risk: low-risk (AIP <0.1), moderate risk (AIP 0.1-0.24) and high risk (AIP >0.24).[15] Cutoff value applied for serum TC, TG, LDL-C and HDL-C was according to National Cholesterol Education Program (NCEP) guidelines.[19]

Data were analyzed on SPSS version 23. After analyzing the distribution of data by Kolmogorov-Smirnov test, mean and standard deviation were derived for the parametric continuous data while median and inter-quartile range was calculated for non-parametric data. Mean values of the variables with parametric distribution were compared between βTM patients and healthy subjects by independent sample t-test while Mann Whitney U Test was applied to compare variables with non-parametric distribution. For categorical parameters, frequency was determined and comparison was performed by Chi-Square Test between the two study groups. Association of AIP with serum Ferritin, plasma hemoglobin and BMI was determined by Spearman Correlation test. The probability value (p) was considered significant if it was ≤ 0.05. Association was considered strong with correlation coefficient (r) ≥ 0.60, moderate with r: 0.40-0.59, weak with r: 0.20-0.39, very weak with r: 0.00 to 0.19.

Results

Our study included a total of 120 participants comprising 64 βTM patients and 56 healthy subjects. Mean age of βTM patients was 13.2 ± 4 years while healthy subjects were of average 12.6 ± 5 years age (p = 0.489). Among the βTM patients, 34(53.1%) were from female gender while 30(46.9%) were male and among healthy subjects, 31(55.4%) were female and 25(44.6%) were male (p =0.807). Diagnosis of βTM was confirmed at an average age of 1 ± 0.9 years. Consanguinity was positive in 55(86%), family history of thalassemia was positive in 20(31%) βTM patients. Subjects included in both study groups belonged to the families of ex-service men and were from the same socioeconomic background. Dietary history based on 24-hour recall did not reveal any difference in dietary patterns between the two groups.

Anthropometric parameters including weight, height and BMI were significantly lower in the βTM patients than the healthy individuals. Median values of weight, height and BMI in the βTM and healthy subjects were 25(23-29) kg vs. 35(29-53) kg (p <0.001), 129(124-132) cm vs. 147(131-171) cm (p <0.001) and 15.6(14.4-16.5) kg/m^2 vs. 16.9(15.6-17.8) kg/m^2 (p = 0.001) respectively. Among βTM patients, 36(56.2%) were found underweight with BMI <5th percentile and remaining 28(43.8%) had healthy weight with BMI between 5th and 84th percentile while in the healthy group, only 4(7.1%) subjects were underweight (BMI <5th percentile), 50(89.3%) were in the healthy weight category (BMI between 5th and 84th percentile) and 2(3.6%) were overweight with BMI between 85th and 94th percentile (p <0.001). Low BMI noted in most of the βTM patients can be attributed to persistent anemia due to chronic hemolysis and iron overload following repeated blood transfusions, both of which are commonly observed in this disease group. Majority of the βTM patients in our study, 32(50%) received transfusions every two weeks with average 24 transfusions annually (Table I). Most of the βTM patients in our study, 59(92.2%), were on oral Deferasirox treatment and only 5 (7.8%) were receiving both oral Deferasirox and Inj. Deferoxamine (Table I). Markedly elevated serum Ferritin levels were noted among βTM patients compared to healthy individuals; 1945(1356-2460) ng/ml vs. 56(36-88) ng/ml (p <0.001) (Table II). Among the βTM patients, 8 (12.5%) had serum Feritin <1000 ng/ml, 31(48.4%) had Ferritin level in range of 1000-2000 ng/ml, 14(21.9%) had between 2000-3000 ng/ml, 4(6.3%) between 3000-4000 ng/ml and 7(10.9%) had Ferritin level above 4000

ng/ml. On the other hand, all healthy participants had serum Ferritin level within normal limits. Low pre-transfusion hemoglobin level was seen in βTM patients compared to healthy individuals with median Hb level of 8.3(7.5-9.0) g/dl vs. 12.4(11.9-12.8) g/dl (p <0.001) (Table II). Low hemoglobin and elevated serum Ferritin levels noted in βTM patients reflected anemia secondary to chronic hemolysis and transfusion-associated iron overload among them.

Lipid parameter analysis revealed significantly decreased serum TC, serum HDL, serum LDL while elevated serum TG levels among βTM patients compared to their healthy counterparts; 3.6 (3.1-4.0) mmol/l vs. 4.3 (3.9-4.7) mmol/l (p <0.001), 1.0 (0.9-1.1) mmol/l vs. 1.3 (1.2-1.4) mmol/l (p <0.001), 2.5 (2.0-2.8) mmol/l vs. 2.8 (2.5-3.0) mmol/l (p = 0.002) and 1.8 (1.0-2.2) mmol/l vs. 1.0 (0.9-1.2) mmol/l (p <0.001) respectively (Table II). Low serum total cholesterol level in βTM patients indicated its increased utilization owing to ineffective erythropoiesis while low HDL and elevated triglyceride levels seemed to contribute towards higher plasma atherogenic index among them.

We assessed premature atherosclerosis risk via plasma Atherogenic Index by calculating logarithm of triglyceride to HDL ratio. Markedly elevated AIP results were observed in βTM patients than their healthy counterparts signaling greater predisposition to atherogenic alterations; AIP 0.27 (0.08-0.38) vs. 0.06 (0.03-0.08) (p <0.001) (Table II). Atherosclerosis risk categorization of AIP was carried out, 25(39.1%) βTM patients had high atherosclerosis risk (AIP > 0.24), 15(23.4%) were having moderate risk (AIP 0.1-0.24) and 24(37.5%) patients had low risk of atherogenicity (AIP < 0.1). In comparison, majority of the healthy subjects, 52(92.8%), exhibited low-risk (AIP < 0.1), 3(5.4%) had moderate risk (AIP 0.1-0.24) and 1(1.8%) had high risk of atherogenicity (AIP > 0.24) (p <0.001) (Figure 1). These findings highlight the elevated risk of premature atherosclerotic complications in βTM patients.

Association of AIP with other variables including serum Ferritin, Hb level and BMI was evaluated among βTM patients by Spearman Correlation analysis. AIP exhibited moderate positive correlation with serum Ferritin (r = 0.41, p = 0.001). A negative correlation was observed between AIP and plasma Hb level (r= -0.65, p <0.001). This indicates a possible link of anemia and iron overload with atherogenic lipid alterations. No correlation was noted between AIP and BMI (r = 0.046, p = 0.721) indicating no significant contribution of anthropometric measures in promoting atherogenic derangements among these patients.

Table I: Frequency of demographic and clinical variables among βTM patients (n = 64).

Variables	Categories	Frequency (n)	Percentage (%)
Age (years)	<10	16	25
	10-20	41	64
	>20	7	11
Gender	Male	30	46.9
	Female	34	53.1
Transfusion Frequency	Every 2 weeks	32	50
	Every 3 weeks	4	6.2
	Every 4 weeks	28	43.8
Iron-Chelating Therapy	Deferasirox	59	92.2
	Deferasirox+ Deferoxamine	5	7.8

Table-II: Comparison of Biochemical and Anthropometric Parameters between βTM patients and healthy subjects (n=120)

Biochemical Parameters	βTM patients (n=64) Median(IQR)	Healthy subjects (n=56) Median(IQR)	*P* value (Man-Whitney U test)
Serum Total Cholesterol (mmol/l)	3.6 (3.2-4.0)	4.3 (3.9-4.7)	<0.001*
Serum Triglyceride (mmol/l)	1.9 (1.0-2.2)	1.0 (0.9-1.2)	<0.001*
Serum HDL-c (mmol/l)	1.0 (0.9-1.2)	1.3 (1.2-1.4)	<0.001*
Serum LDL-c (mmol/l)	2.5 (2.1-2.8)	2.8 (2.5-2.9)	0.002*
Atherogenic Index of Plasma (AIP)	0.27 (0.08-0.38)	0.06 (0.03-0.08)	<0.001*
Plasma Hemoglobin (g/dl)	8.3(7.5-9.0)	12.4(11.9-12.8)	<0.001*
Serum Ferritin (ng/ml)	1945(1356-2460)	56(36-88)	< 0.001*
BMI (kg/m^2)	15.6(14.4-16.5)	16.9(15.6-17.8)	0.001*

*Significant p value < 0.05

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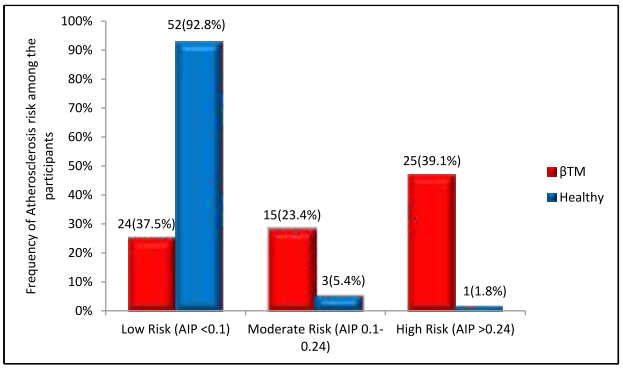

Figure 1: Frequency of Atherosclerosis risk among the study subjects.

Table III: Correlation of serum Ferritin, pre-transfusion Hb level and BMI with Atherogenic Index of Plasma in βTM patients (n = 64)

Variables	Atherogenic Index of Plasma	
	r	*p* value
Serum Ferritin (ng/ml)	0.41	0.001*
Pre-transfusion Hemoglobin (g/dl)	-0.65	<0.001*
Body Mass Index (kg/m^2)	0.046	0.721

*Significant *p* value < 0.05; r = correlation coefficient (≤ 0.19 very weak, 0.2-0.39 weak, 0.40-0.59 moderate, 0.6-0.79 strong, 0.8-1 very strong).

Discussion

Beta thalassemia major is associated with various metabolic derangements notably lipid abnormalities that can subsequently lead to premature atherosclerosis. Dyslipidemia in these patients can not only increase the propensity for cardiovascular events due to increased atherogenesis, but it can also pose a high risk of cerebro-vascular complications in them.[17] AIP has been suggested as a better predictor of ASCVD than the standard lipid testing and other atherogenic indices in different disease groups, since AIP has been reported to be less cumbersome, inexpensive and outperforms than the predictive ability of the individual lipid values.[15, 16, 18] In the current study, we aimed to assess the risk of premature atherosclerosis in βTM patients by using Atherogenic Index of Plasma.

In our study, 46.9% of βTM patients were male while 53.1% were female with slight female predominance. Similar findings have been reported by a previous study from Pakistan with 52.8% female and 47.2% male βTM patients as well as by other international studies.[1, 7, 9] Significantly low BMI was noted among βTM patients with 56.2% being underweight (BMI <5th percentile) compared to only 7.1% underweight among the healthy subjects (*p* < 0.001). Similar findings have been reported by the studies executed in Iraq and India documenting markedly low BMI in βTM patients.[1, 11] We also observed low plasma hemoglobin and elevated serum Ferritin levels in beta-thalassemia patients than the healthy subjects; 8.3(7.5-9.0) g/dl vs. 12.4(11.9-12.8) g/dl (*p* <0.001) and 1945(1356-2460) ng/ml vs. 56(36-88) ng/ml (*p* <0.001) respectively. Other local and international studies from Pakistan, Egypt and India also supported our results and documented similar decline in hemoglobin level and marked elevation of serum Ferritin level in patients with βTM than their healthy counterparts.[1, 8, 9, 10, 20] Low hemoglobin, low BMI and high serum Ferritin identified in βTM patients appear to be inter-linked. Ineffective erythropoiesis and chronic hemolysis cause low Hb and chronic tissue hypoxia in these patients. This can lead to increased basal metabolic rate demand and energy utilization contributing towards low BMI. Sub-optimal growth in these patients can also be attributed to increased utilization of nutrients in erythropoietic activities.[5, 21] Ongoing hemolysis along with frequent transfusions results in a state of iron overload in these patients. Excess iron gets deposited in important organs such as pituitary gland, thyroid gland and liver, further contributing in growth impairment. Iron overload also produces oxidative stress with resultant metabolic disturbances notably affecting lipid metabolism.[20]

Lipid analysis revealed derangements among βTM patients than the healthy subjects characterized by significant decrement in serum TC, LDL-C, HDL-C and a significant increment in TG levels (*p* <0.001). Low cholesterol level has been suggested to result from decreased hepatic cholesterol synthesis due to hepatocyte oxidative injury from iron overload, increased cholesterol consumption for erythropoiesis, and an accelerated cholesterol uptake by histiocytes.[1] Reduced hepatic and extra-hepatic lipase activity in these patients has been speculated to cause hyper-triglyceridemia.[4] Low HDL-C is considered an independent risk factor for cardiovascular disease and high TG levels are also known for their atherogenic potential;[13] however,

role of low total cholesterol and LDL in atherogenicity is not clear. It is proposed that LDL despite of being low in these patients can still contribute in atherogenesis since oxidized LDL is formed in these patients as a result of lipid peroxidation and it is reported to be more atherogenic than the regular LDL.[10] Ashar and colleagues in their study noted lipid derangements among βTM patients similar to our study with low serum total cholesterol, HDL and LDL while elevated triglyceride levels.[7] Sherief and colleagues measured lipid levels and serum Osteoprotegerin levels while Ibrahim and colleagues assessed lipid levels and CAIMT in βTM patients as indicators of atherogenesis. Both of these studies documented decreased serum TC, HDL-C, LDL-C levels and increased TG levels along with increased CAIMT and Osteoprotegerin level, indicating high atherosclerosis risk in these patients.[10, 17] In contrast, a study from Iran conducted by Haghpanah and colleagues didn't find any difference in lipid levels across the two groups.[6] Another study by Shekar and colleagues reported elevated TC and LDL-C levels in these patients, unlike our results.[20] These discrepancies can be attributed to variable dietary preferences and lifestyle across different ethnic regions.

We evaluated the risk of premature atherosclerosis in our subjects via Plasma Atherogenic Index and found considerably elevated levels among βTM patients than their healthy counterparts with median levels 0.27 (0.08-0.38) vs. 0.06 (0.03-0.08) respectively (p <0.001), highlighting the propensity of increased atherosclerosis in βTM patients. There are only few available studies who evaluated atherosclerosis risk in βTM patients by using AIP and most of them have reported higher AIP results among βTM patients than in healthy individuals suggesting high risk of atherogenicity in them.[11, 17, 20] Sanghamitra and colleagues executed a research in India to determine atherosclerosis risk in children with beta thalassemia major and reported elevated lipid indexes including plasma atherogenic index, Castelli's risk index I & II and Atherogenic coefficient in these patients compared to healthy children; AIP 4.43 ± 2.25 vs. 1.78 ± 0.92 respectively.[11] Another study conducted in Egypt compared AIP levels between βTM patients with CAIMT <0.5mm and those with CAIMT >0.5mm. They documented elevated AIP in both βTM groups irrespective of CAIMT size; AIP 0.29±0.04 and 0.52±0.08.[17] Shekar and colleagues evaluated atherogenic lipid derangements in βTM children and compared them with healthy subjects. They also reported significant increase in atherogenic risk in βTM children than the healthy comparators as reflected by AIP 0.87±0.45 vs.0.48±0.21.[20] Further prospective studies are however needed to validate the use of AIP as an early atherogenic marker in βTM patients.

Association of plasma atherogenic index was assessed with Ferritin level which revealed moderate positive correlation of AIP with serum Ferritin (r = 0.41, p= 0.001) indicating role of iron overload in premature atherosclerosis. Consistent with our finding; Ibrahim et al, Shekar and colleagues, AlSaadi and Jabbar also documented significant positive correlation of AIP with serum Ferritin in βTM patients.[1, 13, 17, 20] Formation of reactive oxygen species in iron overload by Fenton reaction followed by oxidation of lipids has been suggested to play a vital role in pathogenesis of altered lipid metabolism. This oxidation results in formation of more atherogenic oxidized LDL as well as causes a reduction in functional HDL which otherwise has anti-atherogenic and anti-oxidant effects.[8] Iron accumulation in liver also leads to altered lipid metabolism, decreased synthesis of apolipoproteins and decline in fatty acid oxidation.[21] Net result will be low serum total cholesterol and HDL while increased triglyceride levels leading to high AIP. We also noted a strong negative correlation of AIP with pre-transfusion Hb level (r= - 0.65, p <0.001), implying that patients having low pre-transfusion Hb can have increased risk of atherogenicity. This can be explained by ongoing hemolysis causing low Hb level in these patients which not only alters lipid levels due to dilution effects but also augments ineffective erythropoiesis with increased utilization of cholesterol. In addition, hemolysis as reflected by low Hb also causes synthesis of oxidative stress markers causing lipid per-oxidation and further derangement of AIP. Supporting our findings, AlSaadi and Jabbar concluded that determinants of AIP; TG and HDL-c, were negatively associated with hemoglobin level among βTM patients in their studies (p <0.01).[1, 13] We observed no significant association of AIP with BMI. Likewise, Shekar and

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colleagues also observed no relationship between plasma atherogenic index and anthropometric parameters.[20]

Elevated AIP levels and increased risk of atherogenicity in βTM patients prompts the need for regular assessment of lipid derangements in them in order to identify high-risk cases earlier and mitigate the effects of the cardio-metabolic complications in them. It is also emphasized that more effective strategies should be formulated to manage potential pro-atherogenic factors identified in these patients including iron overload and dyslipidemia. Parents of these patients should also be counseled to ensure timely blood transfusions for maintaining pre-transfusion hemoglobin level above the recommended cutoff. The limitation of our study was inclusion of small sample size from a single centre. Since it was a cross-sectional study, patients were evaluated at one point of time and could not be re-assessed on follow-up for ongoing biochemical deterioration. In addition, only biochemical evaluation was carried out in this study and no radiological assessment was included. Further prospective, multi-centered researches including larger sample size and addressing the deficient areas are needed to validate these findings and explore the underlying pathogenic mechanisms.

Conclusion

Higher risk of premature atherosclerosis is associated with β-Thalassemia Major, as indicated by elevated plasma atherogenic index level in βTM patients compared to age-matched healthy subjects. In addition, AIP exhibited positive correlation with serum Ferritin and negative correlation with pre-transfusion hemoglobin level among βTM patients. No significant correlation was noted between AIP and BMI in these patients. High atherosclerosis risk in these patients necessitates regular monitoring and timely intervention to reduce future cardiovascular events in this vulnerable population.

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REFERENCES

1. Jabbar HK, Hassan MK, Al-Naama LM. Lipid profile in children and adolescents with β-thalassemia major. Hematol Transfus Cell Ther. 2022. doi.org/10.1016/j.htct.2022.09.1277.
2. Khaliq S. Thalassaemia in Pakistan. Hemoglobin. 2022; 46(1):12-14. doi:10.1080/03630269.2022.2059670.
3. Akiki N, Hodroj M.H, Bou-Fakhredin, R, Matli K, Taher AT. Cardiovascular Complications in Thalassemia: Getting to the Heart of It. Thalass. Rep. 2023; 13: 38–50. doi.org/10.3390/thalassrep13010005.
4. Daswani P, Garg K. Lipid profile in β-thalassemia major children and its correlation with various parameters. Indian J Child Health. 2021; 8(1). doi: 10.32677/IJCH.2021.v08.i01.005.
5. Mohamed S.O.O, Mohamed A.E.A, Salih M.S.K, Salih K.S.K, AbdelRehman A.S.E.E et al. Serum lipid profile abnormalities among beta-thalassemia patients: a systematic review and meta-analysis. Lipids in Health and Disease. 2024; 23: 388. doi.org/10.1186/s12944-024-02377-6.
6. Haghpanah S, Davani M, Samadi B, Ashrafi A, Karimi M. Serum lipid profiles in patients with beta-thalassemia major and intermedia in Southern Iran. J Res Med Sci. 2010; 15(3): 150-154. PMID: 21526074.
7. Ashar S, Sultan S, Irfan SM, Sheeraz A. Serum fasting lipid profile in children and adolescents with β-thalassemia major in southern Pakistan. Malaysian J Pathol. 2015; 37(3):233-238. doi.org/10.1182/blood.V124.21.4899.4899.
8. Nomani H, Bayat G, Sahebkar A, Fazelifar AF, Vakilian F, Jomezade V et al. Atrial fibrillation in beta-thalassemia patients with a focus on the role of iron-overload and oxidative stress: A review. J. Cell. Physiol. 2019, 234, 12249–12266.
9. Nasir C , Rosdiana N, Lubis AD. Correlation between 25-Hydroxyvitamin D and Lipid Profile among Children with Beta Thalassemia Major Open Access Maced J Med Sci. 2018; 6(10):1790-1794. doi.org/10.3889/oamjms.2018.388.
10. Sherief LM, Dawood O, Ali A, Sherbiny HS, Kamal NM, Elshanshory M. Premature atherosclerosis in children with beta-thalassemia major: New diagnostic marker. BMC Pediatrics. 2017; 17:69. doi. Org/10.1186/s12887-017-0820-1.
11. Ray S, Saikia D, Vashisht Y, Sharma S, Meena R K and Kumar M. Dyslipidemia and atherogenic indexes in children with transfusion-dependent thalassemia. Hematol Transfus Cell Ther. 2024; 46(4):345-351. doi.org/10.1016/j.htct.2023.02.006.
12. Huang Q, Liu Z, Wei M, Huang Q, Feng J, Liu Z et al. The atherogenic index of plasma and carotid atherosclerosis in a

community population: a population-based cohort study in China. Cardiovascular Diabetology. 2023; 22:125. doi.org/10.1186/s12933-023-01839-y.
13. AlSaadi EK. Disturbances of lipid profile, hemoglobin and serum Ferritin levels in Thalassemia patients in Misan city, Amara, Iraq. J Med Chem Sci. 2022; 5(5): 779-786. doi.org/10.26655/JMCHEMSCI.2022.5.12.
14. Dobi´a˘sov´a M, Frohlich J. The plasma parameter log (TG/HDL-C) as an atherogenic index: correlation with lipoprotein particle size and esterification rate in apob-lipoprotein-depleted plasma (FERHDL). Clin Biochem. 2001 Oct 1;34(7):583–588. DOI: 10.1016/s0009-9120(01)00263-6.
15. Dobi´asov´a M. AIP—atherogenic index of plasma as a significant predictor of cardiovascular risk: from research to practice. Vnitr Lek. 2006; 52(1):64–71. PMID: 16526201.
16. Nogay NH. Assessment of the correlation between the atherogenic index of plasma and cardio-metabolic risk factors in children and adolescents: might it be superior to the TG/HDL-C ratio? J Pediatr Endocrinol Metab. 2017; 30(9): 947–55.
17. Ibrahim HA, Zakaria SS, Elbatch MM, Elshanshory MR, Eldardiry AE. New insight on premature atherosclerosis in Egyptian children with β-thalassemia major. Afr J Biochem Res. 2018; 12(9):86-93. DOI: 10.5897/AJBR2018.1005.
18. Li Y, Feng Y, Li S, Ma Y, Lin J, Wan J et al. The Atherogenic Index of Plasma (AIP) is a predictor for the severity of coronary artery disease. Front. Cardiovasc. Med. 2023; 10: 215. doi.org/10.3389/fcvm.2023.1140215.
19. National Cholesterol Education Program. Highlights of the report of the Expert panel on blood cholesterol levels in children and adolescents. U. S. Department of Health and Human Services, Public Health Service, National Institute of Health. 1991; 1-11: NIH publication no. 91-2732.
20. Shekar HC, Madhura KL, Bharat KGN, Shrigiri SB, Harish HN. The study of Lipid Profile and Atherogenic indices in children with Transfusion-Dependent Beta thalassemia: A comparative study. Europ J Cardiovasc Med. 2025; 15(7):564-569. doi: 10.61336/ejcm/25-07-95.
21. Habib SMHR, Mondal RK, Ahmed F, Abedin MJ, Rahman MA, Islam DM et al. Study of Dyslipidemia and its Association with Serum Ferritin and Amount of Blood Transfusion in β- Thalassemia Major Patients in a Tertiary Level Hospital. Saudi J Med Pharm Sci. 2022; 8(6): 291-296. doi: 10.36348/sjmps.2022.v08i06.005.

CONFLICT OF INTEREST

Authors declared no conflicts of Interest.

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DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

ORIGINAL ARTICLE

The Relationship of Islamic Lifestyle and Mental Health in Pregnancy: A Cross-Sectional Analysis

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ABSTRACT

Objective: This study aimed to examine the association between adherence to Islamic lifestyle practices and mental health outcomes among pregnant women attending a tertiary care center in Karachi.
Study Design: A cross-sectional analytical study.
Place and Duration of Study: The Obstetrics and Gynecology outpatient department of Jinnah Postgraduate Medical Centre, Karachi, from April 15th to June 15th 2025.
Materials and Methods: The study included 300 pregnant Muslim women aged 15 to 49 years with gestational age over 28 weeks, selected via purposive sampling. Data were gathered using a demographic questionnaire, the 75-item Islamic Lifestyle Questionnaire (covering ten domains), and the DASS-21. Descriptive statistics were calculated, and associations were analyzed using Pearson correlation and linear regression.
Results: The mean age of participants was 30.8 ± 8.2 years, with a mean Islamic lifestyle score of 241.6 ± 51.7. Average depression, anxiety, and stress scores were 4.7, 5.1, and 3.8, respectively. Islamic lifestyle was significantly and inversely correlated with total DASS score ($r = –0.350$, $p < 0.001$). Regression analysis identified Islamic lifestyle as the sole significant predictor of mental health ($\beta = –0.350$, $p < 0.001$), while demographic variables were not significant**.**
Conclusion: Stronger adherence to an Islamic lifestyle is linked to lower depression, anxiety, and stress during pregnancy. Integrating culturally and spiritually tailored interventions into antenatal care could improve maternal psychological well-being.

Keywords: *Anxiety, Depression, Mental Health, Pregnancy, Religion.*

Introduction

Pregnancy is a critical period that poses physical, physiological, and psychosocial changes that may increase a woman's vulnerability to psychological distress. These changes can take a substantial toll on mental and social health, adversely affecting maternal quality of life. Maintaining the mother's mental health during this period is vital to her well-being and for fetal development and long-term outcomes for the child such as healthy neurodevelopment, behaviors, and emotional stability.[1] Moreover, negative maternal mental health during pregnancy can also lead to development of psychiatric problems in children.

Common mental health challenges faced by pregnant women include anxiety, depression and psychological distress with a meta-analysis including 31 studies having reported an incidence of 37% perinatal depression in Pakistani women alone.[2] According to WHO, mental health is the ability to cope up with stress, and be able to learn and work well and contribute to the community. While it has multiple individual and social determinants, lifestyle factors including behaviour, beliefs and values, play an essential role in maintaining the psychological well-being of an individual.[3] Lifestyle is a concept that describes the expression of an individual's values and attitude through their opinion, interests and personal and social behaviour and practices. It is reflective of their social standing and socioeconomic conditions.[4]

Since pregnancy brings physical, mental and social tensions, the prevalence of stress and anxiety in pregnant women increases, which can be a risk factor of preterm birth, low birth weight, high-risk pregnancy, increased nausea and vomiting and increased cesarean sections.[1,4] Maternal stress results in increased concentrations of stress

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hormones within the fetal bloodstream, which can restrict normal growth and maturation of the fetal nervous system. Moreover, negative maternal mental health during pregnancy can also lead to development of psychiatric problems in children.[1] The essence of islamic lifestyle is in performing a set of practices based on islamic teachings which encompasses faith (iman), trust in God (tawakkul), regular prayer (salat), charity (zakat), patience (sabr), and adherence to Islamic rules.[4]Following the Islamic teachings has been linked with healthier cognitive and emotional responses during demanding situations. A belief system that puts their faith in a higher power, engages in disciplined acts of worship, and following Islamic principles such as patience, gratitude, and self-restraint may help individuals regulate negative thoughts and emotions that lead to anxiety and depression.[4]There remains a significant gap in the literature regarding the role of spiritual practices, strong belief in Allah, and religious engagement in addressing depression and anxiety during pregnancy in Pakistan. Although recent studies from Pakistan have examined anxiety-focused cognitive behavioral therapy for the prevention of postnatal depression and explored the relationship between resilience and prenatal mental health, quantitative evidence evaluating faith-based or Islamic spiritual practices as potential protective factors remains limited.[5,6] Unlike Pakistan, in Iran there has been numerous studies that address this concern and evaluate the effect of religious inclination towards combating anxiety and depression during pregnancy.[7] Within the Pakistani sociocultural setting, many women encounter societal, cultural, and familial barriers when seeking help for mental health concerns, including stigma, limited emotional support, and reduced access to mental health services. In such settings, faith and religious practices may function as important internal coping resources. Strengthening resilience may therefore be associated with greater spiritual awareness and understanding of one's rights and responsibilities within Islam. Importantly, religious engagement may act as a complementary approach alongside professional medical care and family support. Examining these factors may help identify culturally acceptable strategies to support maternal mental health in Pakistan.

The objective of the present study is to examine the relationship between following an Islamic lifestyle and mental health status among pregnant women attending a tertiary care hospital in Pakistan. The findings of this study are expected to contribute to the limited literature on faith-related determinants of maternal mental health. Once published, this research may support clinicians in integrating psychosocial and spiritual considerations into routine maternal healthcare, encourage further large-scale research in this underexplored area, and create awareness among population, and ultimately help improve maternal well-being and pregnancy outcomes in Pakistan.

Materials and Methods

This analytical cross-sectional study was carried out at the Outpatient Department of Obstetrics and Gynecology at Jinnah Postgraduate Medical Centre (JPMC), Karachi, over a duration of three months, from 15th April to 15th June 2025.

Ethical approval for this study was obtained from the Ethics Committee of Jinnah Postgraduate Medical Centre, Karachi, Pakistan, under reference number NO.F.2-81/2025-GENL/323/JPMC.

A total of 300 pregnant women were recruited by non-probability purposive selection. Participants were chosen according to specific eligibility criteria, including being aged 15 to 49 years, having a confirmed gestational age exceeding 28 weeks via ultrasound, a planned pregnancy, no known obstetric complications as assessed by the attending consultant, no prior psychiatric illness, and self-identification as Muslim. Individuals failing to meet these criteria were excluded from the study.

Following the acquisition of formal written informed consent from each participant, data collection was conducted utilizing three instruments, the questionnaire was accessible to all the authors and participants authorized to collect and document the responses. The initial component was a demographic questionnaire that documented essential details including age, number of pregnancies, gestational age, body mass index (BMI), and the family's monthly income. The second instrument utilized was the Islamic Lifestyle Questionnaire (ILQ), initially created by Kaviani in 2011, consisting of 75 items aimed at assessing adherence to Islamic values and practices across ten

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lifestyle domains, which include prayer and worship, moral conduct, health behavior, financial transactions, familial and social relationships, beliefs, punctuality, pursuit of knowledge, and accountability towards oneself and others.[8] This questionnaire was obtained from an openly accessible source and was free to use.

Each item was evaluated on a 5-point Likert scale, from 'Strongly Disagree' (1) to 'Strongly Agree' (5), where higher scores signify increased conformity with Islamic teachings. The Islamic Lifestyle Questionnaire developed by Kaviani (2011) contains 75 items rated on a five-point Likert scale, producing overall scores that may range from 75 to 375. These totals were grouped into three distinct levels of adherence. Scores from 75 to 187 were interpreted as low adherence, reflecting limited incorporation of Islamic lifestyle practices. Totals between 188 and 262 were categorized as moderate adherence, indicating a partial or variable alignment with Islamic principles. Scores from 263 to 375 were considered high adherence, signifying a strong faith in Islamic lifestyle behaviors. In this classification, a higher score corresponds to a greater degree of adherence.[8] The measure has previously exhibited adequate psychometric qualities, evidenced by a Cronbach's alpha of 0.71 and acceptable construct and concurrent validity, including a correlation coefficient of 0.64 with the Religious Orientation Test. It has been successfully utilized in previous studies investigating the correlations between Islamic living and diverse mental health and psychosocial consequences.

The third instrument employed was the Depression, Anxiety and Stress Scale–21 (DASS-21), a standardized and validated instrument consisting of 21 items categorized into three subscales, each addressing a specific mental health topic. Each question was evaluated using a four-point Likert scale, with scores ranging from 0 to 3, and subscale values ranging from 0 to 21. Scores were classified into severity levels from normal to highly severe, and subjects were thereafter characterized as either mentally stable or unstable according to these thresholds. Normal DASS-21 scores show no clinically relevant signs of stress, anxiety, or depression. Standard standards state that, after doubling the initial scores, the usual ranges are 0–9 for depression, 0–7 for anxiety, and 0–14 for stress. Individuals who fall within these categories are regarded as having typical emotional functioning.[9]

Data were analyzed using **SPSS version 16.0.** Descriptive statistics that included sociodemographic, obstetric, and clinical variables are presented as means with standard deviation for continuous variables and, frequencies with percentages for categorical variables. **Pearson's correlation analysis** was used to assess the relationships between age, family monthly income, gravida, Islamic Lifestyle Score, and total DASS-21 score. To identify predictors of mental health outcomes, **linear regression analysis** with a stepwise method was performed, with the total DASS-21 score as the dependent variable. Variables that did not show statistical significance were excluded from the final analysis. A **p-value < 0.05** was considered statistically significant for all analyses.

Results

The study sample consisted of 300 pregnant women aged 30.82 ± 8.185 years, with a mean BMI of 25.78 kg/m². The literacy rate was 79.33%, with 18% graduates and 20% postgraduates. The majority were in their first trimester, with 74 (24.7%) experiencing their first pregnancy. The mean weight was healthy, with a healthy BMI of 18.5-24.9. The majority were obese, with 23.3%) being underweight. Almost 31% had a family monthly income below PKR 20,000, indicating poor economic status. 27 participants had unstable mental status, with DASS-21 scores between 30-51.

The findings indicate that only the Islamic lifestyle was significant, whereas the other demographic characteristics were disregarded. With each unit increase in the Islamic lifestyle score, the average mental health score declines by 0.6 units. The model indicates that depression, anxiety, and stress (DASS-21) were adversely correlated with the number of prior pregnancies and positively correlated with family monthly income.

In order to study the correlations between age, family monthly income, number of pregnancies (gravida), Islamic Lifestyle Score, and DASS-21 total score, Pearson's correlation analysis was utilized. The analysis revealed a statistically significant negative correlation between the Islamic Lifestyle Score and the DASS-21 total score ($r = –0.350$, $p <$

0.001). This suggests that a higher level of adherence to Islamic lifestyle practices was associated with reduced levels of stress, anxiety, and depression. Age (r = –0.002), family monthly income (r = 0.103), and gravida (r = –0.050) did not exhibit any significant correlations with the DASS-21 total score. (Table I)

A linear regression analysis was performed with the total DASS score as the dependent variable to further investigate these relationships. The findings indicated that the Islamic Lifestyle Score significantly predicted psychological well-being in pregnant women (β = –0.350, p < 0.001). The regression model accounted for approximately 12.3% of the variance in DASS scores (R^2 = 0.123), suggesting a modest yet significant relationship (Table II). Other demographic variables, such as gravida, maternal education, family income, residence, and BMI, were excluded from the final model due to lack of statistical significance in the stepwise regression analysis. (Table III) The model indicated that the Islamic Lifestyle Score was the sole significant predictor, exhibiting a negative correlation with psychological distress (B = –0.060, β = –0.350, p < 0.001). This suggests that increased adherence to Islamic lifestyle practices is associated with reduced levels of depression, anxiety, and stress. Other demographic factors, such as gravida, maternal education, family monthly income, place of residence, and BMI, did not demonstrate statistically significant associations with mental wellness in this sample (p > 0.05). The findings indicate that demographic characteristics had minimal impact, whereas adherence to an Islamic lifestyle was identified as a significant factor influencing the mental well-being of the pregnant women examined. (Table III).

Table I: Descriptive Statistics of Participant age and Study Variables

Variable	Mean	SD	Min	Max
Age (Years)	30.82	8.19	18	44
BMI (kg/m²)	25.78	6.11	18.5	40.8
Gravida	2.49	1.13	1	4
Islamic Lifestyle Score	241.61	51.65	99	299
Depression Score	4.72	3.52	0	14
Anxiety Score	5.10	3.30	0	13
Stress Score	3.76	3.11	0	12
DASS-21 Total Score	13.58	8.85	0	51

Table II: Pearson Correlation Matrix of Family Income and Number of Children with Depression, Anxiety and Stress and Islamic Lifestyle

Variable	Age (years)	Family Monthly Income (PKR)	Gravida (number)	Islamic Lifestyle Score (0 – 375)	DASS Total Score (0–63)
Age (years)	1	0.006	0.061	0.000	–0.002
Family Monthly Income (PKR)		1	–0.018	–0.029	0.103
Gravida (number)			1	0.079	–0.050
Islamic Lifestyle Score				1	**–0.350***
DASS Total Score					1

*indicates correlation significant at $p < 0.001$.

Table III: Linear Regression Model Predicting DASS-21 Total Score Based On Islamic Lifestyle And Demographic Characteristics (n = 300)

Predictor	B	SE	Beta	t	p-value
Constant	28.073	2.297	—	12.223	<0.001
Islamic Lifestyle Score	–0.060	0.009	–0.350	–6.454	<0.001
Gravida	–0.023	0.056	–0.023	–0.414	0.679
Maternal Education	–0.061	0.054	–0.061	–1.127	0.261
Family Monthly Income (PKR)	0.093	0.054	0.093	1.711	0.088
Residence	0.067	0.054	0.067	1.231	0.219
BMI (kg/m²)	–0.032	0.055	–0.032	–0.580	0.563

Model statistics: R = 0.350, R^2 = 0.123, Adjusted R^2 = 0.120, F(6, 293) = 7.95, p < 0.001

Discussion

This study aimed to evaluate the association between adherence to an Islamic lifestyle and pregnancy-specific stress in women receiving antenatal care at Jinnah Hospital Karachi in 2025. The findings demonstrated statistically.

significant inverse correlation between Islamic lifestyle adherence and mental health concerns during pregnancy. Pregnant women who followed Islamic principles exhibited reduced levels of stress and anxiety, aligning with existing literature that emphasizes the protective role of religious and spiritual engagement in promoting maternal mental well-being.

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In clinical practice, religiosity is one of the frequent coping strategies noted in patients dealing with stressful situations, and as such constitutes the spiritual/religious coping (SRC). This method is often used to cope with pregnancy- related stress, and these beliefs are directly related to low stress and decreased levels of anxiety and depressive symptoms.[10,11] Islamic lifestyle can bring a beneficial influence on human health.[12]

Our findings showed a statistically significant inverse correlation ($r = -0.350$, $p < 0.001$) between Islamic lifestyle practices and the incidence of mental health struggles like depression and anxiety. The result of a regression analysis highlighted Islamic lifestyle as the primary predictor influencing maternal psychological well-being, accounting for 12.3% of the variance in DASS-21 scores. As opposed to other studies, demographic variables such as age and income did not show a statistically significant relationship with mental health outcomes in our final model. This result suggests how Muslim women who practice the Islamic way of life avoid antenatal psychological distress.

A negative relation ($r = -0.310$) was also established between the implementation of an Islamic lifestyle and mental health concerns among Iranian pregnant women. This reinforces our findings which suggest that conforming to Islamic beliefs lead to decreased incidence of mental health disorders for these women.[4] It also implies how religious practices bridge geographical differences especially among Muslim populations. It was also observed that unique Islamic rituals like prayer (Salah) and supplication (Dua), are helpful in reducing perinatal anxiety by establishing belief in a higher authority.[13]

It has also been studied that positive religious coping mechanisms like treating pregnancy as a trial that would be rewarded tenfold, reduced ill thoughts. On the other hand, negative religious coping mechanisms like attributing the pain of pregnancy as punishment from God, increased stress and anxiety.[11] In our study, the strong inverse correlation suggests that our participants employed positive coping strategies. However, a faint positive correlation between positive religious coping mechanisms and depression was established among Turkish pregnant women. The COVID-19 pandemic might have been a major stressor that explains this discrepancy.[10] Our study was conducted in a non-pandemic structure and hence avoided the uncertainty and stress factor. Being spiritually healed and healthy reduced fear during the childbirth process which supports our observation that the Islamic lifestyle adherence leads to lower psychological distress.[12]

Different methods like relaxation techniques, mindfulness, and listening to Quranic verses have also been highly sought out for reducing anxiety in both high-risk and low-risk pregnant women.[14] Our data encourages the incorporation of these culturally redundant practices into routine prenatal care. By introducing spiritual history-taking and propagating Islamic practices, healthcare providers can pioneer a holistic care model that addresses the psychological needs of the mother.

This study has numerous limitations. First, this is a cross-sectional study design which does not determine cause and effect. An Islamic lifestyle reduces anxiety but women with better mental health would be more likely to follow through that lifestyle with discipline. Secondly, there remains a risk of social desirability bias. Third, we only included one tertiary setup in our study. The incidence of depression and anxiety in pregnancy vary by many factors including social and demographic factors.[15] Therefore, our study might not justify the experiences of rural women or those from different socioeconomic backgrounds beyond urban Karachi.

To counter these limitations, future research projects should employ a longitudinal design by following Islamic lifestyle practices among pregnancies throughout the perinatal duration. Practices that involve active mindfulness in line with Islamic beliefs should be encouraged along with educational initiatives. This will contribute substantially towards their clinical implementation.[7,14]

Conclusion

Pregnancy is a period of heightened psychological vulnerability, and this study demonstrates that stronger adherence to Islamic lifestyle practices is significantly associated with lower levels of depression, anxiety, and stress among pregnant women. These findings highlight the importance of integrating culturally and spiritually sensitive approaches into antenatal care to support maternal

mental health and enhance overall well-being. Promoting Islamic lifestyle practices may serve as an effective, accessible strategy to reduce psychological distress during pregnancy in Muslim populations.

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Disclaimer

The views expressed in this study are solely those of the authors and do not necessarily reflect the official policy or position of Jinnah Postgraduate Medical Centre or any affiliated institutions.

Conflict of interest:

The authors declare no conflict of interest related to this study.

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REFERENCES

1. Premji SS, Lalani S, Shaikh K, et al. Comorbid anxiety and depression among pregnant Pakistani women: prevalence and associated factors. *Int J Environ Res Public Health.* 2020;17(19):7295. doi: 10.3390/ijerph17197295.
2. Atif N, Lovell K, Rahman A. Maternal mental health in Pakistan: a systematic review and meta-analysis. *Int J Ment Health Syst.* 2021;15(1):1–15. doi: 10.1186/s13033-021-00472-4.
3. World Health Organization. Mental health: strengthening our response. Geneva: World Health Organization; 2022. Available from: WHO (online report) doi: 10.1007/s00127-022-02336-8 *(WHO citation acceptable without DOI if journal allows).*
4. Pakzad R, Dolatian M, Jahangiri Y, Nasiri M. Relationship between Islamic lifestyle and mental health in pregnant women: a cross-sectional study. *Bangladesh J Med Sci.* 2020;19(3):394–400. doi: 10.3329/bjms.v19i3.45854.
5. Surkan PJ, Malik A, Perin J, Atif N, Rowther A, Zaidi A, Rahman A. Anxiety-focused cognitive behavioral therapy delivered by non-specialists to prevent postnatal depression: a randomized, phase 3 trial. *Nat Med.* 2024;30(3):675–682. doi: 10.1038/s41591-024-02809-x.
6. Bhamani SS, Arthur D, Van Parys AS, Letourneau N, Wagnild G, Premji SS, Asad N, Degomme O. Resilience and prenatal mental health in Pakistan: a qualitative inquiry. *BMC Pregnancy Childbirth.* 2022;22(1):839. doi: 10.1186/s12884-022-05176-y.
7. Ghodrati F, Moghtariyan T, Akbarzadeh M. Islamic-based preventive strategies for postpartum blues. *Saudi J Med Pharm Sci.* 2016;4(3):197–203. doi: 10.36347/sjams.2016.v04i03.063.
8. Kaviani M. The quantification and measurement of Islamic lifestyle. *Ravanshenasi Va Din (Psychology and Religion).* 2011;4(2):27–38. Available from: https://www.magiran.com/p934990.
9. Antony MM, Bieling PJ, Cox BJ, Enns MW, Swinson RP. Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. *Psychol Assess.* 1998;10(2):176–181. doi: 10.1037/1040-3590.10.2.176.
10. Bakır N, Vural PI, Demir C. Relationship between religious coping strategies and depression, anxiety, and stress among pregnant women during the COVID-19 pandemic. *J Relig Health.* 2021;60(5):3379–3393. doi: 10.1007/s10943-021-01391-7.
11. Mirzaee F, Hasanpoor-Azghady SB, Amiri-Farahani L. Religious coping and pregnancy anxiety among Iranian women: a cross-sectional study. *BMC Psychiatry.* 2022;22:298. doi: 10.1186/s12888-022-03922-2.
12. Hosaini S, Yazdkhasti M, Moafi Ghafari F, et al. Association of spiritual health with pregnancy stress and childbirth fear: a path analysis. *PLoS One.* 2023;18(12):e0294910. doi: 10.1371/journal.pone.0294910.
13. Simonovich SD, Quad N, Kanji Z, Tabb KM. Faith practices reduce perinatal anxiety and depression in Muslim women: a mixed-methods scoping review. *Front Psychiatry.* 2022;13:826769. doi: 10.3389/fpsyt.2022.826769.
14. Rahimi F, Moenimehr M. Investigating non-pharmacologic treatment methods in reducing anxiety in pregnant women of low-risk and high-risk groups: a systematic review. *Q Horiz Med Sci.* 2022;28(3):300–329.
15. Khouj MA, Albasri S, Albishri AA, Softa SM, Almaslamani AS, Ahmad HM. Prevalence of stress, anxiety, and depression among pregnant women in Jeddah. *Cureus.* 2022;14(7):e27174. doi: 10.7759/cureus.27174.

CONFLICT OF INTEREST

Authors declared no conflicts of Interest.

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DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

ORIGINAL ARTICLE

Comparison of Hedstrom and Protaper Universal Retreatment Files for Root Canal Retreatment Using Two Different Solvent

Hassan Rasheed Khan[1], Saima Azam[2], Kiran Saba[3], Beenish Qureshi[4]

ABSTRACT

Objective: To compare the efficacy of Hedstrom files and ProTaper Universal Retreatment files in gutta-percha/sealer removal during root canal retreatment using chloroform and orange solvent.

Study Design: In-vitro Randomized Experimental Study.

Place and Duration of Study: Islamabad Dental Hospital in the department of Operative Dentistry and at the National University of Science and Technology Islamabad over a period of 8 months from 3 Jan 2022 to 31 Aug 2022.

Materials and Methods: Sixty mandibular premolars were prepared and then obturated. Specimens were randomly divided in four groups and the gutta percha was removed with Hedstorm files with chloroform (Group A), Hedstorm files with orange solvent (Group B), ProTaper Universal system with chloroform (Group C), ProTaper Universal system with orange solvent (Group D). Residual GP/sealer were outlined on digital radiographs using an AutoCAD software and recorded in millimeter square for coronal, middle and apical 1/3rd of root. Time taken for complete removal was recorded using a stop watch. The data was analyzed using SPSS version 22.0. One-way ANOVA with post-hoc analysis was used to compare the amount of residual GP/ sealer among the four groups and for the comparison of time taken to remove the root filling. Post-hoc Tukey's test was further applied for comparison amongst the groups. A *p* value of ≤ 0.05 was considered statistically significant.

Results: The mean endodontic retreatment time in groups A, B, C and D were 7.15 min, 7.44 min, 5.46 min and 5.38 min respectively. One-way ANOVA and post hoc analysis showed significant difference of group A and group B with group C and group D (p value<0.001). Comparison of the mean GP/sealer remnants using One-way ANOVA and post hoc analysis showed no significant difference between all the groups (p value=0.778).

Conclusion: ProTaper Universal retreatment files demonstrated faster results as compared to the hand instruments (Hedstrom files) in removing GP/sealer. All the techniques left some residual GP/sealer as seen on radiographs.

Keywords: *Endodontic sealer, Gutta percha, ProTaper retreatment files, Retreatment, Solvent*

Introduction

Scientific advancements in endodontics have managed to retain millions of teeth which could not be saved otherwise.[1] Despite improvements, in some cases root canal therapy may lead to an endodontic failure.[2,3] Persistent bacterial growth and recolonization of the root canals leads to the failure of endodontic treatment, requiring retreatment.[4] Gutta-percha and sealer are widely used as obturating material. For endodontic retreatment many techniques are employed to remove gutta-percha, which include mechanical methods like hand files, rotary instruments, the use of heat and ultrasonics.[5] Solvents soften gutta-percha which helps in its removal, thus their use is recommended during root canal retreatment.

Traditionally, retreatment employed Hedstrom files also with K type files in conjunction with various endodontic solvents.[6] Recently NiTi rotary systems have been introduced for retreatment. These systems provides appropriate tip diameter and taper which not only facilitates the penetration of the files

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in the obturating material but also its removal from the canal.[7] Gutta-percha dissolution is ensured by a meticulous retreatment instrumentation technique in conjunction with an efficient solvent like chloroform and xylene. Use of chloroform for retreatment has recently been debated due to its toxicity and carcinogenicity.[8] Xylene can be used clinically but it is also thought to be toxic to the tissues.[9]Therefore, use of various alternate solutions have been suggested, like orange solvent for softening of filling materials.[10]

Studies have been conducted to compare the gutta-percha dissolving ability of various solvents like eucalyptol and orange solvent. These essential oils have proved to be safer and biocompatible but the reported efficacy compared to chloroform is different in different studies.[11,9] Various studies have been published to compare efficacy of rotary instruments in removing root filling material to other traditional methods.[12,13] However, none of the retreatment options seem to assure completely debris free canal walls.

Endodontic retreatment is a crucial procedure that aims to salvage teeth that have failed due to previous endodontic treatment. The success of this procedure largely depends upon the efficiency of removal of GP/sealer. Since previous studies have reported mixed results in terms of efficacy of the newer techniques compared to traditional methods, the need for our study arises. The aim of this study was to compare manual Hedstrom files and ProTaper Universal system in terms of removal of gutta-percha/sealer during endodontic retreatment procedure employing two GP solvents and to explore a technique that is effective and quick during retreatment.

Materials and Methods

The current In-vitro experimental study was carried out at Islamabad Dental Hospital and National University of Science and Technology Islamabad over a period of 8 months from 3-01-22 to 31-08-22, after approval from the institutional review board(Letter Number IMDC/DS/IRB /044) the current). Total 60 mandibular premolars were selected for the study using World Health Organization sample size calculator.[14] A*p*value of 0.05 or less was considered significant at Confidence interval of 95% (with margin of error 5%). The sample was divided into 4 groups with 15 teeth in each group by simple randomization method (using Random number table method), **Group A**: Hedstrom Files with Chloroform, **Group B**: Hedstrom Files with Orange solvent (Henry Schein, USA), **Group C**: ProTaper Universal Retreatment files (Dentsply, USA) with Chloroform, **Group D**: ProTaper Universal Retreatment files with Orange solvent. Randomization was done to balance the known and unknown factors to eliminate bias. Mandibular pre-molars with one root, straight canal, fully formed apices were included in the study, while teeth with radiographic evidence of calcifications, intra canal obstructions, internal resorption, previous endodontic treatment and teeth with root caries were excluded. External surfaces of the sample teeth were washed and the buccal and mesial sides of the root were marked with one groove and two grooves respectively.

The teeth were decoronated using a highspeed handpiece (W&H, Austria) and tapering fissure (MANI ISO 198/018 TR-S13) bur at the Cemento-Enamel Junction (CEJ) to ensure specimen standardization and eliminate variables, such as coronal tooth anatomy and the shape of access cavities. The teeth were stored in 10% formalin (Avonchem, UK). All the experimental procedures were done by one operator to reduce variation and increase reliability.Orifices were enlarged using high-speed (W&H, Austria) and round diamond bur (MANI ISO 001/014 BR-41) with copious water spray. Working length was determined radiographically 0.5mm from the radiographic apex using paralleling technique. Step-back canal preparation technique was employed, while irrigatingwith 5mL of 3% sodium hypochlorite (NaOCl) (PD, Swiss). Apical patency was ensured using K-files in size 10 (mani K files) between each file. A size 40K file was used as master apical file (MAF). Canals were flushed again with 3% NaOCl at the completion of instrumentation. After drying with paper points (TopDent, USA), the canals were obturated with gutta-percha (TopDent, USA) and sealer (Sealapex, SybronEndo, USA) using cold lateral condensation technique. Gutta-percha was seared off using a heated condenser. To evaluate the root canal obturation, two radiographs were taken in bucco-lingual and mesiodistal direction. Root canal orifices were restored with glass ionomer cement (GIC) (Ketac Molar, 3M ESPE, Germany). The

teeth were stored for 30 days in an incubator at a temperature of 37°C to simulate oral environment and allow the sealer to set.

The teeth were randomly divided into 4 groups for endodontic retreatment. Following GIC removal, #2 and #3 Gates Glidden drills were used for coronal flaring to a depth of 2mm into the orifice. In group A chloroform 0.5 ml was injected in the canal using a syringe and immediately instrumented with H-files (Henry Schein, USA) using 25, 30, and 35 files in a circumferential quarter-turn push and pull motion to remove gutta-percha/ sealer from the canal. The same procedure was used in group B, but 0.5mL of orange solvent (Henry Schein, USA) was used. In group C, Torque and speed (1.5-2 N.cm and 300rpm respectively) for protaper universal retreatment files were adjusted according to the manufacturer's instructions. Chloroform (0.5mL) of was introduced in the canal and D1 file was used for first entry into the gutta-percha. The D2 file was used for removing gutta-percha at the mid third of the root. While D3 file was used for removal of apical root filling material. Procedure similar to Group C was followed in group D with 0.5mL of orange solvent instead of chloroform. During retreatment procedure, copious irrigation was done with 5mL of 3% of NaOCl. Complete preparation was achieved in all the groups with no gutta-percha/sealer residue on the retreatment instrument, the canal was smooth and the file reached the working length.

The residual root filling material was evaluated exposing digital periapical radiographs in two different directions (bucco-lingual and mesio-distal) at 90-degree angle. The root canal walls and the residual GP/sealer were outlined by AutoCAD operator in both radiographs for each tooth using AutoCAD software. (Figure 1). Area of the canal covered with residual GP and/or sealer was calculated in bucco-lingual and mesio-distal dimensions and expressed in mm2. A mean value was calculated for each tooth by adding the residual GP/sealer in bucco-lingual and mesio-distal area and dividing by 2. Each tooth was divided was further divided into 3 portions (coronal, mid, apical) for residual GP/sealer. GP removal process was timed using stopwatch. Time was taken from placement of first drop of GP solvent in root canal till the file reaches working length with no visible GP on it. The data was analyzed using SPSS version 22.0. One-way ANOVA with post hoc analysis was used to compare amount of residual GP/ sealer among the four groups and for the comparison of time taken to remove the root filling. Post-hoc Tukey's test was further applied for comparison among the groups.

Results

Two teeth were excluded from the study because of instrument separation (Group A and Group B). The comparison of the amount of residual root filling material showed no statistically significant difference among the groups (p value=0.778). (Table I)

When the coronal, middle and apical 1/3rd were compared, there was no statistically significant difference among the four groups, although there was overall greater amount of residual GP/sealer in the coronal 1/3rd.(Table I)

The mean endodontic retreatment time in group A, group B, group C and group D were 7.15 min, 7.44 min, 5.46 min and 5.38 min respectively, showing statistically significant difference amongst the groups (p value<0.001). Group D showed less time to remove gutta-percha from the root canal followed by group C, group A, and group B.(Table 2) Results of multiple comparisons are shown in the Table II.

The amount of residual root filling as seen on radiograph is shown in figure 1. The yellow outline indicates root canal wall, red horizontal lines divide the root into coronal middle apical 1/3rd and the red line surrounding the root canal wall represents the residual GP/ sealer.

Table I: Comparison of Residual Root Filling the Groups

Group	Coronal Mean± SD	Middle Mean± SD	Apical Mean± SD
A	0.019±0.035	0.015±0.022	0.014±0.035
B	0.009±0.015	0.007±0.013	0.016±0.033
C	0.021±0.0422	0.012±0.021	0.001±0.003
D	0.009±0.026	0.010±0.029	0.030±0.054
p value	0.601	0.794	0.207

Discussion

The current study revealed that all the techniques left residual GP/sealer in the canal. In terms of time taken to remove the GP/sealer, group D and C performed better compared to group A and B. Thorough removal of existing GP/Sealer during retreatment is crucial to expose the necrotic tissue or microbes that may have become a source of

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Table II : Multiple Comparisons of Retreatment Time In Minutes Among The Four Groups Using Post-Hoc Tukey's Test

(I) Groups of Teeth	(J) Groups of Teeth	Mean Difference (I- J)	Std. Error
A	B	-.28643	.17584
	C	1.69143*	.17289
	D	1.76876*	.17289
B	A	.28643	.17584
	C	1.97786*	.17289
	D	2.05519*	.17289
C	A	-1.69143*	.17289
	B	-1.97786*	.17289
	D	.07733	.16988
D	A	-1.76876*	.17289
	B	-2.05519*	.17289
	C	-.07733	.16988

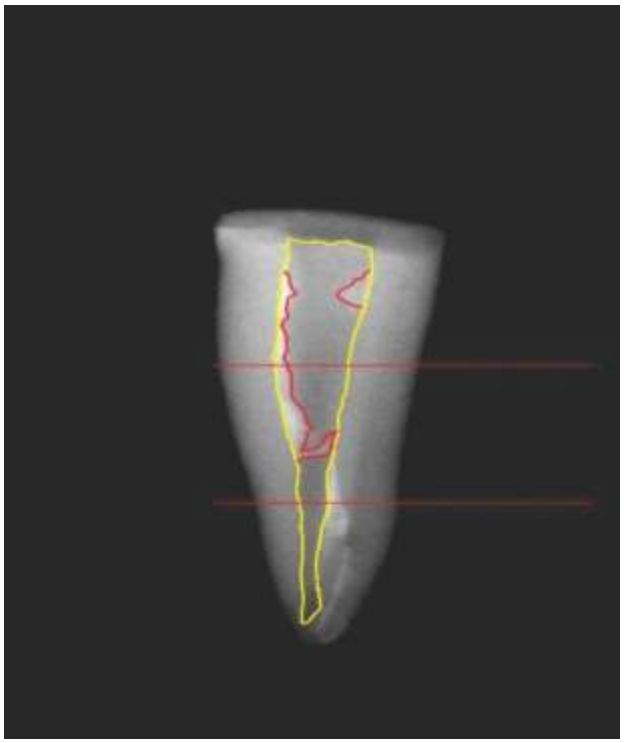

Figure 1 : Radiograph of Sample Tooth Showing Residual

infection resulting in failure of treatment. Retreatment with manual instruments is a time taking procedure particularly with well obturated canals. Therefore, the use of rotary nickel titanium instruments is considered to reduce patient and operator fatigue.[14]

Due to the difficulties met during the removal of the existing obturating material, numerous studies have been carried out to investigate new instruments for endodontic retreatment. Various techniques have been evolved for this purpose such as hand (K-files and H-files), rotary (Gates Glidden burs, Peeso reamers, and NiTi instruments), reciprocating (One Wave and Reciproc), heat-carrying instruments, chemical agents like solvents, ultrasonic device, and lasers.[15]

In this study ProTaper Files were compared with H-files and two different solvents for retreatment. ProTaper Universal Retreatment Instruments have a specific design of their flutes and their rotary motion has the tendency to pull the GP towards their flutes, therefore directing it coronally. Additionally, rotary motion of engine-driven files produces heat due to friction that plasticizes the GP making removal easy.[7,16]

Neither of the techniques advocated in current study completely removed gutta-percha/sealer as detected by the radiographs. This is in harmony with former studies,[17] where authors recommend that absolute removal of obturating material from the canals is difficult and traces are always left regardless of the technique used. Muraleedhar AV,[18] quantified the residual gutta-percha/sealer during retreatment using rotary and hand files (K-file and H -file). All the techniques left traces of GP/ sealer.

On the contrary, some studies concluded that ProTaper Universal retreatment instruments were efficient compared to manual instruments in retreatment. The reason is the differences in the methodology compared to the current study. Giuliani V et. al.,[19] reported ProTaper Universal retreatment files were quick and left significantly less residual GP compared to K- files. In our study, H-files were used which have better cutting efficiency and therefore removes GP/ sealer better compared to K files. Shivanand S et. al.,[20] in his study used a stereomicroscope to examine the cut sections of teeth, inferred that ProTaper instruments were efficient resulting in less residual GP. In the current study periapical radiograph was used to detect residual GP which cannot give a good image of 3-dimensional tooth structure leading to misinterpretation of results. This could be the reason of contrast with the study.

Rotary systems generate heat as a result of frictional movements. Excessive heat causes the “smearing” of root canal walls with the GP leading to incomplete removal. Moreover, sealer is usually brushed onto

the canal walls during the retreatment procedure, thereby making it difficult to remove because there is weak connection between sealer and GP.[21] Therefore, thorough canal cleaning and re-preparation is of utmost significance after GP and sealer removal.

In terms of residual GP/sealer in the coronal, middle and apical areas, there was no significant differences but overall increased GP/sealer were found in coronal 1/3rdfollowed by the middle and then apical 1/3rdin all groups. Jain A reported similar results in their study.[22] The lack of complete GP/sealer removal from the coronal 1/3rdcould be because of the fact that lateral condensation technique of obturation has tendency to entrap large amounts of sealer in the obturating material and creates a condensed mass in the coronal, middle rather than the apical part. This leads to in increased residual GP and sealer in these areas.[23]

The mean endodontic retreatment time showed statistically significant variation of group A and group B with group C and group D (p value<0.001). Group D was less time-consumingtechnique and group B was more time consuming. The result is in accordance with earlier studies demonstrating rotary NiTi instruments are less time consuming in retreatment compared to hand instruments. Similar results were found by other studies stating rotary files as more efficient than hand files.[24,18]

Chloroform is an effective solvent for dissolving gutta-percha. Although it is still commonly used in our region, the possible adverse effects associated with chloroform cannot be overlooked as it has been classified as a carcinogen and is toxic to the periapical tissues. Xylol, orange oil and thyme oil are proved to be better compared to other solvents.[25] In the present study, chloroform and orange solvent performed equally well with hand files and ProTaper Retreatment files.

Conclusion

All the techniques left some gutta percha/sealer as seen on periapical radiographs, but ProTaper retreatment files readily removed gutta percha/sealer removal compared to hand files. Orange solvent and chloroform are equally effective GP solvents.

The radiographic analysis showed some limitations as it gives only a two-dimensional information. Therefore advanced 3-dimensional evaluation strategies are recommended for better analysis. In vitro conditions cannot fully mimic vivo environment hence further research is required to authenticate the results.

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REFERENCES

1. Khan FR, Ghafoor R, Umer F, Rahman M. Inculcating research curriculum in operative dentistry-endodontics residency programme: Experience and outcomes. JPMA. The Journal of the Pakistan Medical Association. 2021;71(1 (Suppl 1)):S127.
2. Tariq H, Qureshi R. ASSESSMENT OF PERIAPICAL PERIODONTITIS IN ROOT CANAL TREATMENT FAILURE PATIENTS RELATED TO THE LENGTH OF ROOT CANAL FILLING. Pakistan Oral & Dental Journal. 2023 Mar 30;43(1):10-4.
3. Song M, Kim HC, Lee W, Kim E. Analysis of causes of failure in nonsurgical endodontic treatment. *J Endod*. 2018;44(2):193–200. doi:10.1016/j.joen.2017.08.021.
4. Siqueira JF Jr, Rôças IN. Present status and future directions in endodontic microbiology. *Int Endod J.* 2022;55(6): 512–530. doi:10.1111/iej.13707.
5. Silva EJNL, Belladonna FG, Zuolo AS, et al. Effectiveness of retreatment instruments for removing filling material: systematic review and meta-analysis. *J Endod*. 2018;44(9):1369–1378. doi:10.1016/j.joen.2018.05.012.
6. Martos J, Ferrer-Luque CM, González-Rodríguez MP. Dissolving efficacy of endodontic solvents on gutta-percha. *Braz Oral Res.* 2020;34:e032. doi:10.1590/1807-3107bor-2020.vol34.0032.
7. Uzun I, Guler B, Ozdemir HO, et al. Retreatment time and apically extruded debris using ProTaper Universal Retreatment files. *Aust Endod J.* 2019;45(2):186–191. doi:10.1111/aej.12303.
8. Almeida JFA, Kato AS, Silva EJNL, et al. Toxicity and biocompatibility of gutta-percha solvents used in endodontic retreatment. *Clin Oral Investig*. 2021;25:423–435. doi:10.1007/s00784-020-03457-8.
9. Plotino G, Grande NM, Pameijer CH, Somma F. Dissolution of gutta-percha by organic solvents: a laboratory study. *J Endod*. 2020;46(8):1152–1157. doi:10.1016/j.joen.2020.05.012.
10. Carvalho CN, Freire LG, Gavini G. Micro-CT evaluation of ProTaper Universal Retreatment system with and without solvents. *J Endod.* 2019;45(6):744–749. doi:10.1016/j.joen.2019.02.009.
11. Keskin C, Sarıyılmaz E, Demiral M. Effectiveness of orange oil, eucalyptus oil, and chloroform on gutta-percha dissolution. *Microsc Res Tech.* 2018;81(9):981–985. doi:10.1002/jemt.23056.

https://doi.org/10.57234/jiimc.december25.2638

12. De-Deus G, Belladonna FG, Zuolo AS, et al. Micro-CT evaluation of ProTaper Universal Retreatment system. *J Endod.* 2019;45(9):1133–1138. doi:10.1016/j.joen.2019.06.003.
13. Tomer AK, Miglani A, Sahni S, Goud BV, Vaidya S, Kumari A. Comparison of efficacy of three Ni-Ti instruments in removal of guttapercha from root canal during retreatment-an in vitro study. IOSR J Dent Med Sci. 2017;16(04):32-7. doi:10.9790/0853-1604023237.
14. Kumar SK, Kumar M, Sharma N, Arora P, Bhatt M, Akkanapally S. Comparative Evaluation of the Efficacy of Different Ni-Ti Rotary Instruments in Removal of Gutta-Percha During Root Canal Retreatment: An in vitro Study. Journal of Advanced Oral Research. 2024 May;15(1):39-46.
15. Peters OA, Arias A, Choi A. Mechanical considerations in endodontic retreatment. *J Endod.* 2020;46(9 Suppl): S40–S47. doi:10.1016/j.joen.2020.06.007.
16. Silva EJNL, Sá L, Belladonna FG, et al. Heat generation and efficiency of ProTaper retreatment instruments. *Int Endod J.* 2021;54(6):922–931. doi:10.1111/iej.13465.
17. Zuolo AS, De-Deus G, Belladonna FG, et al. Effectiveness of rotary NiTi instruments in retreatment. *Clin Oral Investig.* 2018;22(9):3123–3129. doi:10.1007/s00784-018-2386-7.
18. Muraleedhar AV, Satish SV, Patil AM, Kovvuru SK, Patil S. Comparative Evaluation of Efficacy of Three Different Rotary Retreatment Systems with Manual Instrumentation in Removing Gutta-Percha from Root Canals--An In Vitro Study. Journal of Evolution of Medical and Dental Sciences. 2021 Apr 5;10(14):1025-30.
19. Giuliani V, Cocchetti R, Pagavino G. Efficacy of ProTaper universal retreatment files in removing filling materials during root canal retreatment. J Endod. 2008;34(11):1381-4. doi: 10.1016/j.joen.2008.08.002.
20. Shivanand S, Patil CR, Thangala V, Kumar PR, Sachdeva J, Krishna A. To evaluate and compare the efficacy, cleaning ability of hand and two rotary systems in root canal retreatment. The J. Contemp. Dental. Pract. 2013 May 1;14(3):440. doi: 10.5005/jp-journals-10024-1341.
21. Suassuna FC, de Araújo DK, Amorim AM, Melo SL, Heck RJ, Antonino AC, Bento PM, Silva DF, de Melo DP. Thermal and volumetric assessment of endodontic filling techniques using infrared thermography and micro-CT. Journal of Oral Science. 2023;65(1):34-9. doi.10.2334/josnusd.22-0285.
22. Jain A, Nikhil V. Efficiency of rotary retreatment instruments in coronal, middle and apical thirds. *J Conserv Dent.* 2020;23(5):510–515. doi:10.4103/JCD.JCD_282_20.
23. Keleş A, Köseoğlu M, Keskin C. Influence of obturation technique on retreatment efficiency. *BMC Oral Health.* 2021;21:194. doi:10.1186/s12903-021-01546-3.
24. Kuriakose B, Maria R. Efficacy of Two Rotary Systems Versus Manual Instrumentation During Retreatment: An In Vitro Study. Acta Scientific Dental Sciences (ISSN: 2581-4893). 2022 Mar;6(3).
25. Aiswarya N, Girish TN, Ponnappa KC. An in vitro evaluation of effectiveness of Xylene, Thyme oil and Orange oil in dissolving three different endodontic sealers. Journal of Conservative Dentistry and Endodontics. 2023 May 1;26(3):305-10.

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DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

ORIGINAL ARTICLE

Outcomes Following Lichtenstein Mesh Repair: Single Center Study

Wasif Khan, Muhammad Shah, Daim Ali, Adeel Zaib Khan, Zarab Jan, Abdullah

ABSTRACT

Objective: The aim of this study was to evaluate postoperative early and late complications of primary inguinal hernia repair by Lichtenstein Mesh Technique.

Study Design: A Cross-Sectional Study.

Place and Duration of Study: Department of General Surgery, MTI/Hayatabad Medical Complex, Peshawar, from 14 June 2024 to 14 December 2024.

Materials and Methods: A total of 69 patients with primary inguinal hernia, aged 18–70 years, were enrolled via non-probability consecutive sampling. All patients underwent Lichtenstein tension-free mesh repair performed by a consultant surgeon. Early (≤30 days) complications, including hematoma and wound infection, and late (6 months) complications, including chronic groin pain and recurrence, were recorded. The clinico-demographic data were documented, and statistical analysis was performed using SPSS 23. Chi Square and Fisher's Exact test was used and the p value ≤ 0.05 was considered statistically significant.

Results: Among the 69 patients, the recurrence rate was 10.1%. The significant associations were found between hernia recurrence and the following variables: hernia duration ≥5 years ($p < 0.001$), low socioeconomic status ($p < 0.001$), illiteracy ($p < 0.001$), and presence of comorbidities ($p = 0.001$), postoperative hematoma ($p < 0.001$), and chronic groin pain ($p < 0.001$). No statistically significant association was observed with age, hernia type or side, residence, or surgical site infection.

Conclusion: Lichtenstein mesh repair proved safe with acceptable postoperative outcomes. The recurrence rate was 10.1%, significantly linked to prolonged hernia duration, low socioeconomic and educational status, comorbidities, hematoma, and chronic groin pain.

Keywords: *Lichtenstein, Inguinal Hernia, Recurrence.*

Introduction

Inguinal hernia repair is a frequently conducted surgical procedure worldwide. Annually, it constitutes approximately 73% of all abdominal wall hernias and the number of people getting this surgery surpasses 20 million.[1] Mesh repair represents one of the most frequently employed techniques, accounting for approximately 700,000 hernia repairs annually in the United States alone.[2,3] Risk factors for inguinal hernia formation can be categorized into patient-related variables, such as age and sex, and external factors, including physically demanding occupations. The condition exhibits a marked male predominance, with a sevenfold greater frequency in males than in females and demonstrates a predilection for the right side.[4]

The definitive method for hernia diagnosis is clinical examination of the groin. However, clinical examination alone may overlook smaller inguinal hernias; hence, ultrasound (US), magnetic resonance imaging (MRI), and computed tomography (CT) has been used as confirmation or complementary investigations.[5]

The optimal treatment strategy for primary inguinal hernia has been extensively investigated worldwide; however, limited evidence exists regarding the most effective method for repairing recurrent inguinal hernias, and the appropriate surgical approach for this condition remains controversial.[6] Contemporary literature identifies open, tension-free mesh repair as the predominant approach for inguinal hernia management, with the Lichtenstein technique serving as the established standard due to its low recurrence rates and consistent postoperative outcomes. Although laparoscopic repair may reduce early postoperative discomfort, evidence shows comparable long-term results, reinforcing the

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Lichtenstein method as a widely accessible and reliable option.[7,8]

Synthetic mesh in inguinal hernia repair reduces recurrence but may cause persistent groin pain, foreign body sensation, functional limitations, and, rarely, mesh migration or rejection, highlighting the need for careful surgical technique and follow-up.[7,8,9]

Despite the widespread use of mesh-based inguinal hernia repair and extensive global research on primary hernias, evidence regarding postoperative outcomes in routine clinical settings of our region remains insufficient. Existing studies largely focus on recurrence rates, while data on early and late postoperative complications following the Lichtenstein technique are limited and inconsistent. Moreover, variations in patient profiles, surgical expertise, and follow-up practices create a need for locally generated evidence. This gap underscores the importance of evaluating postoperative outcomes within our population. The aim of this study was to evaluate postoperative early and late complications of primary inguinal hernia repair by Lichtenstein mesh technique.

Materials and Methods

This descriptive cross-sectional study was conducted at the Department of General Surgery, MTI/Hayatabad Medical Complex, Peshawar, from 14 June 2024 to 14 December 2024. After obtaining informed consent and Institutional Review Board (IRB) approval (CPSP/REU/SGR-2022-21-13583). The study employed a non-probability consecutive sampling technique. A total of 69 patients were included, based on a calculated sample size using a 4.7% overall postoperative recurrence rate of the Lichtenstein technique for inguinal hernia repair, with a 95% confidence interval and 5% margin of error, using the World Health Organization (WHO) calculator.[10] The eligible patients underwent the Lichtenstein tension-free mesh repair, performed by a consultant general surgeon.

Inclusion criteria comprised of patients aged 18 to 70 years, diagnosed with primary inguinal hernia and scheduled to undergo the Lichtenstein mesh repair, regardless of gender or ethnicity.

While exclusion criteria included patients younger than 18 years, those with recurrent inguinal hernias, hernias managed by techniques other than the Lichtenstein method, obstructed or strangulated hernias, and patients who could not be followed up post-discharge.

The technique involved the placement of a polypropylene mesh over the posterior wall of the inguinal canal, secured with 2/0 polypropylene sutures, without transfixed or excised hernia sacs. Clinico-demographic data, including age, sex, body mass index (BMI), residence, education, socioeconomic status, duration of hernia, laterality, and comorbidities, were documented. Hernia type was recorded intraoperatively.

The outcomes assessed included both early and late postoperative complications. Early complications were defined as those occurring within 30 days post-surgery and included postoperative hematoma, identified through clinical examination and ultrasonography, and postoperative wound infections, defined by the presence of all three of the following: redness, swelling, and pus discharge confirmed via culture.[10] Late complications were assessed at six months postoperatively and included chronic groin pain—defined as persistent pain beyond three months and evaluated using a Visual Analogue Scale (VAS) ranging from 0 (no pain) to 10 (worst possible pain)—and recurrence, defined as the reappearance of a hernia at or near the original site, confirmed clinically and by ultrasound.

Statistical analysis was performed using SPSS version 23. Descriptive statistics such as frequencies and percentages were calculated for categorical variables, including gender, residence, education status, socioeconomic status, hernia side and type, comorbidities, and complications. Continuous variables such as age, BMI, duration of symptoms, and chronic pain scores were summarized using mean ± standard deviation or median with interquartile range (IQR), depending on data normality assessed via the Shapiro–Wilk test. Stratification was conducted for variables including age, gender, hernia type, hernia side, duration of symptoms, postoperative hematoma, surgical site infection (SSI), and chronic pain against the primary outcome of recurrence. Chi-Square or Fisher's Exact tests were applied post-stratification, with a p value ≤ 0.05 considered statistically significant.

Results

The mean age of patients was 42.82±13.06 years. The mean BMI was 24.86±4.09 kg/m^2. Table I shows

the demographic and clinical characteristics of the 69 study participants, including residence, socioeconomic status, education level, hernia characteristics, and postoperative complications.

Table I: Descriptive Statistics (n = 69)

Variable	Category	n (%)
Residence	Urban	26 (37.7%)
	Rural	43 (62.3%)
Socioeconomic Status	Good (>30000 Rs Income/month)	12 (17.4%)
	Poor (<30000 Rs income/month)	57 (82.6%)
Education Status	Literate	17 (24.6%)
	Illiterate	52 (75.4%)
Side of Hernia	Right Inguinal (RIH)	49 (71.0%)
	Left Inguinal (LIH)	20 (29.0%)
Surgical Site Infection	Yes	10 (14.5%)
	No	59 (85.5%)
Type of Hernia	Direct	19 (27.5%)
	Indirect	50 (72.5%)
Comorbidities	None	54 (78.3%)
	Present	15 (21.7%)
Hematoma	Yes	7 (10.1%)
	No	62 (89.9%)
Chronic Pain	Yes	9 (13.0%)
	No	60 (87.0%)
Good (>30000Rs Income/month), **Poor** (<30000 Rs income/month)[11] **Literate**: ability to read and write. **Illiterate**: inability to read and write.[11]		

As illustrated in **Figure 1**, the recurrence rate of hernia was 10.1% (7 out of 69 patients), while 62 patients (89.9%) experienced no recurrence

Figure 1: Recurrent Rate

Table 2 displays the cross-tabulation of various clinical and demographic variables with hernia recurrence status. Statistically significant associations were observed using Fisher's Exact test for hernia duration ≥ 5 years ($p < 0.001$), low socioeconomic status ($p < 0.001$), illiteracy ($p < 0.001$), presence of comorbidities ($p = 0.001$), presence of hematoma ($p < 0.001$), and chronic pain ($p < 0.001$). Variables analysed using Chi-Square test that did not show significant associations with recurrence included age ($p = 0.720$), hernia type ($p = 0.948$), and hernia side ($p = 0.393$). Surgical site infection and residence, analysed using Fisher's exact test and Chi-Square test respectively, also did not show significant associations with recurrence ($p = 0.987$ and $p = 0.052$ respectively).

Table II: Comparison of Clinico-demographic With Recurrence

Variable	Category	Recurrence (Yes) n = 7	Recurrence (No) n = 62	P-value
Age Categories	18–40 yrs	3 (42.9%)	31 (50.0%)	0.720
	41–70 yrs	4 (57.1%)	31 (50.0%)	
Hernia Duration	< 5 years	2 (28.6%)	62 (100%)	**<0.001**
	≥ 5 years	5 (71.4%)	0 (0%)	
Residence	Urban	5 (71.4%)	21 (33.9%)	**0.052**
	Rural	2 (28.6%)	41 (66.1%)	
Socioeconomic Status	Low (Yes)	5 (71.4%)	7 (11.3%)	**<0.001**
	Adequate (No)	2 (28.6%)	55 (88.7%)	
Education Status	Illiterate	6 (85.7%)	11 (17.7%)	**<0.001**
	Literate	1 (14.3%)	51 (82.3%)	
Type of Hernia	Direct	2 (28.6%)	17 (27.4%)	0.948
	Indirect	5 (71.4%)	45 (72.6%)	
Side of Hernia	Right (RIH)	4 (57.1%)	45 (72.6%)	0.393
	Left (LIH)	3 (42.9%)	17 (27.4%)	
Surgical Site Infection	Yes	1 (14.3%)	9 (14.5%)	0.987
	No	6 (85.7%)	53 (85.5%)	
Comorbidities	Present	5 (71.4%)	10 (16.1%)	**0.001**
	None	2 (28.6%)	52 (83.9%)	
Hematoma	Yes	6 (85.7%)	1 (1.6%)	**<0.001**
	No	1 (14.3%)	61 (98.4%)	
Chronic Pain	Yes	6 (85.7%)	3 (4.8%)	**<0.001**
	No	1 (14.3%)	59 (95.2%)	

Discussion

In the present study, the overall recurrence rate after inguinal hernia repair was 10.1%, which is within the range reported in international literature. Our findings align with Movahedi *et. al.,*[12] who also reported a recurrence rate of approximately 10%, highlighting the importance of surgical technique and postoperative care. However, this contrasts with Shah et. al.,[13] who documented a significantly lower recurrence rate, possibly due to differences in patient selection criteria and the use of mesh-based tension-free techniques.

A significant association was found between hernia duration ≥ 5 years and recurrence ($p < 0.001$). Our findings align with Lee et. al.,[14] who observed that

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prolonged hernia duration leads to greater tissue weakness and complexity during repair. Conversely, this contrasts with Parker et. al.,[15] who found no significant correlation between duration of hernia and recurrence.

Low socioeconomic status and illiteracy were also significantly associated with recurrence. Our findings align with Laane et al.,[16] who emphasized the role of limited health literacy and delayed healthcare-seeking behaviour in adverse surgical outcomes. In contrast, Kuo et al.,[17] reported no such association, attributing recurrence primarily to technical surgical factors rather than patient demographics.

Postoperative complications, specifically hematoma and chronic pain were strong predictors of recurrence. Our findings align with Tigora et al.,[18] who suggested that tissue trauma and poor wound healing contribute to structural compromise and subsequent recurrence. This contrasts with Reistrup et al.,[19] who argued that postoperative pain does not directly influence long-term hernia recurrence.

The presence of comorbidities was also significantly linked to recurrence, aligning with findings from Siddaiah et al.,[20] who observed that systemic conditions such as diabetes and chronic cough impair healing and increase the risk of recurrence.

The differences between our findings and those reported in other studies are likely explained by variations in sample size, patient characteristics, and surgical techniques, as well as the quality of postoperative care. Such variability reminds us that hernia recurrence is a multifactorial outcome rather than the result of a single determinant. For example, while prolonged hernia duration appeared to play a clear role in our cohort, other investigators have not observed the same effect, suggesting that its impact may depend on patient selection and operative circumstances.

Limitations

This study was limited by its single-center design and relatively small sample size, which may affect the generalizability of the findings. Additionally, long-term follow-up data were not available, which could underestimate the actual recurrence rate. Other factors, such as surgeon expertise and type of mesh used, were not controlled and may have influenced outcomes.

Conclusion

Lichtenstein mesh repair proved safe with acceptable postoperative outcomes. The recurrence rate was 10.1%, significantly linked to prolonged hernia duration, low socioeconomic and educational status, comorbidities, hematoma, and chronic groin pain.

REFERENCES

1. Messias BA, Almeida PL, Ichinose TMS, Mocchetti ÉR, Barbosa CA, Waisberg J, et al. The Lichtenstein technique is being used adequately in inguinal hernia repair: national analysis and review of the surgical technique. Rev Col Bras Cir. 2023; 50:655-60. doi: 10.1590/0100-6991e-20233655-en.
2. Jan Z, Ali S, Ahmed N, Sarwar MA. Comparison of Common Postoperative Complications between Lichtenstein Open Repair and Laparoscopic Transabdominal Pre-peritoneal (TAPP) Repair for Unilateral Inguinal Hernia. Cureus. 2021; 13(9): 17863-68. doi: 10.7759/cureus.17863.
3. Qazi M, Zeb J, Abbas S, Jan MM, Zarin M, Subhan A et al. Lichtenstein Tension Free Mesh Repair as a Treatment Modality for Inguinal Hernias: An Experience at Khyber Teaching Hospital, Peshawar. J Saidu Med Coll Swat. 2019; 9(2): 201-204. doi:10.52206/jcsm.2019.9.2%25p.
4. Sofi J, Nazir F, Kar I, Qayum K. Comparison between inguinal hernia repair using TAPP & Lichtenstein techniques: a retrospective cohort. Ann Med Surg. 2021; 72:103054-58. doi: 10.1016/j.amsu.2021.103054.
5. McBee PJ, Walters RW, Fitzgibbons RJ. Current status of inguinal hernia management: A review. Inter J Abd Wall Hernia Surg. 2022;5(4):159-64. doi: 10.4103/ijawhs.ijawhs_36_22.
6. Aiolfi A, Cavalli M, Del Ferraro S, Manfredini L, Bonitta G, Bruni PG et al. Treatment of inguinal hernia: systematic review and updated network meta-analysis of randomized controlled trials. Ann Surg. 2021;274(6):954-61. doi: 10.1097/SLA.0000000000004735.
7. Khan N, Babar TS, Ahmad M, Ahmad Z, Shah LA. Outcome and cost comparison of laparoscopic transabdominal preperitoneal hernia repair versus open lichtenstein technique. J Postgrad Med Inst. 2013; 27(3):310-16.
8. Umerzai FK, Kalim M, Hussain M. Efficacy of local versus spinal anaesthesia for mesh inguinal hernioplasty in terms of postoperative pain. J Postgrad Med Inst. 2016;30(4):318-22.
9. Ge H, Liang C, Xu Y, Ren S, Wu J. Desarda versus Lichtenstein technique for the treatment of primary inguinal hernia: a systematic review. Int J Surg. 2018; 50:22-7. doi:10. 1016.j.ijsu.2017.11.955.
10. Hajili K, Vega Hernandez A, Otten J, Richards D, Rudroff C, et al. Risk factors for early and late morbidity in patients with cardiovascular disease undergoing inguinal hernia repair with a tailored approach: a single-center cohort study. BMC Surg. 2023; 23:11. doi:10.1186/s12893-023-01905-y.
11. Amin T. Pakistan's threshold: World Bank fixes new poverty lines at $4.20/person/day. Business Recorder. 2025 Jun 6

[cited 2025 Nov 27]. Available from: https://www.brecorder.com/news/40366574.
12. Movahedi H, Nazemi L, Dehghani F, Ghadyani S. The rate of hernia recurrence in surgical patients with mesh repair and non-mesh repair. Acad J Surg. 2024;7(4):95-100. doi:10.18502/ajs. v7i4.17464.
13. Shah MY, Raut P, Wilkinson TRV, Agrawal V. Surgical outcomes of laparoscopic total extraperitoneal (TEP) inguinal hernia repair compared with Lichtenstein tension-free open mesh inguinal hernia repair: a prospective randomized study. Medicine (Baltimore). 2022;101(26): e29746. doi: 10.1097/MD.0000000000029746.
14. Lee CS, Kim JH, Choi BJ, Im Lee J, Lee SC, Lee YS et al. Retrospective study on prevalence of recurrent inguinal hernia: a large-scale multi-institutional study. Ann Surg Treat Res. 2020;98(1):51-5. doi: 10.4174/astr.2020.98.1.51
15. Parker SG, Mallett S, Quinn L, Wood CP, Boulton RW, Jamshaid S et al. Identifying predictors of ventral hernia recurrence: systematic review and meta-analysis. BJS Open. 2021;5(2): zraa071. doi: 10.1093/bjsopen/zraa071.
16. Laane C, Chen L, Rosenkrantz L, Schuurman N, Hameed M, Joos E. Socioeconomic status does not influence the presentation of patients with inguinal hernia at an urban Canadian teaching hospital. Can J Surg. 2022;65(2): E282-E289. doi: 10.1503/cjs.007920.
17. Kuo YH, Chiu CC, Tseng LY, Wu CH, Chen MH, Fang YC et al. Long-term trends and predictors of medical resource utilization and medical outcomes in inguinal hernia repair: a nationwide cohort study. World J Surg. 2021;45(6):1771-8. doi: 10.1007/s00268-021-06012-8.
18. Tigora A, Paic V, Garofil DN, Bratucu MN, Zurzu M, Nuta D et.al Preoperative risk factors in hernia recurrence: a single-center study. J Mind Med Sci. 2024;11(1):146-55. Doi:10.22543/2392-7674.1487.
19. Reistrup H, Andresen K, Rosenberg J. Low incidence of recurrence and chronic pain after groin hernia repair in adolescents: a systematic review and meta-analysis. Langenbecks Arch Surg. 2023;408(1):211. doi: 10.1007/s00423-023-02947-9.
20. Siddaiah Subramanya M, Ashrafi D, Memon B, Memon MA. Causes of recurrence in laparoscopic inguinal hernia repair. Hernia. 2018; 22:975-86. doi: 10.1007/s10029-018-1817-x.

CONFLICT OF INTEREST

Authors declared no conflicts of Interest.

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DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

ORIGINAL ARTICLE

Comparison of Mean Duration of Postoperative Analgesia in Patients Undergoing Cesarean Section Under Spinal Anesthesia with Bupivacaine Vs. Bupivacaine Plus Buprenorphine

Adil Ashraf[1], Kainat[2], Ahsan Ali Ghuari[3], Muhammad Salman Maqbol[4]

ABSTRACT

Objective: To compare the effect of intrathecal bupivacaine alone vs intrathecal buprenorphine as an adjuvant to bupivacaine on postoperative analgesia in cesarean section patients receiving spinal anesthesia.

Study Design: The Quasi experimental study.

Place and Duration of Study: "Department of Anesthesia", Lahore General Hospital, Lahore, from 1st May 2022 to 29th May 2023.

Materials and Methods: Sixty pregnant women (ASA I-II, aged between 20-35 years) scheduled for elective cesarean section were enrolled through non-probability consecutive sampling. "Group B" received 1.8ml of 0.5 % hyperbaric bupivacaine with 0.5ml normal saline, while "Group BB" was administered 1.8ml of 0.5% hyperbaric bupivacaine combined with 60µg buprenorphine. All participants were informed of study objectives and provided written consent. Postoperative pain was evaluated using the visual analog scale (VAS). The duration of analgesia, total rescue analgesic use, onset of sensory block, and adverse effects were recorded 24 h after surgery.

Results: Group BB showed significant longer duration of postoperative analgesia and reduced need for rescue analgesics. Maximum VAS scores were also significantly lower in Group BB, with 73.3% of patients reporting a score of 4. Mild sedation (16.7%) and nausea/vomiting (10%) were noted in Group BB, but no respiratory depression was observed. All neonates had Apgar scores > 7 at 1 and 5 minutes.

Conclusion: Intrathecal buprenorphine combined with bupivacaine in cesarean section significantly improves pain control and prolongs the analgesic effect. Given its favorable benefit-risk profile, it can be considered a safe and effective adjunct to spinal anesthesia.

Keywords: *Analgesia Bupivacaine, Buprenorphine, Cesarean Section, Spinal Anesthesia.*

Introduction

Effective management of postoperative pain remains a fundamental aspect of surgical care, particularly in cesarean sections (C-sections) among the most frequently performed surgeries worldwide.[1] Inadequate control of postoperative pain can delay recovery, hinder mobilization, impair maternal-neonatal bonding and increase the risk of persistent pain and postpartum depression.[2,3,4] Despite its transient nature, postoperative pain requires timely and appropriate intervention to prevent long term consequences.[5]

Regional anesthesia, especially spinal anesthesia, is widely used for cesarean delivery owing to its fast onset, dense sensory blockade, and lower systemic drug exposure in both the mother and neonate.[6,7,8] Bupivacaine, a long acting, amide local anesthetic, is commonly used in subarachnoid block (SAB); However, when used alone at higher doses (12-15mg), it may lead to profound hypotension and inadequate postoperative analgesia duration.[9] To address these limitations, opioids and various adjuvants —including opioids, α2 agonists, and NMDA antagonists— have been incorporated into spinal anesthesia regimens.[10,11,12,13]

Buprenorphine, a partial µ-opioid receptor agonist,

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has shown promising results as an adjuvant due to its high lipid solubility, strong receptor affinity, and prolonged duration of action, with minimal risk of respiratory depression.[14] Its antihyperalgesic properties and favorable safety profile make it particularly suitable for intrathecal administration in obstetric patients. Studies suggest that buprenorphine combined with bupivacaine enhances postoperative analgesia and reduces the need for supplemental analgesics compared with bupivacaine alone.[15,16]

However, despite growing international evidence, there is a paucity of local data evaluating the analgesics efficacy and safety of this combination in cesarean sections. This study aims to compare the postoperative analgesic profile and analgesics requirements of bupivacaine alone, versus combined with buprenorphine in patients undergoing cesarean section under spinal anesthesia.

Materials and Methods

This quasi experimental study was conducted at the "Department of Anesthesia, Lahore General Hospital, Lahore" from 1st May 2022 to 29th May 2023 after receiving ethical approval from the Institutional Review Board (No: UHS/education/126-22/3033).

A total of 60 pregnant women, aged 20-35 years, scheduled for elective lower segment cesarean section (LSCS) under spinal anesthesia, were enrolled through non-probability consecutive sampling and allocated into two groups (B and BB, n= 30 each) after obtaining informed consent. Based on previous literature, the mean (±SD) postoperative analgesia duration in bupivacaine group was assumed to be 2.67±1.39 hours, and in the bupivacaine combined with buprenorphine group vs. 12.3±6.5 hours.[16] The sample size was calculated using these values by WHO sample size calculator with a confidence level of 95% and power of 80%, yielding fewer than 10 participants in each group. However, 30 patients in each group included 30 patients in each group to ensure adequate power and account for potential variability.

The inclusion criteria were ASA physical status I and II, gravid females >36 weeks undergoing elective cesarean section, and those who gave informed consent. The exclusion criteria were ASA III or IV, emergency surgeries, comorbidities (e.g. cardiac disease, diabetes and hypertension), use of beta-blockers, or anticoagulants (INR>1.5), placental abnormalities, eclampsia, fetal distress, known drug allergies to study drugs, contraindications to spinal anesthesia, and partial or failed spinal block.

All patients received aspiration prophylaxis with oral famotidine 40 mg the night before surgery and intravenous metoclopramide 10 mg with oral famotidine on the morning of the surgery. Standard monitoring was applied, and IV access was obtained with an 18-gauge cannula. The patients were preloaded with 20 ml/kg 0.9% saline. After urinary catheterization, spinal anesthesia was administered at the L3-L4 level in the sitting position using a 25G spinal needle under aseptic measures.

Group B received 1.8 ml of 0.5% hyperbaric bupivacaine combined with 0.2 ml normal saline, whereas Group BB was received the same volume of bupivacaine with 60 µg buprenorphine (measured using a Monoject tuberculin syringe). The study was single-blinded. The drugs were administered by anesthesiologists who were not involved in patient care or data collection. The principal investigator, who was blinded to group allocation, recorded all postoperative parameters.

After the subarachnoid block (SAB), patients in both groups were positioned supine with a right hip wedge. Surgery was started upon achieving the T4 sensory level. Intraoperative fluids were maintained with normal saline, and oxytocin was administered after delivery. Apgar scores were calculated at 1 and 5 minutes. No intraoperative sedatives or additional analgesics were administered.

After surgery, analgesia was monitored hourly using a visual analog scale (VAS) with duration defined as the time from the completion of surgery to the first VAS score ≥4 for 24 hours postoperatively. Rescue analgesia (IV tramadol 20 mg) was administered when needed. The VAS scores, total rescue analgesic use, adverse effects (nausea, vomiting, sedation and respiratory depression) and peak sensory levels were recorded. Sedation was scored from zero to 3. Nausea and vomiting were managed with ondansetron 4 mg IV and pheniramine maleate was given for pruritus when required.

Data were analyzed using IBM SPSS Statistics for Windows, Version 28 (Released 2021; IBM Corp, Armonk, New York, USA). Continuous variables,

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including duration of postoperative pain, peak sensory level, surgery duration and maximum 24h VAS were reported as mean ± SD and analyzed using the independent t-test. Categorical variables such as the incidence of nausea, vomiting, sedation, and respiratory depression were expressed as frequencies and percentages and compared among groups using chi-square or Fisher's exact test depending on how the data were distributed. Statistical significance was defined as p-value < 0.05, with 95% confidence interval (CI) reported for all comparisons.

There were no dropouts or losses to follow-up during the study period; All 60 participants completed the study as per protocol. No serious complications related to anesthesia were recorded.

Results

Both groups had comparable baseline characteristics including age, height, weight, and duration of surgery, with no statistically significant differences (p > 0.05) (Table I). The peak sensory level attained was similar between groups with T4 being the most common level in both groups. In Group B, 63.3% reached T4, 30% reached T3, and 6.7% reached T2, while in Group BB, 40% reached T4, 50% reached T3, and 10% reached T2. The difference between groups was not statistically significant (p > 0.005) (Table II).

The onset of analgesia was slightly rapid in Group BB (3.22±0.71 min) than in Group B (3.95±0.7 min), but not significant (p > 0.005) (Figure I).

The duration of postoperative analgesia was also longer in Group BB (12.2±6.4 hours) as compared to Group B (2.75±1.4 hours) (p < 0.001).

Rescue analgesic requirements were lower in Group BB (mean dose = 1.02) than in Group B (mean dose = 2.1) (p < 0.001). The maximum VAS pain scores recorded during first 24 h after surgery were also lower in Group BB (p < 0.001). In Group B, 9 (30%) patients required additional analgesia versus only one (3.3%) in Group BB (p < 0.001). The most frequent highest VAS score in Group BB was 4, observed in 22(73.3%) patients (p < 0.001) (Table III).

No neonatal complications were noted, and all neonates had Apgar scores of >7 at 1 and 5 min in either group. In terms of side effects, 10% (n= 3) of Group BB had experienced nausea and vomiting, and 16.7% (n=5) reported mild to moderate sedation with a mean sedation score of (0.33±0.66). No respiratory depression was observed. In Group B, no side effects were recorded.

Table I: Demographic Characteristics of Study population

Characteristics	Group B (mean ± SD)	Group BB (mean ± SD)
Age (years)	26.1±2.04	27.21±1.55
Height (cm)	156.1±4.2	157±5.3
Weight (kg)	61±4.0	62±4.42
Duration of procedure (min)	53±12.2	50±12.2

SD: Standard deviation

Group B: patients receiving bupivacaine only

Group BB: patients receiving buprenorphine combined with bupivacaine

Table II: Comparison of Peak Sensory Block Levels between Group B and Group BB

Peak sensory level	Group B (n)	Group BB (n) %	*P* value
T2	2 (6.6%)	3 (10%)	0.19
T3	9 (30%)	15 (50%)	
T4	19 (63.3%)	12 (40%)	

Group B: bupivacaine

Group BB: buprenorphine + bupivacaine

Table III: Comparison of Highest Postoperative Pain Scores Between Group B and Group BB

VAS Score	Group B (n) %	Group BB (n) %	*p*-value
1	0	0	.0001
2	0	3 (10%)	
3	0	2 (6.6%)	
4	6 (20%)	22 (73.3%)	
5	16 (53.3%)	3(10%)	
6	8 (26.6%)	0	

VAS score: Visual Analogue Scale

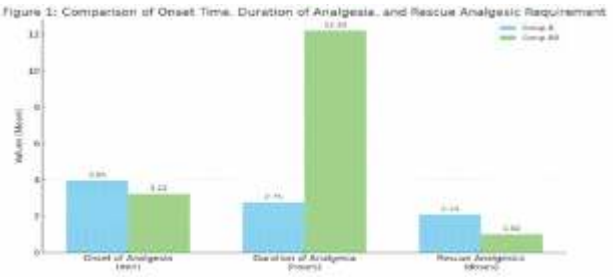

Figure I: Comparison of Onset Time, Duration and Rescue Analgesic Requirements in Both Groups

Group B: patients receiving bupivacaine only

Group BB: patients receiving buprenorphine combined with bupivacaine

Discussion

Subarachnoid block (SAB) with local anesthetics such as bupivacaine remains the standard choice for cesarean section; however, its use alone provides suboptimal postoperative pain control, increased requirement of rescue analgesics and maternal dissatisfaction.[9,10]The addition of intrathecal opioid adjuvants has been explored to extend analgesic duration while improving patient comfort minimizing systemic side effects.[15,16]

The present study demonstrates that administrating 60 µg intrathecal buprenorphine with bupivacaine significantly prolonged the duration of analgesia and reduced the need for rescue analgesia, without adverse impact on maternal or neonatal outcomes.

In this study, adding buprenorphine to bupivacaine (Group BB) extended the mean duration of postoperative analgesia compared to bupivacaine alone (Group B), thereby reducing the need for supplemental analgesia. Similar observations have been reported by other studies, even at varying doses, buprenorphine enhances analgesic duration with a faster onset of action.[17,20]

Visual analog scale (VAS) scores further confirmed improved pain control in the BB group, where 73.3% of patients reported a maximum VAS score of 4, significantly lower than those in Group B. Das et al. (2023) reported comparable analgesic superiority of intrathecal buprenorphine over fentanyl in cesarean delivery.[21]The faster onset of analgesia in Group BB can be attributed to its high µ-receptor affinity and lipophilicity facilitating rapid penetration into the spinal tissue[22,23]

Despite this, peak sensory levels remained comparable between groups, indicating that the dermatomal spread of anesthesia is predominantly governed by the fixed dose and volume of bupivacaine.[24]

Buprenorphine may cause adverse effects including sedation, nausea, and vomiting which generally increase at higher doses.[23,25] In this study, the BB group receiving 60µg intrathecally, experienced side effects including mild sedation (16.7%), nausea/vomiting (10%). Importantly, these effects were transient and manageable. No respiratory depression was noted. These side effects appear to be clinically acceptable considering their significant analgesic benefits.

All neonates had Apgar score >7 at 1- and 5-minutes, confirming no negative impact on neonatal condition when intrathecal buprenorphine was used at doses <75µg.[12,23]

This research is limited by its single-center approach, small sample size and absence of hourly pain measurements, only peak VAS scores were recorded due to nursing workflow realties in a high volume public hospital. While 60µg of buprenorphine was selected based on a balance between efficacy and safety, higher doses may yield different outcomes and warrant further investigation. Additionally, we did not evaluate maternal hemodynamics postoperatively or conduct an umbilical cord blood gas analysis, which could have provided more objective neonatal data.

Future research should include multicenter, large RCTs comparing intrathecal adjuncts with formal maternal satisfaction scoring, real-time pain mapping and detailed hemodynamic monitoring stratified dosing of buprenorphine to identify an optimal balance between analgesia and side effects.[23]

Conclusion

Intrathecal buprenorphine combined with bupivacaine in cesarean section significantly improves pain control and prolongs the analgesic effect. Given its favorable benefit-risk profile, it can be considered a safe and effective adjunct to spinal anesthesia.

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REFERENCES

1. Crandon R, Storr N, Padhy S, Parker P, Lun S, Hughes I, et al. Enhanced recovery after caesarean section: Implementation of an ERAC protocol in a tertiary obstetric hospital. *J Perioper Pract.* 2024. https://doi.org/10.1177/17504589241256458.
2. Arroyo-Fernández FJ, Calderón Seoane JE, Torres Morera LM. Strategies of analgesic treatment after cesarean delivery: Current state and new alternatives. *Rev Esp Anestesiol Reanim (Engl Ed).* 2020;67(3):167–75. https://doi.org/10.1016/j.redar.2019.11.005.
3. Yun X, Ling-Qun H. Enhanced recovery after cesarean delivery. *Transl Perioper Pain Med.* 2023;10(2). https://doi.org/10.31480/2330-4871/174.

https://doi.org/10.57234/jiimc.december25.2596

4. Pinho B, Costa A. Impact of enhanced recovery after surgery (ERAS) guidelines implementation in cesarean delivery: A systematic review and meta-analysis. *Eur J Obstet Gynecol Reprod Biol.* 2024;292:201–9. https://doi.org/10.1016/j.ejogrb.2023.11.028.
5. Pombo A, Guimarães H, Araújo AM, Nunes CS, Cabido H, Lemos P. Anesthesia and postoperative analgesia for cesarean section: A retrospective observational study. *J Obstet Anaesth Crit Care.* 2025;15(1):53–8. https://doi.org/10.4103/joacc.joacc_25_24.
6. Ung TY, Jee YS, You HJ, Cho CK. Comparison of the effect of general and spinal anesthesia for elective cesarean section on maternal and fetal outcomes: a retrospective cohort study. Anesth Pain Med (Seoul). 2021;16(1):49-55. https://doi.org/10.17085/apm.20072.
7. Silverman M, Zwolinski N, Wang E, Lockwood N, Ancuta M, Jin E, et al. Regional analgesia for cesarean delivery: A narrative review toward enhancing outcomes in parturients. *J Pain Res.* 2023;16:3807–35. https://doi.org/10.2147/jpr.s428332.
8. Algarni RA, Albakri HY, Albakri LA, Alsharif RM, Alrajhi RK, Makki RM, et al. Incidence and risk factors of spinal anesthesia-related complications after an elective cesarean section: A retrospective cohort study. *Cureus.* 2023;15(1):e34198. https://doi.org/10.7759/cureus.34198.
9. Lim G, Facco FL, Nathan N, Waters JH, Wong CA, Eltzschig HK. A review of the impact of obstetric anesthesia on maternal and neonatal outcomes. *Anesthesiology.* 2018;129(1):192–215. https://doi.org/10.1097/aln.0000000000002182.
10. Swain A, Nag DS, Sahu S, Samaddar DP. Adjuvants to local anesthetics: Current understanding and future trends. *World J Clin Cases.* 2017;5(8):307–23. https://doi.org/10.12998/wjcc.v5.i8.307.
11. Dhawale TA, Sivashankar KR. Comparison of intrathecal fentanyl and buprenorphine as an adjuvant to 0.5% hyperbaric bupivacaine for spinal anesthesia. *Anesth Essays Res.* 2021;15(1):126–32. https://doi.org/10.4103/aer.aer_59_21.
12. Lorato SS, Reshad S, Seifu E, Gebrehiwot G, Achule A, Amsalu H, et al. Comparison of intrathecal bupivacaine with tramadol and bupivacaine with dexamethasone for post-cesarean section pain relief extension: A prospective observational study. *Ann Med Surg.* 2025;87(3):1159–64. https://doi.org/10.1097/MS9.0000000000003056.
13. Pascarella G, Ruggiero A, Garo ML, Strumia A, Difolco M, Papa MV, et al. Intrathecal dexamethasone as an adjuvant for spinal anesthesia: A systematic review. *Minerva Anestesiol.* 2024;90(7–8):662–71. https://doi.org/10.23736/s0375-9393.24.18054-6.
14. Gudin J, Fudin J. A narrative pharmacological review of buprenorphine: A unique opioid for the treatment of chronic pain. *Pain Ther.* 2020;9(1):41–54. https://doi.org/10.1007/s40122-019-00143-6.
15. Saleh M, Malik S, Memon GN, Rehman M. Comparative study on analgesia duration with bupivacaine–buprenorphine combination vs. bupivacaine alone for cesarean delivery. *Anaesth Pain Intensive Care.* 2023;27(5):501–5. https://doi.org/10.35975/apic.v27i5.2303.
16. Shrinivas TR, Ali L, Jamagond S. Comparative evaluation of intrathecal bupivacaine 0.5% with intrathecal bupivacaine 0.5% and 60-µg buprenorphine for postoperative analgesia in elective cesarean section patients. *J Pharm Bioallied Sci.* 2022;14(Suppl 1):S167–8. https://doi.org/10.4103/jpbs.jpbs_879_21.
17. Ravindran R, Sajid B, Ramadas K, Susheela I. Intrathecal hyperbaric bupivacaine with varying doses of buprenorphine for postoperative analgesia after cesarean section: A comparative study. *Anesth Essays Res.* 2017;11(4):952–6. https://doi.org/10.4103/aer.aer_82_17.
18. Kosel J, Bobik P, Tomczyk M. Buprenorphine – the unique opioid adjuvant in regional anesthesia. *Expert Rev Clin Pharmacol.* 2016;9(3):375–83. https://doi.org/10.1586/17512433.2016.1141047.
19. Ture P, Ramaswamy AH, Shaikh SI, Alur JB, Ture AV. Comparative evaluation of anesthetic efficacy and hemodynamic effects of a combination of isobaric bupivacaine with buprenorphine vs. isobaric levobupivacaine with buprenorphine for spinal anesthesia – A double-blinded randomized clinical trial. *Indian J Anaesth.* 2019;63(1):49–54. https://doi.org/10.4103/ija.IJA_667_17.
20. Das N, Lahkar B, Brahma H, Borah B. Analgesic efficacy in cesarean section: A comparison between fentanyl and buprenorphine as an adjuvant to bupivacaine under subarachnoid block. *New Indian J OBGYN.* 2023;10(1):77–83. https://doi.org/10.21276/ obgyn.2023.10.1.13.
21. Pande LJ, Arnet RE, Piper BJ. An examination of the complex pharmacological properties of the non-selective opioid modulator buprenorphine. *Pharmaceuticals (Basel).* 2023;16(10):1397. https://doi.org/10.3390/ph16101397.
22. Cansian JM, D'Angelo Giampaoli AZ, Immich LC, Schmidt AP, Dias AS. The efficacy of buprenorphine compared with dexmedetomidine in spinal anesthesia: A systematic review and meta-analysis. *Braz J Anesthesiol (Engl Ed).* 2024;74(6):844557. https://doi.org/10.1016/j.bjane.2024.844557.
23. Huang YY, Chang KY. Sensory block level prediction of spinal anesthesia with 0.5% hyperbaric bupivacaine: A retrospective study. *Sci Rep.* 2021;11(1):9105. https://doi.org/10.1038/s41598-021-88726-2.
24. Jacob AR, Paul J, Rajan S, Ravindran GC, Kumar L. Effect of injection speed of heavy bupivacaine in spinal anesthesia on quality of block and hemodynamic changes. Anesth Essays Res. 2021;15(4):348-51. https://doi.org/10.4103/aer.aer_1_22.
25. White LD, Hodge A, Vlok R, Hurtado G, Eastern K, Melhuish TM. Efficacy and adverse effects of buprenorphine in acute pain management: systematic review and meta-analysis of randomised controlled trials. Br J Anaesth. 2018;120(4):668-78. https://doi.org/10.1016/j.bja.2017.11.086.

CONFLICT OF INTEREST

Authors declared no conflicts of Interest.

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DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

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ORIGINAL ARTICLE

Antibiotic Susceptibility Pattern of Carbapenem Resistant Acinetobacter Baumannii Isolated from Clinical Specimen

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ABSTRACT

Objective: To determine the antibiotic susceptibility pattern of Carbapenem-resistant *Acinetobacter baumannii* isolated from the different clinical samples.

Study Design: It was a cross-sectional study.

Place and Duration of Study: Department of Microbiology, Khyber Medical University, and the Department of Microbiology, Armed Forces Institute of Pathology (AFIP) from January 2024 to December 2024.

Materials and Methods: After obtaining ethical approval, Various samples from the intensive care units and wards were collected. It included pus, tissue, non-directed bronchial lavage, blood, bronchoalveolar lavage, sputum, fluid, urine, nasopharyngeal swab, drain, bone, and Cerebrospinal fluid, which were processed in the laboratory. All the samples were inoculated on appropriate culture media, and the bacteria were identified by using Gram stain, motility, colony morphology, and biochemical tests. Antibiotic susceptibility was performed by using the Kirby disc diffusion method according to the Clinical and Laboratory Standards Institute (CLSI 2024). Isolates showing resistance or intermediate sensitivity to meropenem and imipenem were considered resistant. Susceptibility pattern of the rest of the antibiotics was noted according to CLSI 2024. SPSS version 26 was used for the data analysis.

Result: Out of 57 Carbapenem-resistant *Acinetobacter baumannii* 52 (91.2%) were sensitive to minocycline, 39(68.4%) were sensitive to tigecycline, 4(7%) to gentamicin, 3(5.2%) were sensitive to cefepime, 2(3.5%) to ceftazidime, 1(1.8%) to levofloxacin, tazo-pipracillin and ceftriaxone and showed no sensitivity to amikacin, ciprofloxacin and ampicillin-sulbactam. Tetracycline was tested in urine samples, and Carbapenem-resistant *Acinetobacter baumannii* showed 100% sensitivity towards it.

Conclusion: Carbapenem-resistant *Acinetobacter baumannii* showed very low susceptibility to maximum antibiotics. The highest was towards minocycline.

Keywords: *Carbapenem Resistant Acinetobacter baumannii (CRAB), Clinical and Laboratory Standards Institute (CLSI), Disk Diffusion Technique.*

Introduction

Acinetobacter baumannii is a Gram-negative, aerobic, non-motile coccobacillus that does not ferment carbohydrates, shows pleomorphic characteristics, and is known for causing hospital-acquired opportunistic infections.[1] Until 1971, the genus *Acinetobacter* was not considered a definitive human pathogen and was therefore often disregarded when isolated from clinical specimens.[2] *Acinetobacter baumannii* is now frequently isolated from a variety of clinical specimens, particularly from hospitalized patients. Colonization rates are notably higher among patients in Intensive Care Units (ICUs), particularly on mechanical ventilation.[3,4] It is considered a significant nosocomial pathogen responsible for serious infections such as ventilator-associated pneumonia, bloodstream infections, urinary tract infections, meningitis, and wound infections, especially in immunocompromised patients [5] *Acinetobacter baumannii* can withstand harsh environmental conditions, including desiccation and extreme pH levels, making infection

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control really difficult in intensive care and burn units. Its remarkable resistance to drying allows it to persist on inanimate surfaces for prolonged periods, facilitating transmission within hospital environments and contributing to both outbreaks and long-term endemic presence.[5,6]

In the mid-20th century, *Acinetobacter baumannii* was believed to retain at least intermediate susceptibility to third- and fourth-generation cephalosporins, fluoroquinolones, semisynthetic aminoglycosides, and carbapenems, with nearly 100% of isolates remaining sensitive to imipenem. However, during the late 1980s and 1990s, the global emergence and spread of imipenem-resistant *Acinetobacter* strains significantly limited treatment options. By the late 1990s, carbapenems (Doripenam, Ertapenam & Meropenem) remained the primary and often the only effective antimicrobials against severe *Acinetobacter* infections.[7]

During the last two decades, Carbapenem-resistant *Acinetobacter baumannii* (CRAB) has been designated as a top-priority critical pathogen by the World Health Organization, highlighting the urgent need for new antibiotic research and development. It has also been recently classified by the CDC as a serious and immediate public health threat [5]. WHO also included it among the ESKAPE pathogens (*Enterococcus faecium*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa,* and *Enterobacter* species) a group of bacteria known for their ability to evade the effects of multiple antibiotics, thereby significantly limiting treatment options.[8]

This global health dilemma is due to the overuse of antibacterial agents, which has led to the development of resistance in *Acinetobacter* species against many commonly used antibiotics. A strong positive correlation has been identified between antibiotic resistance rates and antibiotic usage, accompanied by an increasing trend in antimicrobial resistance.[4] Multidrug resistance in *Acinetobacter baumannii* is mediated through multiple mechanisms, such as modification of target sites, enzymatic inactivation of antibiotics by production of carbapenamase, reduced drug uptake due to decreased permeability or increased efflux pump activity, and the ability to form biofilms.[9]

When referring to Southeast Asia, it is observed that Carbapenem resistance is notably high among Gram-negative bacteria in hospitals across South and Southeast Asia, particularly in *Acinetobacter baumannii* isolates. South Asia is considered the likely origin of the New Delhi metallo-β-lactamase-1 (NDM-1) gene, which encodes one of the most widely disseminated carbapenemases across various bacterial species and geographic regions[10]. Oxa-23 is the most prevalent carbapenemase enzyme found in *Acinetobacter baumannii*[11]

As one of the major Southeast Asian countries, Pakistan faces a substantial infectious disease burden caused by various bacterial species, among which *Acinetobacter* species have emerged as prominent pathogens.[7] This situation continues to cause serious threats and challenges to the country's healthcare system. According to research conducted so far, more than 60% of *Acinetobacter baumannii* isolates in Pakistan are resistant to carbapenems[7]

The objective of our study was to determine the sensitivity of Carbapenem-resistant *Acinetobacter baumannii* to a panel of antibiotics according to the Clinical and Laboratory Standards Institute (CLSI) 2024 guidelines.

Materials and Methods

After getting ethical approval KMU/IPDM/IEC/202335 on 18 Dec 2023, the study was conducted at the Department of Microbiology, Khyber Medical University, and the Department of Microbiology, Armed Forces Institute of Pathology (AFIP) from January 2024 to December 2024. It was a cross-sectional study; the sample size was calculated by following the formula used for descriptive studies.[12] (Formula: $n= z^2pq/e^2$), Where n is the sample size, z is the standard normal variate (value is 1.96 at a 5%margin of error),p is the expected proportion in the population based on previous studies[13] (3.5% overall average prevalence, q is equal to 1-p, and e is the margin of error (0.05). The estimated sample size calculated was 52. Non-probability convenience sampling was used. Samples were received from patients admitted to the medical, surgical ICUs, NICU, and wards. Carbapenem-resistant *Acinetobacter baumannii* isolated from different clinical specimens were included in the study. Duplicate isolates from the same patient and *Acinetobacter baumannii* sensitive to carbapenem

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were excluded from the study. Samples were collected from the department of microbiology, Armed Forces Institute of Pathology (AFIP), and processed in the laboratory by inoculating on Blood, Chocolate, and MacConkey agar, and for urine culture, Cystine Lactose Electrolyte Deficient (CLED) agar was used. The culture plates were incubated at 35°C ±2°C for 20-24 hours. Initial identification was done by colony morphology, lactose fermentation, and Gram staining. API 10S and 20E were used to identify up to the genus and species level. According to CLSI 2024, antibiotic susceptibility test of imipenem (10µg) and meropenem (10µg), ampicillin-sulbactam (20µg), ciprofloxacin (5µg), levofloxacin (5µg), Ceftazidime (30µg), Gentamicin (10µg), Minocycline (30µg), Cotrimoxazole(25µg), Tazo-pipracillin (110µg), Cefepime (30µg), amikacin(30µg), tetracycline(30µg), ceftriaxone (30µg) was done by Kirby Bauer disk diffusion method. Isolates showing resistance or intermediate sensitivity to meropenem and imipenem were considered resistant. Susceptibility pattern of the rest of the antibiotics was noted according to CLSI 2024. SPSS version 26 was used for the data analysis. For qualitative analysis, frequencies and percentages were used, and for quantitative analysis, means ± SD were used.

Results

During the study period, a total of 848 samples were positive; out of these positive samples, Gram-positive cocci were 190(22.4%), and Gram-negative rods were 658(77.6%). Out of Gram-negative rods 213(32.3%) were *Escherichia coli*, 141(21.4%) were *Klebsiella pneumoniae,*126(19.1%) were *Pseudomonas*, 59(8.9%) were *Acinetobacter baumannii*, 33(5%) were *Proteus,* 27(4.1%) were *Serratia,*17(2.5%) were *Enterobacter*,14(2.1%) were *Salmonella typhi*, 12(1.8%) were *Burkholderia* and 6(0.9%) were *Salmonella paratyphi.*

Out of 59 *Acinetobacter baumannii,* 57(97%) were carbapenem-resistant, and these were included in the study. samples received from male patients were 42(73.7%), and 15(26.3%) were from female patients. The mean age of the patients was 43.46. The minimum age was newborn, and the maximum was 83 years.

Samples yielded carbapenem resistant *Acinetobacter baumannii* were from pus 14(24.6%), tissue 12(21.1%), non-directed bronchial lavage 10(17.5%), blood 5(8.8%), bronchoalveolar lavage 4(7%), sputum 3(5.3%), fluid 3(5.3%) urine 2(3.5%) and 1 (1.8%) sample of each nasopharyngeal swab, drain, bone and Cerebrospinal fluid as shown in figure 1

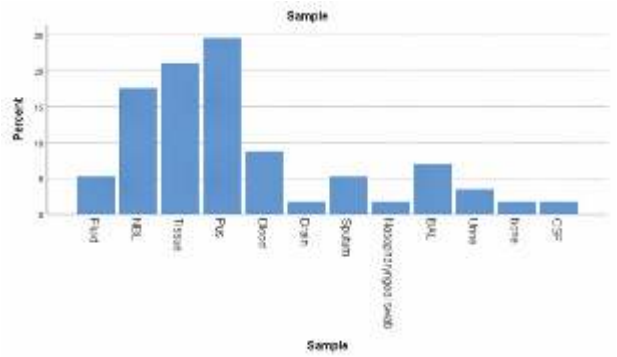

Figure 1: Samples Yielded Growth of Carbapenem-Resistant *Acinetobacter Baumannii*

Out of 57 carbapenem resistant *Acinetobacter baumannii* 52 (91.2%) were sensitive to minocycline, 39(68.4%) were sensitive to tigecycline, 4(7%) to gentamicin 3(5.2%) were sensitive to cefepime, 2(3.5%) to ceftazidime, 1(1.8%) to levofloxacin, tazo-pipracillin and ceftriaxone and showed zero sensitivity to amikacin, ciprofloxacin and ampicillin-sulbactam. Tetracycline was tested in urine samples, and CRAB showed 100% sensitivity towards it, as shown in Figure 2 and Table I.

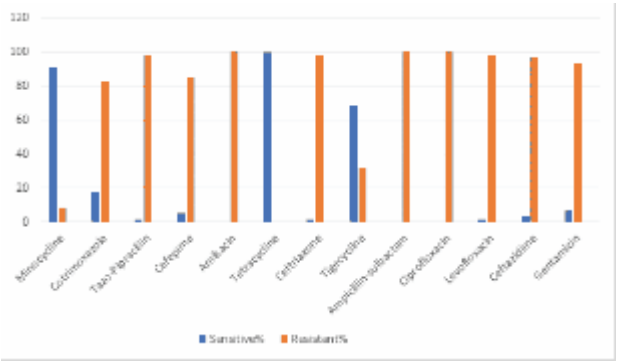

Fig 2: Antimicrobial Resistance Pattern of Antimicrobials against CRAB

Discussion

According to the WHO, Carbapenem-resistant *Acinetobacter baumannii* (CRAB) is recognized globally as a priority one, critical pathogen due to its extensive drug resistance and its association with nosocomial outbreaks, especially in intensive care units. In our study, CRAB isolates exhibited an

Table I: CRAB Susceptibility Profile

Antibiotics	Sensitive n(%)	Resistant n(%)
Ampicillin-Sulbactam	0	57(100)
Ciprofloxacin	0	57(100)
Levofloxacin	1(1.8)	56(98.2)
Ceftazidime	2(3.5)	55(96.5)
Gentamicin	4(7)	53(93)
Minocycline	52(91.2)	5(8.8)
Cotrimoxazole	10(17.5)	47(82.4)
Tazo-Pipracillin	1(1.8)	56(98.2)
Cefepime	3(5.2)	54(84.8)
Amikacin	0	57(100)
Tetracycline	2(100)	00
Ceftriaxone	1(1.8)	56(98.2)
Tigecycline	39(68.4)	18(31.6)

alarming resistance pattern, with 100% resistance to Ampicillin-Sulbactam, Ciprofloxacin, and Amikacin. These results are consistent with recent surveillance data that report similar high resistance rates across many regions, making these antibiotics largely ineffective against CRAB infections.[14,15]

The resistance to fluoroquinolones Levofloxacin (98.2%) and Ciprofloxacin (100%) is particularly concerning. Resistance mechanisms in *A. baumannii* include mutations in the *gyrA* and *parC* genes and the overexpression of efflux pumps, which have been well documented in recent literature.[16] High resistance to third-generation cephalosporins Ceftazidime (96.5%), Cefepime (84.8%), and Ceftriaxone (98.2%)—is also consistent with previous findings, often attributed to the widespread production of OXA-type carbapenemases and ESBLs[17]

Aminoglycoside resistance was notable, with complete resistance to Amikacin and 93% resistance to Gentamicin, similar to the results reported by Sajerli et al., who found high levels of aminoglycoside-modifying enzymes in clinical CRAB isolates.[18.] Furthermore, Tazo-Piperacillin resistance (98.2%) reflects the inefficacy of β-lactam/β-lactamase inhibitor combinations against CRAB, as previously reported in other studies.[19]

Amongst all the tested anti-microbial agents, **Minocycline** demonstrated the highest sensitivity rate (91.2%), followed by **Tigecycline** (68.4%). These results are consistent with various meta-analyses and clinical studies conducted around the world, highlighting the continued effectiveness of Minocycline against CRAB, even when resistance to other tetracyclines is present [20,21] Tigecycline, although less effective than Minocycline, remains a valuable option, particularly for initial treatment.[22]

Conversely, Gentamicin displayed low sensitivity (7%), confirming its limited role against CRAB compared to Minocycline. Cotrimoxazole showed 17.5% sensitivity, which, while limited, might still offer a role in combination therapy in certain clinical contexts, as noted by Al-Sheboul.[23]

These findings emphasize the critical need for robust antimicrobial stewardship, ongoing resistance surveillance, and the development of new agents, such as Cefiderocol, which has shown promise against CRAB in recent trials [24]. In the absence of effective therapeutic options, infection control practices and targeted therapy based on susceptibility data remain key pillars in managing CRAB infections.

Conclusion

CRAB showed very low sensitivity towards maximum antibiotics. Maximum sensitivity was shown towards minocycline (91.2%) and then tigecycline (68.4%). However, tetracycline showed good sensitivity if used in UTI patients. So, the treatment of the patient depends on pathogen-directed susceptibility. For empirical treatment, continuous surveillance of antibiotic susceptibility is needed.

Conflict of Interest

There is no conflict of interest declared by any author.

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Data Availability

The data that support the findings are available on request from the corresponding authors.

REFERENCES

1. Lee YL, Ko WC, Hsueh PR. Geographic patterns of Acinetobacter baumannii and carbapenem resistance in the Asia-Pacific Region: results from the Antimicrobial Testing Leadership and Surveillance (ATLAS) program, 2012-2019. International Journal of Infectious Diseases. 2023 Feb 1;127:48-55. 10.1016/j.ijid.2022.12.010 .
2. Liu G, Catacutan DB, Rathod K, Swanson K, Jin W, Mohammed JC, et al Deep learning-guided discovery of an

https://doi.org/10.57234/jiimc.december25.2738

antibiotic targeting Acinetobacter baumannii. Nature Chemical Biology. 2023 Nov;19(11):1342-50. https://doi.org/10.1038/s41589-023-01349-8.
3. Castillo-Ramírez S, Aguilar-Vera A, Kumar A, Evans B. Acinetobacter baumannii: much more than a human pathogen. Antimicrobial Agents and Chemotherapy. 2025 Sep 3;69(9):e00801-25. https://doi.org/10.1128/aac.00801-25.
4. Jiang Y, Ding Y, Wei Y, Jian C, Liu J, Zeng Z. Carbapenem-resistant Acinetobacter baumannii: A challenge in the intensive care unit. Frontiers in microbiology. 2022 Nov 10;13:1-15. doi.org/10.3389/fmicb.2022.1045206.
5. Müller C, Reuter S, Wille J, Xanthopoulou K, Stefanik D, Grundmann H et al. A global view on carbapenem-resistant Acinetobacter baumannii. MBio. 2023 Dec 19;14(6): e02260-23. https://doi.org/10.1128/mbio.02260-23.
6. Hamidian M, Nigro SJ. Emergence, molecular mechanisms, and global spread of carbapenem-resistant Acinetobacter baumannii. Microbial genomics.2019Oct;5(10):e000306. https://doi.org/10.1099/mgen.0.000306.
7. Khalid F, Saleem S, Ahmad I. High prevalence of carbapenem-resistant Acinetobacter baumannii-associated respiratory tract infections in Pakistani hospitals. J. Pak. Med. Assoc. 2020 Sep 1;70(9):16302. https://doi.org/10.5455/JPMA.35384.
8. Ejaz H, Ahmad M, Younas S, Junaid K, Abosalif KO, Abdalla AE, et al Molecular epidemiology of extensively-drug-resistant Acinetobacter baumannii sequence type 2 co-harboring bla NDM and bla OXA from clinical origin. Infection and drug resistance. 2021 May 25:14()1931-9. https://doi.org/10.2147/IDR.S310478.
9. Arif M, Asif A, Nazeer K, Sultan S, Riaz S. Coexistence of β-lactamase genes and biofilm-forming potential among carbapenem-resistant Acinetobacter baumannii in Lahore, Pakistan. The Journal of Infection in Developing Countries. 2024 Jun 30;18(06):943-9. https://doi.org/10.3855/jidc.19119.
10. Hsu LY, Apisarnthanarak A, Khan E, Suwantarat N, Ghafur A, Tambyah PA. Carbapenem-resistant Acinetobacter baumannii and Enterobacteriaceae in South and Southeast Asia. Clinical microbiology reviews. 2017 Jan;30(1):1-22. https://doi.org/10.1128/cmr.00042-16.
11. Lee CM, Kim YJ, Jung SI, Kim SE, Park WB, Choe PG, et al. Different clinical characteristics and impact of carbapenem-resistance on outcomes between Acinetobacter baumannii and Pseudomonas aeruginosa bacteraemia: a prospective observational study. Scientific Reports. 2022 May 20;12(1):8527. https://doi.org/10.1038/s41598-022-12482-0.
12. Charan J. Biswas T. How to calculate sample size for different study designs in medical research? Indian Journal of Psychological Medicine 2013Apr-Jun;35(2):121-126. https://doi.org/10.4103/0253-7176.116232.
13. Said D, Willrich N, Ayobami O, Noll I, Eckmanns T, Markwart R. The epidemiology of carbapenem resistance in Acinetobacter baumannii complex in Germany (2014–2018): an analysis of data from the national Antimicrobial Resistance Surveillance system. Antimicrobial Resistance & Infection Control. 2021 Mar 1;10(1):45. https://doi.org/10.1186/s13756-021-00909-8.
14. World Health Organization. Antimicrobial resistance surveillance in Europe 2022–2020 data. https://iris.who.int/handle/10665/351141.
15. Alotaibi T, Abuhaimed A, Alshahrani M, Albdelhady A, Almubarak Y, Almasari O. Prevalence of multidrug-resistant Acinetobacter baumannii in a critical care setting: A tertiary teaching hospital experience. SAGE Open Medicine2021Mar;9:1-5. https://doi.org/10.1177/20503121211001144.
16. Kyriakidis I, Vasileiou E, Pana ZD, Tragiannidis A. Acinetobacter baumannii antibiotic resistance mechanisms. Pathogens. 2021 Mar 19;10(3):373. https://doi.org/10.3390/pathogens10030373.
17. Zarrilli R, Pournaras S, Giannouli M, Tsakris A. Global evolution of multidrug-resistant *Acinetobacter baumannii*: Molecular epidemiology and resistance mechanisms. *Front Microbiol*. 2020;11:2164. https://doi.org/10.1016/j.ijantimicag.2012.09.008.
18. Sajerli B, Makai K, Lakatos L, Sarkadi-Nagy Á, Burián K, Orosz L. Aminoglycoside resistance dynamics and its predictive value for carbapenem resistance in multidrug-resistant Acinetobacter baumannii and Klebsiella pneumoniae. Journal of Global Antimicrobial Resistance. 2025 June21:43:309-318. https://doi.org/10.1016/j.jgar.2025.05.012.
19. Peleg AY, Hooper DC. Hospital-acquired infections due to gram-negative bacteria. *N Engl J Med*. 2020;382(12):1136–49. https://www.nejm.org/doi/abs/10.1056/nejmra0904124.
20. Paul S, Pande R. To Study the Incidence, Risk Factors, Antibiotic Susceptibility, Resistant Mechanism and Treatment Outcome in Critically Ill Patients with Carbapenem Resistant Acinetobacter Baumanii (CRAB) Infection in a Tertiary Care Setup: A Prospective Observational Study. Indian Journal of Critical Care Medicine: Peer-reviewed, Official Publication of Indian Society of Critical Care Medicine. 2025 May 31;29(Suppl 1):S242. 10.5005/jaypee-journals-10071-24933.183.
21. Kim T, Jeon EH, Hong YK, Jung J, Kim MJ, Sung H, et al. Minocycline Susceptibility of Carbapenem-Resistant Acinetobacter baumannii Blood Isolates from a Single Center in Korea: Role of tetB in Resistance. Infection & Chemotherapy. 2025 Feb 5;57(1):111. 10.3947/ic.2024.0110.
22. Zhang S, Di L, Qi Y, Qian X, Wang S. Treatment of infections caused by carbapenem-resistant Acinetobacter baumannii. Frontiers in Cellular and InfectionMicrobiology2024Jul18; 14:1-11 https://doi.org/10.3389/fcimb.2024.1395260.
23. Al-Sheboul SA, Al-Moghrabi SZ, Shboul Y, Atawneh F, Sharie AH, Nimri LF. Molecular characterization of carbapenem-resistant Acinetobacter baumannii isolated from intensive care unit patients in Jordanian hospitals. Antibiotics. 2022 Jun 21;11(7):835. 10.3390/antibiotics11070835.
24. Bassetti M, Vena A, Sepulcri C, Giacobbe DR, Peghin M. Treatment of bloodstream infections due to Gram-negative bacteria with difficult-to-treat resistance. Antibiotics. 2020 Sep 22;9(9):632. http://doi.ort/10.3390/antibiotics9090632.

CONFLICT OF INTEREST

Authors declared no conflicts of Interest.

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DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

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ORIGINAL ARTICLE

Role of MRI in Epilepsy: A Retrospective Study at POF Hospital, Wah Cantt

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ABSTRACT

Objective: To establish the role of magnetic resonance imaging (MRI) in the management of epilepsy and to determine the proportion of MRI brain findings in young patients with epilepsy.

Study Design: Retrospective cross-sectional descriptive study.

Place and Duration of Study: Department of Diagnostic Radiology, POF Hospital Wah Cantt, from January 1, 2025 to February 28, 2025.

Materials and Methods: A total of 172 patients were selected by non-probability consecutive sampling. MRI brain images, obtained using the epilepsy protocol, from patients aged 1 to 30 years with a clinical history of epilepsy were retrospectively retrieved from the hospital Picture Archiving and Communication System (PACS) between June 1, 2018, and May 31, 2024. Patient age, gender, and MRI findings were recorded on a predesigned proforma. Data were analyzed using SPSS version 23.0. Age was expressed as mean ± standard deviation, while gender and MRI findings were presented as frequency and percentage. For abnormal MRI findings and the two most common abnormalities 95% confidence interval (CIs) were calculated.

Results: Out of 172 patients, 51.2% were males and 48.8% females, with a mean age of 18 ± 7.29 years. Structural brain abnormalities were detected in 94 patients (54.7%, 95% CI: 47.2%–61.9%), most commonly white matter hyperintensities (15.1%, 95% CI: 10.5%–21.2%) and mesial temporal sclerosis (14.5%, 95% CI: 10.0%–20.6%).

Conclusion: Dedicated MRI brain epilepsy protocol serves as a first-line neuroimaging modality in epilepsy management, as it allows accurate detection of structural lesions that can influence treatment decisions.

Keywords: *Epilepsy, Magnetic Resonance Imaging, Seizure.*

Introduction

Epilepsy is a chronic disorder characterized by a consistent propensity for recurrent and unprovoked seizures, leading to neurobiological, cognitive, psychological, and social problems.[1, 2] It is the most common neurological disorder in the world, accounting for 1% of the global disease burden. According to the WHO, 50 million people worldwide are suffering from epilepsy.[3] The prevalence of epilepsy in Pakistan is 9.99 per 1,000.[4] It is more common in males than females.[4] Its incidence rises until the age of 20, and then declines.[3] Its prevalence is higher in developing countries due to the high incidence of endemics, perinatal complications, and poor healthcare facilities.[5,6]

Early detection of the cause of epilepsy is crucial, especially in young patients as each seizure increases the risk of injury to the developing brain, resulting in permanent behavioral and cognitive disorders.[7] Routine MRI brain sequences (T1, T2 weighted spin echo and Fluid Attenuated Inversion Recovery FLAIR) may miss subtle epileptogenic lesions due to limited slice thickness and suboptimal orientation. However dedicated epilepsy protocols SPACE sequence, (Sampling Perfection with Application optimized Contrast using different flip angle Evolution) provide superior grey white matter contrast, better delineation of cortical architecture, sulcal patterns and multiplanar reconstruction without loss of resolution. Thus, this protocol significantly improves lesion detection and localization and provides help in early diagnosis, management, surgical planning and prognosis.[8]

In Pakistan, very limited local literature is available describing the role of MRI in epilepsy and spectrum

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the MRI brain findings in young epileptic patients. This gap in local data limits clinicians' ability to make evidence-based decisions for early diagnosis and management. This study aimed to establish the role of MRI with dedicated epilepsy protocol in epilepsy by determining the proportion of structural brain abnormalities in young patients.

Materials and Methods

This retrospective cross-sectional study was conducted in the Radiology Department of POF Hospital Wah Cantt from January 1, 2025 to February 28, 2025 over a period of 2 months after obtaining ethical committee approval (Letter no: IRB/POFH/01-2025/RADIOLOGY/03, dated 01.01.2025). As this study involved retrospective review of preexisting data, informed consent was not required. The data were securely stored to ensure confidentiality and patient identifiers were removed. The minimum required sample was calculated as 15 by using the WHO formula with 95% CI (Z= 1.96), d= 0.05 and a prevalence of epilepsy 9.99 per 1000 [4] however a total of 172 patients were included in the study by non-probability consecutive sampling to enhance study reliability. MRI brain images obtained using the epilepsy protocol from patients aged 1 to 30 years with a clinical history of epilepsy were retrospectively retrieved from the hospital Picture Archiving and Communication System (PACS) between June 1, 2018 and May 31, 2024 over a period of 6 years. Younger patients were prioritized because epilepsy is more common in childhood. MRI brain scans of patients with clinical history of epilepsy older than 30 years or those with a history of seizures due to conditions other than epilepsy were excluded from the study. MRI brain scans without a dedicated epilepsy protocol were also excluded.

After fulfilling the inclusion and exclusion criteria, a total 172 MRI images of the patients were selected. All patients underwent MRI brain on a Siemens Magnetom Aera 1.5T. The dedicated epilepsy protocol used in our hospital includes Sampling Perfection with Application optimized Contrast using different flip angle Evolution (SPACE) T1-weighted sagittal, T2-weighted sagittal and T2-weighted dark fluid sagittal images with MPR planning, ep2d-diff-3scan-trace, T2-SWI axial and contrast-enhanced T1WI when needed. All MRI images were analyzed by a senior radiologist with 15 years of experience to identify brain abnormalities. Findings were recorded on the proforma as the presence or absence of MRI-evident structural brain abnormalities along with the patient's age, gender, and clinical history. If any structural abnormality was present, its complete name and description were recorded according to predefined operational MRI criteria derived from established neuroimaging literature (Appendix A).

The data were entered and analyzed using SPSS version 23. Patient age was expressed as mean ± standard deviation, while gender and MRI brain findings were reported as frequencies and percentages. For abnormal MRI findings and the two most common abnormalities 95% confidence interval (CI) were calculated.

Results

A total of 172 patients were included in the study. The mean age of the patients was 18 ± 7.29 years (median: 18; mode: 30) with an age range of 1-30 years. There were 88 males (51.16%) and 84 females (48.84%) (Table I).

A total of 94 patients had structural brain abnormalities on MRI, giving a frequency of **54.7% (95% CI: 47.3–62.0%).** The common findings were white matter hyperintensities (WMHs) (n = 26; 15.1%, 95% CI: 10.5%–21.2%) and mesial temporal sclerosis (MTS) (n = 25; 14.5%, 95% CI: 10.0%–20.6%).

The other findings were focal cortical dysplasia (FCD) type II (n = 4; 2.33%), pachygyria (n = 2; 1.16%), grey matter heterotopia (GMH) (n = 1; 0.58%), encephalomalacia (n = 8; 4.65%), enlarged amygdala (n = 3; 1.74%), porencephalic cyst (n = 2; 1.16%), ulegyria (n = 2; 1.16%), periventricular leukomalacia (PVL) (n = 2; 1.16%), arachnoid cyst (n=6; 3.49%), chiari I malformation (n=2; 1.16%), chiari II malformation (n=2; 1.16%), intracranial lipoma (n=1; 0.58%), vascular malformations (n = 2; 1.16%), including arteriovenous malformation (AVM) and developmental venous anomaly (DVA), and atrophy related causes including cerebral atrophy (n = 3; 1.74%), cerebellar atrophy (n = 1; 0.58%) and hemicerebral atrophy (n = 2; 1.16%) (Table II).

Discussion

In this retrospective cross-sectional study 54.7% of patients had abnormal findings on MRI. The most common findings were white matter hyperintensities (WMHs) and mesial temporal

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Table I: Demographic Characteristics of Study Participants

Variable	Values
Mean age	18 ± 7.29
Median age	18
Mode	30
Age Range	1- 30 years
Male	88 (51.16%)
Female	84 (48.84%)

Table II: Distribution of MRI Findings in Patients with Epilepsy (n = 172)

MRI Finding	n (%)	95% CI
Normal MRI brain	78 (45.3%)	—
MRI with structural brain abnormality	94 (54.7%)	47.3–62.0
White matter hyperintensities (WMHs)	26 (15.1%)	10.5–21.2
Mesial temporal sclerosis (MTS)	25 (14.5%)	10.0–20.6
Malformations of cortical development (MCD)		
Focal cortical dysplasia (FCD) type II	4 (2.33%)	—
Pachygyria	2 (1.16%)	—
Grey matter heterotopia (GMH)	1 (0.58%)	—
Other causes		
Encephalomalacia	8 (4.65%)	—
Enlarged amygdala	3 (1.74%)	—
Porencephalic cyst	2 (1.16%)	—
Ulegyria	2 (1.16%)	—
Periventricular leukomalacia (PVL)	2 (1.16%)	—
Arachnoid cyst	6 (3.49%)	—
Chiari I	2 (1.16%)	—
Chiari II	2 (1.16%)	—
Intracranial lipoma	1 (0.58%)	—
Vascular malformations		
AVM	1 (0.58%)	—
DVA	1 (0.58%)	—
Atrophy-related causes		
Cerebral atrophy	3 (1.74%)	—
Cerebellar atrophy	1 (0.58%)	—
Hemicerebral atrophy	2 (1.16%)	—

sclerosis (MTS). The mean age of patients was 18 years with almost equal gender distribution.

Literature review shows that studies on childhood epilepsy typically report abnormal MRI findings in around 40% of cases,[9,10] our slightly higher proportion (54.7%) may be explained by the fact that we considered not only abnormalities directly causing epilepsy but also those associated with it thereby providing a comprehensive picture of

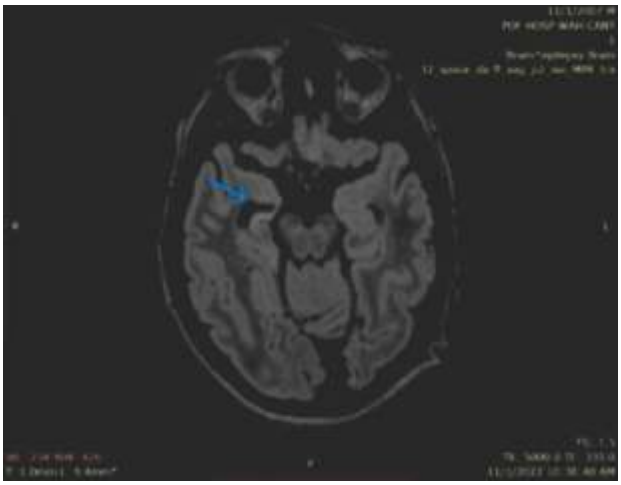

Fig 1.Right mesial temporal sclerosis evident as hippocampal volume loss with mildly dilated temporal horn of lateral ventricle (arrow)

Appendix A

Table: Operational Definitions of Structural MRI Abnormalities

structural brain changes and highlights the clinical value of MRI in detecting both overt epileptogenic lesions and subtle abnormalities that may influence disease course, management and prognosis.

In our study, WMHs were the most common MRI abnormality in epileptic patients. Similar findings have been reported in literature showing higher WMH burden in epileptic patients as compared to healthy controls.[11] WMHs in epilepsy are believed to result from chronic white matter hypoperfusion or blood-brain barrier damage during fits.[12] Thus WMH in young epileptic patients should not be taken as incidental findings although their prognostic value remains uncertain, their higher occurrence warrants future studies focusing on relationship between WMH, seizure outcome, cognitive decline and treatment response.

Mesial temporal sclerosis (MTS) and malformations of cortical development (MCD) that include FCD type II, pachygyria and GMH were also frequent findings in MRI brain of patients in our study. Literature review shows that MTS is the most common structural abnormality associated with focal epilepsy, particularly temporal lobe epilepsy (TLE) (Fig 1).[13] MRI epilepsy protocol (SPACE sequences) remains the gold standard for detection of MTS and MCD due to improved grey white matter differentiation and multiplanar reconstruction.[14] Both MTS and FCD are surgically treatable

Abnormality	MRI-Based Operational Definition	Reference no.
White Matter Hyperintensities (WMHs)	T2WI and FLAIR hyperintense foci, showing no diffusion restriction, located in deep and periventricular white matter	11
Mesial Temporal Sclerosis (MTS)	Hippocampal atrophy, T2WI and FLAIR hyperintensity and widening of the temporal horn	13
Focal Cortical Dysplasia (FCD Type II)	Cortical thickening, blurring of the grey–white junction with radial hyperintensity from cortex to ventricle on T2WI sequences	15
Pachygyria	Cortical thickening with broad and reduced number of gyri and shallow sulci; abnormal grey –white differentiation on T1WI and T2WI sequences.	17
Grey Matter Heterotopia (GMH)	Nodules or bands of grey matter located along lateral ventricles or deep white matter, isointense to cortex on all sequences.	17
Malformations of Cortical Development (MCD)	Group of structural cortical abnormalities from disord ered neuronal migration, including FCD, pachygyria and GMH	17
Encephalomalacia	CSF signal intensity areas with volume loss and surrounding gliosis seen as T1WI hypointensity and T2WI and FLAIR hyperintensity, replacing brain parenchyma	18
Enlarged Amygdala	Amygdala enlargement with intact architecture and with or without T2WI and FLAIR hyperintensity.	19
Porencephalic Cyst	Well defined CSF signal intensity cyst within brain parenchyma communicating with ventricle or subarachnoid space and adjacent gliosis.	20
Ulegyria	Cortical thinning and scarring in deep sulci with preserved gyri	20
Periventricular Leukomalacia (PVL)	Periventricular T2WI /FLAIR hyperintensity with loss of periventricular white matter volume	20
Intracranial lipoma	Fat signal intensity mass on all sequences	20
Cerebral Atrophy	Generalized or regional reduction in cortical volume with widened sulci and ventriculomegaly, assessed visually, usually no altered signal intensity on T1WI and T2WI images.	20
Cerebellar Atrophy	Volume loss of cerebellar hemispheres or vermis with prominent folia confirmed on sagittal and axial sequences.	20
Hemicerebral Atrophy	Unilateral cerebral volume loss with ipsilateral ventricular dilation, assessed visually.	20
Vascular Malformations (AVM/DVA)	AVM: Cluster of flow voids with early venous filling on contrast MRI. DVA: Radial medullary veins converging into a single enlarged collecting vein, show blooming on SWI	21,22
Arachnoid cyst	Well-defined, extra -axial, CSF -intensity lesion without enhancement or restricted diffusion, and causing variable mass effect on adjacent brain structures.	23
Chiari I malformation	Caudal descent of one or both cerebellar tonsils ≥5 mm below the foramen magnum on midsagittal T1WI and T2WI	24
Chiari II malformation	Complex hindbrain malformation characterized by downward displacement of the cerebellar vermis, brainstem, and fourth ventricle small posterior fossa, and beaking of the tectum and associated hydrocephalus	24

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pathologies.[15] MRI also aids in surgical planning and can lead to excellent outcomes, achieving seizure free life in well selected patients.[16,17]

Encephalomalacia is a well known cause of epilepsy and has been associated with poor prognosis in refractory cases.[18] Enlarged amygdala may be a part of temporal lobe epilepsy subtype or represent a nonspecific finding.[19] Porencephalic cyst, ulegyria, PVL and hemicerebral atrophy are well established causes of epilepsy.[20] Among vascular malformation AVMs[21] are strongly associated with epilepsy whereas role of DVA[22] is less frequent. The association between epilepsy and arachnoid cyst[23] and chiari malformations[24] remains controversial in literature. While less frequent in our cohort, their presence highlights the diverse range of structural etiologies detectable on MRI in young epileptic patients.

As it was a single-center retrospective study, the findings may not be generalizable to broader populations. Furthermore, findings were not correlated with clinical data such as EEG findings, seizure type and patients were not followed after imaging. Future prospective, multicenter studies integrating clinical, imaging and follow up outcome data are recommended to better clarify the role of MRI findings in guiding epilepsy management.

Conclusion

Dedicated MRI brain epilepsy protocol serves as a first-line neuroimaging modality in epilepsy management, as it allows early detection of structural lesions that can influence treatment decisions. This is particularly important in young patients, where early diagnosis can impact long-term outcomes.

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REFERENCES

1. Sarmast ST, Abdullahi AM, Jahan N, Abdullahi MI, Ahmed MI, Salisu AD, et al. Current classification of seizures and epilepsies: scope, limitations, and recommendations for future action. *Cureus*. 2020 Sep 20;12(9):e10549. doi:10.7759/cureus.10549.
2. Sirven JI. Epilepsy: a spectrum disorder. *Cold Spring Harb Perspect Med*. 2015 Sep 1;5(9):a022848. doi:10.1101/cshperspect.a022848.
3. Zhang Y, Kong X, Lv J, Yang C, Li X, Yang X, et al. Analysis of the global burden of disease study highlights the global, regional, and national trends of idiopathic epilepsy epidemiology from 1990 to 2019. *Prev Med Rep*. 2023;36:102522. doi:10.1016/j.pmedr.2023.102522.
4. Khatri IA, Iannaccone ST, Ilyas MS, Abdullah M, Saleem S. Epidemiology of epilepsy in Pakistan: review of literature. *J Pak Med Assoc*. 2003 Dec;53(12):594-7.
5. Mogal Z, Aziz H. Epilepsy treatment gap and stigma reduction in Pakistan: a tested public awareness model. *Epilepsy Behav*. 2020 Feb;102:106637. doi:10.1016/j.yebeh.2019.106637.
6. Biset G, Abebaw N, Gebeyehu NA, Estifanos N, Birrie E, Tegegne KD. Prevalence, incidence, and trends of epilepsy among children and adolescents in Africa: a systematic review and meta-analysis. *BMC Public Health*. 2024 Mar 12;24(1):771. doi:10.1186/s12889-024-18236-z.
7. Rozensztrauch A, Kołtuniuk A. The quality of life of children with epilepsy and the impact of the disease on family functioning. *Int J Environ Res Public Health*. 2022 Feb 17;19(4):2277. doi:10.3390/ijerph19042277.
8. Bernasconi A, Cendes F, Theodore WH, Gill RS, Koepp MJ, Hogan RE, et al. Recommendations for the use of structural magnetic resonance imaging in the care of patients with epilepsy: a consensus report from the ILAE Neuroimaging Task Force. *Epilepsia.* 2019;60(6):1054-68. doi:10.1111/epi.15612.
9. Gauci MC, Gauci R, Ruggieri M, Polizzi A, Praticò AD. Clinical, genetic, EEG, neuroimaging insights and conservative treatment in pediatric focal epilepsy: a retrospective observational study. J Clin Med. 2025;14(7):2234. doi:10.3390/jcm14072234.
10. Elmi AM, Ibrahim AA, Hassan MS, Osman FAO, Çelik C, Dirie AM, et al. Magnetic resonance imaging findings and their association with electroencephalographic data in pediatric epilepsy. *Int J Gen Med.* 2024;17:123-130. doi:10.2147/IJGM.S356789.
11. Mao YT, Goh E, Churilov L, McIntosh A, Ren YF, O'Brien TJ, et al. White matter hyperi ntensities on brain magnetic resonance imaging in people with epilepsy: a hospital-based study. *CNS Neurosci Ther.* 2016 Sep;22(9):758-63. doi:10.1111/cns.12571.
12. Uslu N, Uysal E, Karagöz E, Yılmaz M, Yıldız Y, Demir S, et al. Relationship of white matter hyperintensities with clinical features of seizures in patients with epilepsy. *Neurol Sci*. 2022 Jan;43(1):357-63. doi:10.1007/s10072-021-05554-6.
13. Engel J Jr. Mesial temporal lobe epilepsy: what have we learned? Neuroscientist. 2016 Apr;22(2):182-96. doi:10.1177/1073858415593869.
14. Jehi L. The epileptogenic zone: concept and definition.

Epilepsy Curr. 2018 Jul-Aug;18(4):258-262. doi:10.5698/1535-7597.18.4.258.
15. Lerner JT, Salamon N, Hauptman JS, Velasco TR, Hemb M, Wu JY, et al. Assessment and surgical outcomes for mild type I and severe type II cortical dysplasia: a critical review and the UCLA experience. *Epilepsia.* 2009 Jun;50(6):1310-35. doi:10.1111/j.1528-1167.2008.01998.x.
16. Sisodiya SM. Malformations of cortical development: burdens and insights from important causes of human epilepsy. *Lancet Neurol.* 2021 Jan;20(1):48-60. doi:10.1016/S1474-4422(20)30395-1.
17. Severino M, Geraldo AF, Utz N, Tortora D, Pogledic I, Klonowski W, et al. Definitions and classification of malformations of cortical development: practical guidelines. *Brain*. 2020 Oct 1;143(10):2874-94. doi:10.1093/brain/awaa174.
18. Zhong Y. Screening of risk factors for poor prognosis in patients with refractory epilepsy secondary to encephalomalacia. *Comput Math Methods Med*. 2022 Jul 4;2022:5720102. doi:10.1155/2022/5720102.
19. Reyes A, Thesen T, Kuzniecky R, Devinsky O, McDonald CR, Jackson GD, et al. Amygdala enlargement: temporal lobe epilepsy subtype or nonspecific finding? *Epilepsy Res*. 2017 Apr;132:34-40. doi:10.1016/j.eplepsyres.2017.02.019.
20. Cendes F, Theodore WH, Brinkmann BH, Sulc V, Cascino GD. Neuroimaging of epilepsy. *Handb Clin Neurol*. 2016;136:985-1014. doi:10.1016/B978-0-444-53486-6.00051-X.
21. Ogaki A, Ikegaya Y, Koyama R. Vascular abnormalities and the role of vascular endothelial growth factor in the epileptic brain. *Front Pharmacol*. 2020 Feb 4;11:20. doi:10.3389/fphar.2020.00020.
22. El Meskine T, Li J, Reise J, Toffa DH. Epilepsy and cerebral developmental venous anomalies (DVAs): a systematic review. *Epileptic Disord*. 2023 Apr;25(2):209-17. doi:10.1002/epd2.20020.
23. Nikolić I, Kovačević M, Janković M, Vojinović R, Kostić V, Sokić D. The association of arachnoid cysts and focal epilepsy: a hospital-based case-control study. *Epilepsy Res.* 2017;138:56-61. doi:10.1016/j.clineuro.2017.05.014.
24. Pascual-Castroviejo I, Pascual-Pascual SI, Velázquez-Fragua R, Vázquez-López M. Chiari type I and type II malformations and epilepsy: a comprehensive review. *Childs Nerv Syst.* 2008;24(11):1359-1366. doi:10.1007/s00381-008-0699-5.

CONFLICT OF INTEREST

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DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

ORIGINAL ARTICLE

Comparison of Dynamic Compression Plate Versus Titanium Elastic Nailing System in the Management of Pediatric Femoral Diaphyseal Fractures

Muhammad Hammad Abbas[1], Qurat ul Ain Zulfi[2], Saad Adnan Idrees[3], Malik Asad Munir[4], Ayra Jazim Ali[5], Fahad Usman[6]

ABSTRACT

Objective: To compare the clinical outcomes of Dynamic Compression plate (DCP) versus Titanium Elastic Nailing System (TENS) in the surgical management of pediatric femoral diaphyseal fractures in a tertiary care hospital in Pakistan.

Study Design: Prospective non-randomized comparative study.

Place and Duration of Study: Imran Idrees teaching hospital Sialkot, 8 months.

Materials and Methods: This prospective non-randomized comparative study was conducted at Imran Idrees Teaching Hospital, Sialkot from April–December 2023. A total of 60 children (aged 7–12 years) with isolated femoral shaft fractures were enrolled and divided into DCP (n=30) and TENS (n=30) groups. Outcomes measured included fracture union time, operative duration, and postoperative complications. Statistical analysis was performed using SPSS v26, with p value <0.05 taken as significant.

Results: The mean time for fracture union was substantially lower in DCP group. (11.53 ± 0.571 weeks) compared to the TENS group (14.10 ± 2.524 weeks, p=0.001). Conversely, TENS showed a significantly lower operative time (30.83 ± 0.986 minutes) than DCP (53.20 ± 1.243 minutes, p=0.001). A moderate inverse correlation was found between BMI and fracture union time in the TENS group (ρ = -0.455, p=0.013).

Conclusion: Both DCP and TENS are effective surgical options for pediatric femoral shaft fractures. DCP enables faster fracture healing, while TENS reduces operative time. Treatment decisions should be individualized based on patient profile and surgical context.

Keywords: *Dynamic Compression plates, Femoral Fractures, Orthopedic Procedures, Pediatrics.*

Introduction

Pediatric femoral shaft fractures are significant injuries that account for approximately 1.6% to 2% of all pediatric fractures, leading to substantial morbidity worldwide.[1] The management of these fractures in children aged 7 to 12 years has evolved, with surgical intervention becoming the preferred approach to facilitate early mobilization and reduce complications associated with prolonged immobilization.[2] Dynamic Compression Plate (DCP) fixation and Titanium Elastic Nailing System (TENS) are widely used surgical options for pediatric femoral shaft fractures, each offering specific benefits and limitations. The incidence of these fractures varies worldwide and is influenced by socioeconomic factors, traffic safety, and recreational activities, with an estimated annual incidence of 20 per 100,000 children in high-income countries.[3] In underdeveloped countries, the incidence is likely higher due to increased exposure to risk factors, though comprehensive epidemiological data are lacking.[4] These fractures often result from high-energy trauma, such as motor vehicle accidents and falls from significant heights, leading to considerable healthcare utilization and economic burden.[5]

Historically managed conservatively, pediatric femoral fractures in children aged 7–12 years now favor surgery for faster recovery and improved alignment.[6] The American Academy of Orthopaedic Surgeons (AAOS) recommends surgical fixation for this demographic to optimize functional recovery and minimize psychosocial impacts.[7]

DCP provides rigid fixation for complex fractures but

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requires extensive dissection, increasing risks of infection and blood loss.[8] TENS uses flexible intramedullary nails for stabilization, retaining periosteal blood supply, promoting rapid healing, and enabling early weight-bearing.[9] However, TENS may be less effective in managing certain fracture types, such as those that are length-unstable or in older, heavier children.[10]

Recent comparative studies have sought to evaluate the efficacy of DCP versus TENS. A study by Venkataraman et al. reported that both methods achieved satisfactory outcomes, but TENS was associated with shorter operative times and hospital stays.[11] Similarly, Debnath et al. found that TENS resulted in a higher rate of excellent outcomes compared to DCP, with fewer complications. Conversely, some studies suggest that DCP may offer superior stability in complex fractures, albeit with a higher risk of infection due to the invasive nature of the procedure.[12]

Most studies on DCP vs. TENS for pediatric femoral shaft fractures are from high-income countries, leaving a data gap in LMICs like Pakistan. This study aims to compare DCP and TENS outcomes—including union rates and complications—in Pakistani children aged 7-12, providing evidence-based recommendations for resource-constrained settings.

Materials and Methods

This was a Prospective non-randomized comparative study conducted in the Department of Orthopedic Surgery at Imran Idrees Teaching Hospital (IITH), Sialkot, Punjab, Pakistan, following ethical approval granted by the Institutional Review Board (Ref: 2023/IITH/RA/0023, dated 24th April 2023). Patients included in this study were selected through a non-probability consecutive sampling technique from April 2023 to December 2023. Inclusion criteria encompassed pediatric patients aged 7 to 12 years presenting with isolated closed or Gustilo-Anderson Grade I open femoral diaphyseal fractures. Patients with pathological fractures, polytrauma, head injury, neurovascular compromise, previous surgical intervention on the same limb, or fractures involving the proximal or distal femoral metaphyseal or epiphyseal regions were excluded.

The sample size calculation was based on the primary outcome measure (fracture union time). Taking a data from the current similar study by Venkataraman et al. (2022), mean difference in union time of approximately 2.5 weeks between DCP and TENS was anticipated, with a pooled standard deviation of approximately 2.5 weeks. Using OpenEpi software (version 3.01), with 80% statistical power, a 5% significance level (alpha), and assuming equal distribution in each group, the minimum calculated sample size was determined to be 28 patients per group. To account for a potential 10% dropout rate, the sample was increased to 30 patients per group, resulting in a total sample size of 60 patients for the study[3]. Participants were prospectively allocated into two groups based on surgical intervention after informed written consent from their guardians: Group A (n=30) underwent Dynamic Compression Plate (DCP) fixation, involving open reduction and internal fixation with minimal periosteal disruption using AO-standard dynamic compression plates; Group B (n=30) underwent Titanium Elastic Nailing System (TENS), using closed or minimally invasive retrograde insertion of flexible intramedullary nails. Standardized surgical care was taken to prevent complications during the procedure and it was performed under general anesthesia by qualified orthopedic surgeons. Postoperative management was uniform across both groups, comprising prophylactic antibiotic therapy, analgesia, and structured physiotherapy programs. Early range-of-motion exercises commenced as tolerated, with partial weight-bearing initiated between 3–4 weeks in the TENS group and 5–6 weeks in the DCP group based on radiographic evaluation. Follow-up assessments were systematically performed at intervals of 2, 6, 12, and 24 weeks postoperatively. Clinical and radiological data, including demographics, time from injury to surgery, operative duration, fracture union (defined radiologically by bridging callus on three cortices on radiographic views[3].) all postoperative radiographs were evaluated independently by two orthopedic seniors surgeons who are not co authors in this study with more than five years of experience in pediatric fracture management. Both assessors were blinded to the intervention group (DCP vs. Flexible Nail) to minimize detection bias. Postoperative complications (infection, implant irritation, malunion, nonunion), and the necessity for

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secondary procedures were recorded on a structured, validated data collection form. The form underwent internal validation and pilot-testing prior to use. Statistical analyses were conducted using SPSS Statistics (version 26.0). Continuous variables were expressed as mean ± standard deviation and compared via independent-samples Mann–Whitney U test and spearman correlation with statistical significance defined as p-value <0.05.

Results

Table I presents the distribution of participants across different groups and gender. In terms of the group category, there is an equal distribution, with 30 participants (50%) in the Dynamic Compression Plate group and 30 participants (50%) in the Flexible Nail group. Regarding gender, there are 17 females (28.3%) and 43 males (71.7%), giving a total of 60 participants in the study. Mean age of participants was 9.25±1.323 years. The mean Body Mass Index (BMI) of participants was 16.45±1.545. The average operative time was 42.02±11.332 minutes. The mean fracture union time was 12.82±2.228 weeks. The average duration of the fracture prior to treatment was 2.80 ±1.424 days.

Table II shows Dynamic Compression Plate group had a mean operative time of 53.20± 1.243 minutes versus 30.83± 0.986 minutes for the Flexible Nail group, with a significant difference p = 0.001. For fracture union, the Dynamic Compression Plate group had a mean of 11.53 weeks (± 0.571), while the Flexible Nail group had 14.10± 2.524 weeks, also significantly different p = 0.001. No significant difference was found in the duration of the fracture, both groups having a mean of 2.80 days p = 0.848.

The table III. showed a moderate negative correlation BMI and fracture union in weeks (Spearman's rho = -0.373), with a statistically significant p-value of 0.003 (N = 60). A weak negative correlation was found between the duration of fracture in days and fracture union in weeks (Spearman's rho = -0.083), but the p-value of 0.528 indicates that this result is not statistically significant (N = 60). A strong negative correlation was observed between operative time in minutes and fracture union in weeks (Spearman's rho = -0.707), with a highly significant p-value of 0.000 (N = 60). A very weak negative correlation was found between age and fracture union in weeks (Spearman's rho = -0.048), with a non-significant p-value of 0.717 (N = 60).

Table IV presents the correlation between patient and operative variables with fracture union, stratified by fixation method (Dynamic Compression Plate vs. Flexible Nail). Spearman's rho correlation coefficients and corresponding p-values are reported. No significant correlations were observed with age or duration of fracture in either group. In the Dynamic Compression Plate group, BMI and operative time showed weak, non-significant associations. In contrast, in the Flexible Nail group, higher BMI ($\rho = -0.455$, $p = 0.013$) and longer operative time ($\rho = -0.738$, $p < 0.001$) were significantly negatively correlated with fracture union, indicating delayed union with increasing BMI and operative duration.

Table I: Descriptive Statistics

Category	Frequency (n)	Percent (%)
Group		
Dynamic Compression Plate	30	50.0
Flexible Nail	30	50.0
Gender		
Female	17	28.3
Male	43	71.7
Total (Gender)	60	100.0
Variable	**Mean**	**Standard Deviation**
Age	9.25	1.323
BMI	16.45	1.545
Operative Time in Minutes	42.02	11.332
Fracture Union in Weeks	12.82	2.228
Duration of Fracture in Days	2.80	1.424

Table II. Comparative Analysis of Surgical Metrics Between Treatment Modalities

Variable	Group	Mean ± SD	Mann-Whitney U	p-value
Operative Time (minutes)	Dynamic Compression Plate	53.20 ± 1.243	0.000	0.001
	Flexible Nail	30.83 ± 0.986		
Fracture Union (weeks)	Dynamic Compression Plate	11.53 ± 0.571	30.000	0.001
	Flexible Nail	14.10 ± 2.524		
Duration of Fracture (days)	Dynamic Compression Plate	2.80 ± 1.518	437.500	0.848
	Flexible Nail	2.80 ± 1.349		

Table III. Correlation Between variables and Fracture Union Time

Variable	Correlation With	Spearman's rho	p-value	Sample Size (n)
BMI	Fracture Union in Weeks	-0.373	0.003	60
Duration of Fracture in Days		-0.083	0.528	
Operative Time in Minutes		-0.707	0.000	
Age		-0.048	0.717	

Table IV. Fracture Union Correlation by Fixation Method

Variable	Dynamic Compression Plate		Flexible Nail	
	Spearman's rho	p-value	Spearman's rho	p-value
Age	-0.038	0.843	-0.087	0.643
BMI	-0.144	0.495	-0.455	0.013
Operative Time (mins)	-0.101	0.595	-0.738	0.000
Duration of Fracture (days)	0.187	0.324	-0.069	0.713

Discussion:

Femoral shaft fractures are a significant concern in pediatrics, affecting both the child and their family. The incidence follows a bimodal distribution, peaking in infancy and mid-adolescence. Treatment approaches vary depending on the age and fracture pattern[1]. The current study was about 43 males (71.7%) and 17 females (28.3%), which reflects the higher prevalence of fractures in males, consistent with findings from a study involving 911,206 subjects reported that males had a 12.25% incidence of traumatic long-bone fractures, while females had a 6.25% incidence, indicating a higher fracture rate among males[13]. The average age of participants was 9.25±1.323 years ,which is consistent with a study showing that the highest frequency of fractures occurs at 6 years of age in boys and 7 years in girls[14]. The mean BMI of 16.45 was normal, aligning with an average healing time of 12.82±2.228 weeks. Obesity is known to delay fracture healing[15]. The average operative time was 42.02±11.332 minutes, similar to the findings in other pediatric fracture surgeries, where operation times range between 30-60 minutes. Longer operative times may be influenced by factors such as fracture complexity[16]. The average fracture-to-treatment time was 2.80 days (SD = 1.518 for DCP and SD = 1.349 for Flexible Nail), with no significant difference between the two groups (U = 437.500, p = 0.848). This suggests that the time from fracture occurrence to treatment initiation was similar for both groups. Timely surgical intervention following a fracture is essential to minimize the risk of complications and promote efficient healing. Delays beyond 5 days post-injury have been associated with increased complication rates, underscoring the importance of prompt treatment[20].

An inverse relation was significantly found between BMI and fracture union time (Spearman's rho = -0.373, p = 0.003). This indicates that higher BMI is associated with longer fracture healing times. Supporting this finding, Heath et al. reported that obese pediatric patients had a mean time to union of 152 days, significantly longer than the 93.59 days observed in non-obese patients ($p < 0.001$)[21]. The correlation between the duration of the fracture and fracture union time was weak and not statistically significant (Spearman's rho = -0.083, p = 0.528). This suggests that the time elapsed since the injury does not significantly impact the healing time in this cohort. Similarly, Grauberger et al. (2020) found no significant differences in time to union between patients treated within 18 hours of admission and those treated later ($p > 0.05$)[17,22]. A strong negative correlation was observed between operative time and fracture union time (Spearman's rho = -0.707, p = 0.000). This indicates that longer operative times are associated with slower healing. Supporting this, Cintean et al. noted that longer surgical times could be associated with increased complications, potentially affecting healing outcomes[23,24]. The correlation between age and fracture union time was weak and not statistically significant (Spearman's rho = -0.048, p = 0.717). This suggests that age does not have a significant influence on fracture healing time in this sample.

Our data showed no correlation between patient age and fracture union time in both treatment groups (DCP plating: $\rho = -0.038$, $p = 0.843$; ESIN flexible nailing: $\rho = -0.087$, $p = 0.643$). This outcomes is according to the recent studies. For instance, Lakhani

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et al. reported that school-aged children (mean age ~11.5 years) treated with submuscular DCP plating all achieved bone union at an average of about 11 weeks, with no significant age-related delay in healing[25]. In the current study in (DCP) cohort, There was no significant relation seen between BMI and union time (ρ = –0.144, p = 0.495), indicating that heavier vs. lighter children healed at similar rates. In contrast, our ESIN (flexible nail) group demonstrated a moderate inverse correlation between BMI and union time (ρ = –0.455, p = 0.013), meaning higher-BMI patients had shorter union times. In the Flexible Nail group, a significant negative correlation between BMI and fracture union time (Spearman's rho = -0.455, p = 0.013) was observed, suggesting that higher BMI was associated with shorter union time. Similarly, Heath D et al. reported that obesity significantly delayed fracture healing in femoral fractures treated with intramedullary nailing (p = 0.001)[26]. Our study revealed a strong negative correlation between operative time and fracture union time in the Flexible Nail group (Spearman's rho = -0.738, p < 0.001), indicating that longer operative times were associated with shorter union times. No significant correlation between the injury-to-surgery interval and fracture union time in either treatment group. This is consistent with findings by Kumar et al., who reported no statistical difference in final outcomes between patients operated before or after five days (p = 0.6)[21].

Limitations included a single-center setting and small sample size. The 24-week follow-up was limited, missing long-term outcomes. Future studies need larger, multicenter cohorts and Randomized Controlled Trials (RCTs) to improve generalizability and provide robust evidence.

Conclusion

This study demonstrates that both Dynamic Compression Plate (DCP) and Titanium Elastic Nailing System (TENS) are viable surgical techniques for pediatric femoral shaft fractures, each with distinct clinical advantages. DCP was associated with a significantly shorter time to fracture union, making it a favorable option in cases where rigid fixation is essential. TENS, with its minimally invasive approach and shorter operative duration, remains a practical choice in settings where reduced surgical exposure and faster recovery are prioritized. The findings stress the importance of individualized care planning based on fracture type, patient status, and resources of institution. These results contribute valuable regional data to support evidence-based surgical decision-making in pediatric orthopedics, especially in low-resource healthcare settings.

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REFERENCES

1. Nouman R, Khattak SA, Pritha A, Zahid A. Femoral Shaft Fractures in Children: Exploring Treatment Outcomes and Implications. Cureus. 2023;15(10)1-7. https://www.proquest.com/openview/ae87d9963ee63e70a7d318d31e457b60/1?cbl=2045583&pq-origsite= gscholar.
2. Curran PF, Albright P, Ibrahim JM, Ali SH, Shearer DW, Sabatini CS. Practice patterns for management of pediatric femur fractures in low- and middle-income countries. *J Pediatr Orthop*. 2020;40(5):251–258. doi: 10.1097/BPO.0000000000001435. https://journals.lww.com/pedorthopaedics/abstract/2020/05000/practice_patterns_for_management_of_pediatric.21.aspx.
3. Venkataraman S, Ethiraj P, Shanthappa AH, Vellingiri K. Treatment of diaphyseal fractures of the femur in paediatric age group: a comparative study of locking compression plate versus titanium elastic nailing system (TENS). *Cureus*. 2022;14(9):e28924. doi: 10.7759/cureus.28924. https://pubmed.ncbi.nlm.nih.gov/36225519/.
4. Liau GZQ, Lin HY, Wang Y, Nistala KRY, Cheong CK, Hui JHP. Pediatric femoral shaft fracture: an age-based treatment algorithm. *Indian J Orthop*. 2021;55(1):55–67. doi: 10.1007/s43465-020-00281-6. https://link.springer.com/article/10.1007/s43465-020-00281-6.
5. Sun J, Wang T, Zhao N, Chen H, Chen C. Pediatric femoral shaft fractures: the American Academy of Orthopaedic Surgeons clinical practice guidelines versus actual management in a teaching hospital. *Transl Pediatr*. 2024;13(6):938–945. doi: 10.21037/tp-24-175. https://pmc.ncbi.nlm.nih.gov/articles/PMC11228901/.
6. Shah FA, Ali MA, Naeemullah. Outcome of proximal femur shaft fractures in school going children treated with locking compression plates. *Pak J Med Sci*. 2021;37(5):1353–1358. doi: 10.12669/pjms.37.5.3938. https://pmc.ncbi.nlm.nih.gov/articles/PMC8377903/.
7. Donovan RL, Harries L, Whitehouse MR. Flexible nails have a significantly increased risk of complications compared with plating techniques when treating diaphyseal femoral

fractures in children aged 5–12: a systematic review. *Injury*. 2020;51(12):2763–2770. doi: 10.1016/j.injury.2020.09.024. https://www.sciencedirect.com/science/article/abs/pii/S0020138320307646.
8. Edwards TA, Daly C, Donovan RL, Whitehouse MR. Risk of complications following surgical fixation of femoral diaphyseal fractures in children aged 4 to 12 years: a systematic review and meta-analysis. *Injury*. 2022;53(3):1020–1028. doi: 10.1016/j.injury.2021.11.005. https://www.sciencedirect.com/science/article/abs/pii/S002013832100913X.
9. Liu W, Li W, Bai R, et al. Elastic stable intramedullary nailing versus plate internal fixation for pediatric diaphyseal femur fractures: a systematic review and meta-analysis. *Indian J Orthop*. 2024;58(5):484–494. doi: 10.1007/s43465-024-01125-3. https://link.springer.com/article/10.1007/s43465-024-01125-3.
10. James D, Martin D, Kumar A, et al. Elastic stable intramedullary nailing versus submuscular plating in pediatric diaphyseal femur fractures: a randomized controlled trial among children in South India. *J Pediatr Orthop B*. 2022;31(2):e122–e129. doi: 10.1097/BPB.0000000000000933. https://pubmed.ncbi.nlm.nih.gov/35102105/.
11. Singh A, Bierrum W, Wormald J, Ramachandran M, Firth G, Eastwood D. Plate fixation versus flexible intramedullary nails for management of closed femoral shaft fractures in the pediatric population: a systematic review and meta-analysis of adverse outcomes. *J Child Orthop*. 2023;17(5):442–452. doi: 10.1177/18632521231190713. https://pubmed.ncbi.nlm.nih.gov/37799319/.
12. Li D, Wang X, Lu J, Xue M. Submuscular plating vs. elastic stable intramedullary nailing for diaphyseal femur fractures in children: a systematic review and meta-analysis. *Front Pediatr*. 2023;11:1256630. doi: 10.3389/fped.2023.1256630. https://pubmed.ncbi.nlm.nih.gov/38027269/.
13. Heath DM, Ghali AN, Momtaz DA, et al. Socioeconomic status affects postoperative time to union in pediatric patients with a surgically treated fracture. J Bone Joint Surg Am. 2023;105(5):421-428. https://pubmed.ncbi.nlm.nih.gov/37484901/.
14. Engström Z, Wolf O, Hailer YD. Epidemiology of pediatric femur fractures in children: the Swedish Fracture Register. BMC musculoskeletal disorders. 2020 Dec;21:1-8. https://pubmed.ncbi.nlm.nih.gov/33261600/.
15. Manias K, et al. Is there an association between BMI, height, and gender and long-bone fractures during childhood and adolescence? BMC Public Health. 2022;22(1):1234. https://pubmed.ncbi.nlm.nih.gov/37371216/.
16. Zura R, et al. Obesity increases time to union in surgically treated pediatric fracture patients. J Am Acad Orthop Surg Glob Res Rev. 2022;6(1):e22.00132. https://pubmed.ncbi.nlm.nih.gov/34986128/.
17. Grauberger J, O'Byrne M, Stans AA, Shaughnessy WJ, Larson AN, Milbrandt TA. Does shorter time to treatment of pediatric femur shaft fractures impact clinical outcomes?. Journal of Pediatric Orthopaedics. 2020 Jul 1;40(6):e435-9. https://pubmed.ncbi.nlm.nih.gov/32501907/.
18. Angachekar D, Patel S, Shetty S, Atal S, Dhond A, Sharma R, et al. A retrospective analysis of dynamic compression plating versus intramedullary nailing for the management of shaft of humerus fractures in an urban trauma care center. Cureus. 2024 Jan 24;16(1). https://pubmed.ncbi.nlm.nih.gov/38406053/.
19. Wali MG, Baba AN, Latoo IA, Bhat NA, Baba OK, Sharma S. Internal fixation of shaft humerus fractures by dynamic compression plate or interlocking intramedullary nail: a prospective, randomised study. Strategies in Trauma and Limb Reconstruction. 2014 Nov;9:13-40. https://pubmed.ncbi.nlm.nih.gov/25408496/.
20. Ghouri SI, Mustafa F, Kanbar A, Al Jogol H, Shunni A, Almadani A, Abdurraheim N, Goel AP, Abdelrahman H, Babikir E, Ramzee AF. Management of traumatic femur fractures: a focus on the time to intramedullary nailing and clinical outcomes. Diagnostics. 2023 Mar 17;13(6):1147. https://pubmed.ncbi.nlm.nih.gov/36980455/.
21. Heath D, Momtaz D, Ghali A, Salazar L, Gibbons S, Hogue G. Obesity Increases Time to Union in Surgically Treated Pediatric Fracture Patients. JAAOS Glob Res Rev. 2022;6(1):e21.00185. https://pmc.ncbi.nlm.nih.gov/articles/PMC8735756/.
22. Hussien AM, Ibrahim MA, El-kady RH, Shehata EM. Flexible Nails versus Plate for Fixation of Fracture Shaft Femur in Children from 5-12 Years. The Egyptian Journal of Hospital Medicine. 2022 Oct 1;89(1):4444-9. https://ejhm.journals.ekb.eg/article_258461.html.
23. Cintean R, Eickhoff A, Pankratz C, Strauss B, Gebhard F, Schütze K. ESIN in femur fractures in children under 3: is it safe?. European Journal of Trauma and Emergency Surgery. 2022 Oct;48(5):3401-7. https://pubmed.ncbi.nlm.nih.gov/35394142/.
24. Milligan D, Henderson L, Tucker A, Ballard J. Elastic nail fixation versus plate fixation of paediatric femoral fractures in school age patients–A retrospective observational study. Journal of Orthopaedics. 2020 May 1;19:153-7. https://pubmed.ncbi.nlm.nih.gov/32025124/.
25. Lakhani A, Bhatnagar SM, Singh GP, Gupta N, Sharma E. Role of mini-invasive bridge plate in the complex femoral fracture in school going children: a prospective clinical study of 30 cases. Journal of Family Medicine and Primary Care. 2021 Mar 1;10(3):1188-92. https://pubmed.ncbi.nlm.nih.gov/34041149/.
26. Kumar R, et al. Do demographic and perioperative parameters really affect the final outcomes of pediatric femur shaft fractures managed by elastic nails? A prospective study. J Orthop. 2020;23:275–279. https://pubmed.ncbi.nlm.nih.gov/29657465/.

CONFLICT OF INTEREST

Authors declared no conflicts of Interest.

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DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

ORIGINAL ARTICLE

White Cell Indices and NLR Across CKD Stages: Indicators of Subclinical Inflammation

Sadia Rehman[1], Santosh Kumar[2], Anila Bibi[3], Asma Naveed[4], Hina Moazzam[5], Aakash Kamur[6]

ABSTRACT

Objective: To investigate the distribution of neutrophil, lymphocyte, and other white blood cell (WBC) indices across various stages of chronic kidney disease (CKD) and assess their potential role as indicators of subclinical inflammation.

Study Design: It was Cross sectional study.

Place and Duration of Study: A cross-sectional study was conducted at the Nephrology Department, JPMC Karachi, in collaboration with Bahria University, from October 13, 2023, to May 15, 2024.

Materials and Methods: A total of 114 predialysis CKD patients were stratified into stages I–IV based on clinical and laboratory criteria. Complete blood counts, including total WBC count ($\times 10^9$/L), neutrophil (%), lymphocyte (%), eosinophil (%), and monocyte (%), were recorded. The neutrophil-to-lymphocyte ratio (NLR) was calculated. WBC indices were compared across CKD stages using the Kruskal–Wallis test, and correlations with serum creatinine (mg/dL) were analyzed. All statistical analyses were performed using SPSS version 27.

Results: Of the 114 patients, 58.8% were female and 41.2% were male. Although median WBC counts and individual leukocyte subsets did not show statistically significant differences across CKD stages ($p > 0.05$), a progressive rise in NLR was observed with advancing CKD. This trend, while statistically insignificant, may still hold clinical value as it suggests underlying low-grade inflammation. Correlation analysis showed weak associations between WBC indices and serum creatinine, but the observed patterns indicate biological plausibility, supporting the potential role of these markers in disease monitoring.

Conclusion: Although not statistically significant, the rising NLR trend suggests possible subclinical inflammation. In low-resource settings, routine CBC parameters remain a practical and economical tool for early detection and monitoring in CKD.

Key Words: *Biological Markers, Inflammation, Kidney Disease, Leukocyte Count, Neutrophils, Lymphocytes.*

Introduction

Chronic kidney disease (CKD) is a global health problem, affecting nearly 10% of the world's population, with a rising burden in low- and middle-income countries.[1] In Asia, recent meta-analyses report prevalence between 11–13%, largely due to increasing diabetes and hypertension.[2] In Pakistan, community-based studies estimate prevalence between 12–20%, with regional differences based on diagnostic criteria.[3] CKD is defined as reduced estimated glomerular filtration rate (eGFR) and/or kidney damage lasting more than three months.[3,4] It is now viewed as a systemic disease, affecting cardiovascular, endocrine, hematologic, and immune systems. Chronic low-grade inflammation plays a key role in disease progression, comorbidities, and mortality.[4] Inflammation in CKD is multifactorial, driven by uremic toxins, oxidative stress, acidosis, intestinal dysbiosis, and immune dysregulation.[4] Persistent inflammation accelerates atherosclerosis, anemia, bone disease, and cardiovascular risk. Conventional inflammatory biomarkers such as interleukin-6 (IL-6), tumor necrosis factor-alpha (TNF-α), and C-reactive protein (CRP) are well studied but limited in routine practice due to cost and availability.[5,6]

Interest has therefore shifted toward simpler, cost-effective markers from routine blood tests. Among these, white blood cell (WBC) indices, particularly the neutrophil-to-lymphocyte ratio (NLR), have attracted attention.[6,7] The NLR reflects a balance

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between neutrophil-driven inflammation and lymphocyte-mediated regulation.[8] An elevated NLR indicates heightened innate immunity with suppressed adaptive immunity, a pattern linked to various stress and inflammatory states.[9,10]

Elevated NLR has been studied as a prognostic marker in cardiovascular disease, cancer, and critical illness. In CKD, high NLR is associated with faster progression to end-stage renal disease (ESRD), higher cardiovascular events, and greater mortality.[9–11] However, most evidence comes from advanced CKD or dialysis cohorts, with fewer studies exploring early to moderate stages.[11] Subclinical inflammation—present without clinical symptoms—remains underexplored in predialysis patients.[10,11]Beyond NLR, other WBC subsets may contribute to understanding CKD-related inflammation. Monocytes promote atherosclerosis and vascular calcification, while eosinophils, though linked to allergy, may contribute to renal injury.[11,12] Analyzing these indices collectively may improve assessment of immune dysregulation in CKD.

Identifying inflammatory trends early could help stratify high-risk patients for lifestyle interventions, anti-inflammatory strategies, or closer monitoring. If validated, NLR and related indices could become simple, reproducible tools in CKD assessment, especially in resource-limited settings. In Pakistan and similar countries, where advanced tests are not widely accessible, basic hematological indices are particularly relevant. Yet, local data remain limited, with few studies stratifying patients by CKD stage and evaluating WBC profiles. This study addresses the gap by evaluating neutrophil, lymphocyte, and other WBC indices across CKD stages I–IV in predialysis patients. By linking these with renal function, it aims to test whether routine hematological parameters can act as surrogate markers of subclinical inflammation, offering cost-effective clinical value in low-resource settings.

Materials and Methods

This cross-sectional observational study was conducted in the Department of Nephrology, Jinnah Postgraduate Medical Centre (JPMC), Karachi, from October 13, 2023, to May 15, 2024, in collaboration with the Department of Biochemistry, Bahria University Health Sciences Campus (BUHSC), Karachi. Ethical approval was obtained from the JPMC Institutional Review Board (No. F.2-81/2023-GENL/153/JPMC). Written informed consent was obtained from all participants after explanation of the study purpose and procedures.

A total of 114 adult patients with clinically diagnosed chronic kidney disease (CKD) were enrolled through consecutive sampling. Patients were classified into CKD stages I–IV according to Kidney Disease: Improving Global Outcomes (KDIGO) guidelines, based on estimated glomerular filtration rate (eGFR, mL/min/1.73 m^2) calculated via the CKD-EPI formula. Inclusion criteria were adults aged 18–75 years with CKD stages I–IV who were not on dialysis. Exclusion criteria included active infection, autoimmune disease, hematological malignancy, recent surgery, use of immunosuppressive or anti-inflammatory medications within the last three months, pregnancy, lactation, CKD stage V, or incomplete blood test data.

Demographic and clinical data including age, gender, and CKD stage were recorded. Blood pressure (mmHg) was measured in the seated position after 10 minutes of rest using a standard sphygmomanometer. Venous blood samples were collected after an overnight fast and analyzed at the JPMC central laboratory. Complete blood counts were performed using an automated hematology analyzer, with the following white blood cell (WBC) parameters obtained: total WBC count ($\times 10^9$/L), neutrophil percentage (%), lymphocyte percentage (%), eosinophil percentage (%), and monocyte percentage (%). The neutrophil-to-lymphocyte ratio (NLR) was calculated by dividing absolute neutrophil count ($\times 10^9$/L) by absolute lymphocyte count ($\times 10^9$/L). Serum creatinine (mg/dL) and other biochemical tests were also measured to confirm CKD stage.

CKD stages were defined as follows: Stage I, eGFR ≥90 mL/min/1.73 m^2 with evidence of kidney damage; Stage II, eGFR 60–89 mL/min/1.73 m^2; Stage III, eGFR 30–59 mL/min/1.73 m^2; and Stage IV, eGFR 15–29 mL/min/1.73 m^2. Standardized procedures were followed for all laboratory analyses to ensure accuracy and reproducibility.

Statistical analyses were performed using IBM SPSS Statistics version 27. Data normality was assessed with the Shapiro–Wilk test. Quantitative variables were expressed as medians with interquartile ranges

(IQR), while categorical variables were reported as frequencies and percentages. Comparisons of NLR and WBC indices across CKD stages were made using the Kruskal–Wallis H test. Correlations between WBC indices and renal function markers (serum creatinine, eGFR) were evaluated using Spearman's rank correlation coefficient. A p-value <0.05 was considered statistically significant.

Results

Out of 114 patients, 41.2% were males and 58.8% were females. WBC count showed no significant variation across CKD stages (p=0.862). Table I presents the distribution of white cell indices across different stages of chronic kidney disease (CKD). The median white blood cell (WBC) count was 5.9 × 10^9/L (interquartile range [IQR]: 4.8–6.3) in patients with CKD stage I/II, 5.4 × 10^9/L (IQR: 5.1–6.3) in stage III, and 5.6 × 10^9/L (IQR: 5.075–7.1) in stage IV. The difference in WBC counts across stages was not statistically significant (p = 0.862). Median neutrophil percentages were 63% (IQR: 59.75–69) in stage I/II, 68% (IQR: 60–74.25) in stage III, and 66.5% (IQR: 59.5–70.25) in stage IV, with no significant variation across stages (p = 0.401). Similarly, lymphocyte percentages showed minimal difference, with median values of 36.5% (IQR: 28.75–51) in stage I/II, 38.5% (IQR: 31–46.5) in stage III, and 36% (IQR: 32.75–42) in stage IV (p = 0.997). Eosinophil percentages remained consistent at a median of 2% across all CKD stages with slight variability in IQRs, and no significant difference was noted (p = 0.116). Monocyte percentages also remained constant at a median of 2% across all groups with identical IQRs, showing no statistical significance (p = 0.687). These findings indicate that white blood cell indices do not significantly differ across CKD stages in this cohort.

Table II demonstrates the correlation analysis between white blood cell parameters and serum creatinine levels revealed only weak associations. Total white blood cell count showed a very weak positive correlation with serum creatinine (r = 0.072), while neutrophils displayed a slightly stronger but still weak positive correlation (r = 0.116). Lymphocyte percentage demonstrated a weak negative correlation (r = -0.094), suggesting a possible reduction in lymphocyte proportion as renal function declines. The neutrophil-to-lymphocyte ratio (NLR), a marker of subclinical inflammation, had the highest correlation with serum creatinine (r = 0.139), hinting at an increasing inflammatory trend in more advanced CKD, although not statistically significant. Monocyte count had a weak positive correlation (r = 0.081), and eosinophils showed a weak negative correlation (r = -0.044). These trends suggest a potential but non-significant role of inflammatory cell dynamics in CKD progression.

Table I: White Cell Indices Across CKD Stages

Parameter	Stage I/II	Stage III	Stage IV	P-Value
WBC (x10^9/L)	5.9 (4.8-6.3)	5.4 (5.1-6.3)	5.6 (5.075-7.1)	0.862
Neutrophils (%)	63 (59.75-69)	68 (60-74.25)	66.5 (59.5-70.25)	0.401
Lymphocytes (%)	36.5 (28.75-51)	38.5 (31-46.5)	36 (32.75-42)	0.997
Eosinophils (%)	2 (2-3)	2 (1-3)	2 (1.75-3)	0.116
Monocytes (%)	2 (2-3)	2 (2-3)	2 (2-3)	0.687

Table II: Correlation of White Cell Parameters with Serum Creatinine

White Cell Parameter	Correlation with Serum Creatinine (r)
Total WBC count (x10^9/L)	0.072
Neutrophils (%)	0.116
Lymphocytes (%)	-0.094
Neutrophil-Lymphocyte Ratio (NLR)	0.139
Monocytes (%)	0.081
Eosinophils (%)	-0.044

Discussion

This study evaluated white blood cell (WBC) indices—including total WBC, neutrophils, lymphocytes, eosinophils, monocytes—and the neutrophil-to-lymphocyte ratio (NLR) across CKD stages I–IV in 114 predialysis patients. The goal was to determine whether these hematological markers could indicate subclinical inflammation associated with worsening renal function.

Across CKD stages, no statistically significant differences were observed in WBC indices. Median neutrophil percentages rose modestly from 63% in stages I/II to 66.5% in stage IV, while lymphocyte levels remained stable. Other indices, including total WBC, eosinophils, and monocytes, showed minimal variation. Although the upward shift in NLR with advancing CKD was not statistically significant, this trend is clinically noteworthy, as it suggests early immune activation that may precede overt inflammation. Similar findings were reported by

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Alfhaily et al., who observed stable NLR across CKD stages, and by Isler et al., where significant differences emerged only when stages were grouped.[13,14]

Correlation analysis between serum creatinine and WBC indices showed weak, non-significant associations. Yet, the consistent rise in NLR and neutrophils, even if small, aligns with larger cohort studies linking higher NLR to faster eGFR decline and cardiovascular risk.[15,16] This implies that subtle trends may still reflect biologically relevant processes.

The lack of statistical strength may be due to the limited sample size, single-center design, and the focus on early CKD, where inflammation is often less pronounced. Nevertheless, early recognition of these mild changes has clinical value. Detecting subclinical inflammation through NLR, a simple and inexpensive test, could allow earlier monitoring and intervention before complications such as anemia, vascular calcification, or cardiovascular disease develop. This is especially important in low-resource settings where advanced biomarkers like CRP, IL-6, or TNF-α are not routinely available.

Recent studies further support the prognostic role of NLR. A 2023 cohort linked elevated NLR and systemic immune-inflammation index (SII) to incident CKD and disease progression.[17] Another prospective study found NLR predictive of survival and outcomes in predialysis patients.[18] These reinforce that, while WBC indices may not sharply differentiate CKD stages in cross-sectional analyses, they retain prognostic significance for long-term outcomes.

This study has limitations, including small size, cross-sectional design, and absence of conventional inflammatory markers. Comorbid, dietary, and socio-economic factors may also have influenced results. Still, the observed mild upward trend in NLR supports the presence of early subclinical inflammation. This underscores the potential of CBC-derived indices as cost-effective monitoring tools for CKD patients, particularly in Pakistan and other resource-limited regions. Larger, multicenter longitudinal studies are required to define threshold values predictive of progression, cardiovascular events, or mortality.

Conclusion

White cell indices, including NLR, did not show significant variation across CKD stages. However, a slight upward trend in NLR may reflect subclinical inflammation. As CBC parameters are low-cost and routinely available, they may offer a simple adjunct for inflammation monitoring in CKD, particularly in resource-limited settings.

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Conflict of Interest: None

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REFERENCES

1. Bikbov B, Purcell CA, Levey AS, Smith M, Abdoli A, Abebe M, et al. Global, regional, and national burden of chronic kidney disease, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet. 2020;395(10225):709–33. doi:10.1016/S0140-6736(20)30045-3.
2. Zhang L, Wang F, Wang L, Wang W, Liu B, Liu J, et al. Prevalence of chronic kidney disease in China: a cross-sectional survey. Lancet. 2012;379(9818):815–22. doi:10.1016/S0140-6736(12)60033-8.
3. Jessani S, Bux R, Jafar TH. Prevalence, determinants, and management of chronic kidney disease in Karachi, Pakistan—a community based cross-sectional study. BMC Nephrol. 2014;15:90. doi:10.1186/1471-2369-15-90.
4. Imtiaz S, Salman B, Qureshi R, Drohlia MF, Ahmad A. Prevalence of chronic kidney disease in Pakistan: a systematic review. Saudi J Kidney Dis Transpl. 2019;30(6):1253–63. doi:10.4103/1319-2442.272447.
5. Rashid I, et al. Prognostic importance of neutrophil-lymphocyte ratio in non-dialysis chronic kidney disease patients. Explor Med. 2023;4(1):1001141. doi:10.37349/emed.2023.1001141.
6. Alfhaily F, Mohamed H, Elsanousi A, Elsharif M. Inflammatory markers and their association with chronic kidney disease progression in Sudanese patients. Sudan J Med Sci. 2022;17(3):312–20. doi:10.24911/SJMS.165-22-061.
7. Kim J, Kim HJ, Lee H, Han SH, Yoo TH, Kang SW, et al. Neutrophil-to-lymphocyte ratio as a prognostic marker in chronic kidney disease progression: A retrospective cohort study. Kidney Res Clin Pract. 2023;42(1):67–74. doi:10.23876/j.krcp.22.056.
8. Matsushima H, Takai Y, Kimura T, et al. Prognostic value of neutrophil-to-lymphocyte ratio in patients with chronic kidney disease: a retrospective cohort study. BMC Nephrol. 2020;21(1):153. doi:10.1186/s12882-020-01790-4.
9. Li W, Zhao Y, Wang H, Zhang J, Zhang L. Neutrophil-monocyte-to-lymphocyte ratio as a novel predictor for

cardiovascular events and CKD progression in diabetic patients. Eur J Med Res. 2025;30(1):22. doi:10.1186/s40001-025-00864-3.
10. Huang W, Li H, Zhang M, Lin J, Wang C. Predictive value of neutrophil-to-lymphocyte ratio and lymphocyte percentage for new-onset chronic kidney disease: A prospective study. Kidney Int Rep. 2023;8(2):158–65. doi:10.1016/j.ekir.2022.11.024.
11. Aneez M, Saeed R, Khan MT, Rasheed M. Neutrophil-to-lymphocyte and platelet-to-lymphocyte ratios as markers of inflammation and proteinuria severity in CKD: a cross-sectional study. Egypt J Intern Med. 2024;36(1):28. doi:10.1186/s43162-023-00415-w.
12. Zhang Y, Chen J, Li X, Zhou D. Prognostic significance of neutrophil-to-lymphocyte ratio in non-dialysis CKD patients: A prospective observational study. Explor Med. 2023;4(2):122–30. doi:10.37349/emed.2023.1001516.
13. Isler M, Soylu A, Kocak G, et al. The role of neutrophil-to-lymphocyte ratio in early prediction of chronic kidney disease progression. Ren Fail. 2021;43(1):141–7. doi:10.1080/0886022X.2020.1870434.
14. Liu X, Chen X, Zhou X, et al. Neutrophil-to-lymphocyte ratio is associated with progression of chronic kidney disease in patients with type 2 diabetes mellitus. Clin Chim Acta. 2023;545:117347. doi:10.1016/j.cca.2023.117347.
15. Song Y, Yang M, Wang D, et al. Prognostic value of neutrophil-to-lymphocyte ratio in chronic kidney disease: A meta-analysis. Int Urol Nephrol. 2020;52(1):143–53. doi:10.1007/s11255-019-02309-9.
16. Chen T, Zhan Y, Du X, et al. Association of systemic immune-inflammation index with risk of incident chronic kidney disease: A prospective cohort study. J Transl Med. 2023;21(1):412. doi:10.1186/s12967-023-04118-1.
17. Ozkan G, Ulusoy S, Koseoglu C, et al. The predictive role of neutrophil-to-lymphocyte ratio in clinical outcomes of non-dialysis chronic kidney disease patients. Int J Clin Pract. 2021;75(10):e14464. doi:10.1111/ijcp.14464.

CONFLICT OF INTEREST

Authors declared no conflicts of Interest.

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DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

ORIGINAL ARTICLE

The Incidence of Oral Pressure Ulcers Related to Endotracheal Tubes: A Prospective Cohort Study

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ABSTRACT

Objective: To examine the incidence and implications of oral pressure ulcers (OPUs) associated with prolonged intubation and mechanical ventilation, particularly in patients in Intensive Care Units (ICUs). The purpose of the study was to determine the incidence of OPUs in ICU patients with endotracheal tube (ETT) placement.

Study Design: A prospective cohort study was conducted over six months, from 2 February 2024 to 25 July 2024.

Place and Duration of Study: Dr Ramelan Naval Hospital Surabaya Indonesia, during six months 2/02/2024-25/07/2024

Materials and Methods: A total of 372 ICU patients at Dr Ramelan Naval Hospital were included in this study. The participants were limited to ICU patients with ETT placement who presented with OPUs, without any age restriction. The exclusion criteria were patients without ETT and OPU, as well as patients who died before the observation period ended.

Results: The overall incidence of OPUs related to ETT placement was 16.13%, peaking 3–5 days after installation. Males exhibited a higher rate (55%) than females, with the age group 61–75 years and those with underlying pneumonia being the most affected. Mortality among patients was 55.38%, with 1.94% of these cases involving OPUs, while 44.62% survived, of which 33.73% developed OPUs. The higher incidence of OPUs resulted from prolonged pressure exerted by ETT placement, with a peak occurrence between 4–6 days post-ETT installation.

Conclusion: The incidence of OPUs related to ETT placement is relatively low at 16.13%. However, it is associated with a high mortality rate of 55.38%, underscoring the significant clinical impact of this complication. OPUs predominantly develop between 3–6 days post-ETT placement, highlighting the critical need for early identification and preventive measures during this period to improve patient outcomes.

Key Words: *Critical Ill, Endotracheal Tube, Intensive Care Unit, Oral Health, Oral Pressure Ulcer.*

Introduction

Intensive Care Units (ICUs) are the centres of care for critically ill patients who require life support. These patients often experience organ dysfunction, particularly of the cardiovascular and respiratory systems, and a significant portion frequently experiences unconsciousness and airway failure.[1,2] This often necessitates intubation to maintain airway patency and ensure adequate ventilation. The use of mechanical ventilation exerts sustained pressure on the oral cavity, resulting in an open-mouth posture. This posture induces the evaporation of oral moisture, contributing to dry mouth, increased friction and shear forces between the oral mucosa and devices made of rigid, hard materials, thereby increasing the risk of oral pressure ulcers (OPUs).[3]

OPUs represent a distinctive subset of pressure ulcers associated with medical devices,[4] characterised by prolonged compression of oral tissues. Medical device-related pressure ulcers show variable prevalence rates, ranging from 7% to as high as 45% based on Amrani et al, 2020[5] and 11.5% to 75%, according to epidemiological studies from Kim et al,2021.[6] Devices causing such pressure ulcers

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include urinary catheters, nasogastric tubes, oxygen masks, pulse oximeters, cervical collars, electrodes and wiring, orthopaedic fixations and, notably, the endotracheal tube (ETT), which is the most frequently documented cause of medical device-related pressure ulcers.[7]

The prevention and management of OPUs in unconscious patients are imperative to mitigate the intense pain and discomfort that can reduce health-related quality of life.[8] The purpose of this study was to determine the incidence of OPUs in ICU patients with ETT placement. The findings of this study may contribute to the formulation of effective prevention strategies, emphasising professional oral hygiene practices to reduce the occurrence of OPUs.

Materials and Methods

This investigation is a prospective cohort quantitative study employing a descriptive methodology. The study protocol received approval from the Institutional Review Board of Dr Ramelan Naval Hospital under protocol number 29/EC/KEP/2023. This approval was granted based on the study's adherence to the ethical principles outlined in the World Medical Association's Declaration of Helsinki.

Data collection was conducted over a six-month period, from February to July 2023. The total sample size during this period consisted of 372 patients. The sample size for this study was determined using the following formula to calculate the incidence.[9]

$$n = \frac{Z^2.P.(1-P)}{E^2}$$

Where:

Estimated prevalence (P): 50% (0.5)

Margin of error (E): 5% (0.05)

Confidence level: 95%, with Z=1.96Z=1.96

Using this formula, the calculated sample size (n) was 246. Due to the limited population size, the sample size was adjusted using the finite population correction formula:

$$n\,(adjusted) = \frac{n}{1+\frac{n+1}{N}}$$

Here:

Initial sample size (n): 246

Population size (N): 372

The adjusted sample size required for this study was 148 patients (rounded from 147.83). The study sample included all ICU patients with ETT placement, without any age restrictions. The medical records of the patients, including age and underlying conditions such as diabetes mellitus, hypertension, pneumonia, kidney failure, epilepsy and tuberculosis, were recorded. The exclusion criteria were patients without ETT placement and patients who died before the observation period ended.

OPUs were observed in all oral mucosa by a single oral medicine specialist once a day for 15 days. The OPUs were classified based on clinical appearance. Ulcerated lesions with erythema were classified as stage 1, while ulcerated lesions covered by a white or yellow pseudo-membrane, which may be accompanied by bleeding, were classified as stage 2.[6]

Informed consent procedures involved a detailed explanation by the researcher to the family members. Key aspects covered during the informed consent process included an explanation of the study's objectives, the voluntary nature of participation, assurance of confidentiality regarding gathered information and a comprehensive overview of the procedures employed throughout the study. Consent was obtained after ensuring that the legal representatives had a clear understanding of these elements.

The obtained data were compiled, and frequency distribution was analysed with cross-tabulations using Statistical Package for Social Sciences (SPSS) software version 23 (SPSS Inc., Chicago, IL, USA).

Results

The overall incidence rate of OPUs was 16.13% (60 out of 372 cases) (Table I). The peak of OPU-related ETT occurrences was observed on days 3–5 post-ETT installation, with 55% (33/60) of cases occurring during this period. The majority of OPUs were classified as stage 1 75% (45/60), while 15% (15/60) were classified as stage 2 (Table II).

Within this cohort, males exhibited a higher incidence rate (55%) compared to females (45%). The predominant age group affected was 61–75 years, constituting 38.3% (23/60) of cases. The most prevalent underlying conditions were pneumonia (32%), diabetes mellitus (30%), septic shock (16%) and kidney failure (16%) (Table II).

Table I: The incidence of OPU related to ETT installation in ICU

Characteristic	Number (%)
OPU	60 (16.13%)
Non-OPU	312 (83.87%)

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Table II. Incidence and Mortality rates associated with OPUs in the ICU

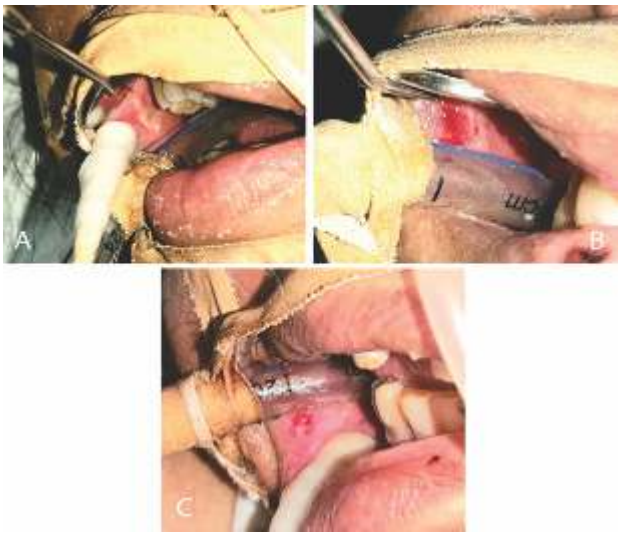
Characteristics	Number (%)
Mortality	206(55.38%)
OPU	4 (1.94%)
Stage 1	4 (1.94%)
Stage 2	0
Non-OPU	202 (98.06%)
Survive	166 (44.62%)
OPU	56 (33.73%)
Stage 1	41 (24.69%)
Stage 2	15 (9.03%)
Non-OPU	110 (66.26%)

Table III: Characteristics of Subjects with OPU in this study

Characteristic	Number (n=60; %)
Sex	
Female	27(45.00%)
Male	33 (55.00%)
Ages (years); Mean ± SD	
0–40; 20.24 ± 14.84	15 (25.00%)
41–60; 51.57 ± 5.19	15 (25.00%)
61–75; 67.11 ± 4.29	23 (38.30%)
76–87; 80.93 ± 4.27	7 (11.70%)
OPU onset (days)	
3–5; 4.09 ± 0.84	33 (55.00%)
6–10; 6.65 ± 2.39	21 (35.00%)
11–14; 12.71 ± 0.76	6 (10.00%)
Type of OPU	
Stage 1	45 (75%)
Stage 2	15 (15%)
Underlying Disease	
Pneumonia	19 (32.00%)
Diabetes Mellitus	18 (30.00%)
Septic Shock	16 (27.00%)
Kidney Failure	16 (27.00%)
Hypertension	6 (10.00%)
Epilepsy	4 (6.00%)
Tuberculosis	4 (6.00%)

Discussion

The incidence of OPUs in this study was recorded at 16.13%, with a predilection for manifestation between days four and six following intubation. This rate is comparatively lower than the 31.3% and 22.6% reported in prior studies after five days of ETT installation.[6,7] The appearance of OPUs may be influenced by several factors, including age, disease severity and underlying conditions.[10] Age appears to be a significant factor in the occurrence of OPUs, as the highest incidence was observed in older patients



Figures: (Figure 1A) Stage 2 OPU Characterised by a Single Ulceration, Coloured by a White or Yellow Pseudo-membrane with Irregular Margins. Surrounding tissue is Erythematous, and in Some Cases, Bleeding may Occur (Figures 1B and 1C).

with an average age of 67.11±4.29 years, a figure that is not markedly different from reported in the study conducted by Noie et al, 2024.[11] However, younger patients with average ages of 20.24±14.84 and 51.57±5.19 years also experienced OPU occurrences. This can be explained by the increased fragility of capillaries, decreased collagen and elastin and reduced perfusion in the elderly.[5]

Critically ill patients with chronic underlying diseases exhibit a high mortality rate (55.38%). The occurrence of OPUs 4–6 days after ETT installation in this study underscores the complexity and multifactorial nature of their development. Proposed etiological mechanisms linking tissue compression to OPU development include ischemia, reperfusion injury, impaired lymphatic drainage and sustained cellular deformation.[12] With the installation of an ETT in the oral cavity, the device creates persistent and consistent pressure on the oral mucosa.[13] This pressure can lead to tissue ischemia, reducing the oxygen supply to the cellular and tissue levels. Consequently, this condition can induce tissue destruction, clinically manifesting as OPUs.[7]

The factors contributing to the incidence of OPUs are multifactorial; however, these ulcers ultimately share a common pathway leading to ischemia and necrosis.[14] When soft tissues are compressed for

prolonged periods between bony prominences and external surfaces, microvascular occlusion, tissue ischemia and hypoxia occur.[15] Pressure exceeding normal capillary pressure (ranging from 12–32 mmHg) results in reduced oxygenation and compromises the microcirculation of the affected tissue. If compression is not relieved, a pressure ulcer can develop.[15] This significant pressure can result from compression by the firm tube of an ETT.[16] OPUs were classified into early lesions and advanced lesions.[17] Early lesions, or stage 1, appear as erythematous areas, which in this study were observed in 75% of cases. Advanced lesions, or stage 2, were observed in 25% of cases. These results differ from the study by Kim CH et al[4]., where stage 2 lesions (31.9%) were more prevalent than stage 1 lesions (14%)[4]. The variation in the stages of OPUs can be attributed to several factors, including the duration of ETT intubation, the method of securing the intubation (e.g. non-commercial ETT holding with or without a bite block using adhesive tape, or a commercial ETT holder) and the patients' conditions.[2,13] All study subjects had chronic underlying diseases such as pneumonia, diabetes mellitus, septic shock and kidney failure, which cause dysregulation in the circulation of nutrients and oxygen in the vasculature, thereby exacerbating ischemia and contributing to the development of OPUs[10,14]

The incidence of mortality in this study was high, but the mortality rate among patients with OPUs was lower (1.94%). This may be due to the systemic conditions of most study subjects, which had poor prognoses. The development of pressure ulcers is not limited to the oral mucosa. In critically ill patients, the potential for pressure ulcer development at any site is present. Pressure ulcers in the skin are caused by static patient positioning, leading to tissue ischemia.[18]

OPUs result in prolonged pain and a decreased quality of life.[8] The areas of mucosa affected by OPUs are easily colonised by bacteria, increasing the risk of infection. Inadequate care, leading to secondary infections, can subsequently increase the risk of sepsis and contribute to morbidity in the patient's systemic condition.[19]

A preventive approach to OPU development in ICU patients can include repositioning the ETT every 24 to 48 hours, regularly disinfecting both the device and maintaining oral cavity hygiene.[13] If OPUs do occur, it is crucial to reposition the device and provide regular topical asepsis and anti-inflammatory therapy at the site of OPU formation.[14] This underscores the pivotal role of professional oral health care in managing and preventing OPUs.[6,20] Collaboration among oral medicine specialists, dental hygiene professionals, anaesthesiologists and intensive care nurses in the management of daily oral health care for intubated patients further contributes to mitigating the occurrence of OPUs.

The incidence of OPUs, which was only 16.38%, with the mortality incidence at 1.94%. However, the incidence and mortality related to OPUs in this study are still reliable. The incidence of OPUs depends on the general condition of the patient, systemic diseases, oral health status and factors related to the ETT. Additionally, the results reflect the effects of regular healthcare practices, such as topical asepsis of the entire mouth and the intraoral surface of the ETT tube, performed by an oral medicine specialist and regularly replacement of endotracheal tube position. The limitation of this study is the relatively small sample size and the short duration of the research, to answered in multicentre studies are needed to determine the global incidence of OPUs and their relationship with other factors.

Conclusion

The incidence of OPUs related to ETT installation is relatively low at 16.13%. However, it is associated with a high mortality rate of 55.38%, highlighting the significant clinical impact of this complication. OPUs predominantly develop between three and six days post-ETT installation, emphasising the critical need for early identification and preventive measures during this period to improve patient outcomes and quality of life.

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REFERENCES

1. Marusiak MJ, Paulden M, Ohinmaa A. Professional oral health care prevents mouth-lung infection in long-term care homes: a systematic review. Can J Dent Hyg. 2023;57(3):180–90.

 https://doi.org/10.57234/jiimc.december25.2312

2. Genc A, Yildiz T. The impact of two distinct endotracheal tube fixation on the formation of pressure ulcer in the intensive care unit: A randomised controlled trial. Int Wound J. 2022;19(6):1594–603. doi: 10.1111/iwj.13757.
3. Nawata W, Umezaki Y, Yamaguchi M, Nakajima M, Makino M, Yoneda M, et al. Continuous Professional Oral Health Care Intervention Improves Severe Aspiration Pneumonia. Case Rep Dent. 2019;2019:3–8. doi: 10.1155/2019/4945921.
4. Kim CH, Kim MS, Kang MJ, Kim HH, Park NJ, Jung HK. Oral mucosa pressure ulcers in intensive care unit patients: A preliminary observational study of incidence and risk factors. J Tissue Viability. 2019;28(1):27–34. doi: 10.1016/j.jtv.2018.11.002.
5. Amrani G, Gefen A. Which endotracheal tube location minimises the device-related pressure ulcer risk: The centre or a corner of the mouth? Int Wound J. 2020;17(2):268–76. doi: 10.1111/iwj.13267.
6. Kim SH, Nah HS, Kim JB, Kim CH, Kim MS. Relationships Between Oral-Mucosal Pressure Ulcers, Mechanical Conditions, and Individual Susceptibility in Intubated Patients Under Intensive Care: A PCR-Based Observational Study. Biol Res Nurs. 2021;23(4):557–67. doi: 10.1177/1099800421998071.
7. Masyitha K, Haryanto, Puspita D, Suriadi, Usman. Pressure ulcers related to medical device in intensive care in Indonesia: A prospective study. Enferm Clin. 2020;30:87–91. DOI:10.1016/j.enfcli.2020.01.006.
8. Trisnaningtyas W, Retnaningsih R, Rochana N. Effects and interventions of pressure injury prevention bundles of care in critically ill patients: A systematic review. Nurse Media J Nurs. 2021;11(2):154–76. DOI: https://doi.org/10.14710/nmjn.v11i2.28881.
9. Parmadiati A, Ayuningtyas N, Radithia D, Ernawati D, Winias S, Surboyo M. Normal variant, salivary flow rate, and taste sensitivity as oral health profile in the elderly community in Surabaya: A cross-sectional study. J Int Oral Heal. 2020;12(6):532–9. DOI: 10.4103/JIOH.JIOH_62_20.
10. Barakat-Johnson M, Barnett C, Wand T, White K. Medical device-related pressure injuries: An exploratory descriptive study in an acute tertiary hospital in Australia. J Tissue Viability. 2017;26(4):246–53. doi: 10.1016/j.jtv.2017.09.008.
11. Noie A, Jackson AC, Taheri M, Sayadi L, Bahramnezhad F. Determining the frequency of pressure ulcers incidence and associated risk factors in critical care patients: A 3-year retrospective study. Int Wound J. 2024;21(11):1–12. doi: 10.1111/iwj.70120.
12. Ben Mbarka F, Ben Jeddou K, Khalfallah M, Jarraya D, Jarraya H, Ouahchi Z, et al. Prevalence and risk factors of pressure ulcers in a Tunisian hospital. Tunisie Medicale. 2017;95(7):494–9.
13. Cavalcanti E de O, Kamada I. Medical-device-related pressure injury on adults: An integrative review. Texto e Context Enferm. 2020;29:1–14. https://doi.org/10.1590/1980-265X-TCE-2018-0371.
14. Kwek MSY, Thangaveloo M, Hui SLB, Madden LE, Phillips AR, Becker DL. Characterisation of an ischemia reperfusion model for the formation of a stage I pressure ulcer in mouse skin. 2021;30(3):352–62. Available from: https://doi.org/10.1016/j.jtv.2021.03.004.
15. Choi BK, Kim MS, Kim SH. Risk prediction models for the development of oral-mucosal pressure injuries in intubated patients in intensive care units: A prospective observational study. 2020;29(4):252–7. https://doi.org/10.1016/j.jtv.2020.06.002.
16. Wickberg M, Falk AC. The occurrence of pressure damage in the oral cavity caused by endotracheal tubes. Nord J Nurs Res. 2017;37(1):2–6. DOI:10.1177/2057158516656109.
17. Cowan L, Broderick V, Alderden JG. Pressure Injury Prevention Considerations for Older Adults. Crit Care Nurs Clin North Am. 2020;32(4):601–9. doi:10.1016/j.cnc.2020.08.009.
18. Alvarado, P P. Endotracheal Tube Intubation Techniques. Treasure Island (FL): StatPearls Publishing; 2023. 560730 p.
19. Kang MK, Kim MS. Article effects of attitude, barriers/facilitators, and visual differentiation on oral mucosa pressure ulcer prevention performance intention. Healthc. 2021;9(1). doi: 10.3390/healthcare9010076.
20. Fulbrook P, Lovegrove J, Hay K, Coyer F. State-wide prevalence of pressure injury in intensive care versus acute general patients: A five-year analysis. J Clin Nurs. 2023;32(15–16):4947–61. doi: 10.1111/jocn.16687.

CONFLICT OF INTEREST

Authors declared no conflicts of Interest.

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DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

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Research papers having serious errors to invalidate a paper's results and conclusions, or publication misconduct may require retraction. Retractions may be requested by an article's author(s), by an institution, by readers, or by the editor.

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- It constitutes plagiarism.
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- It contains material or data without authorization to use.
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At times the article may occasionally be retracted for correction of errors in submission or publication and will be replaced with the corrected one.

Retraction Process

JIIMC adopts the following retraction process to ensure best practice of retraction:

1. An article requiring potential retraction will be brought to the attention of JIIMC editor.
2. Managing Editor will follow the step-by-step guidelines according to the COPE flowcharts and will seek the response from the author of the article as well.
3. JIIMC Publication & Research Integrity Committee will evaluate the evidence of misconduct and response of the authors. Based on the findings, the committee will recommend a final decision whether to retract the publication or otherwise.
4. The final decision is then communicated to the author and, if necessary, any other relevant bodies(PMC, HEC), or the author's institution as deemed appropriate.
5. The retraction-note titled "**Retraction: [article title]"** will be published in the paginated part of a subsequent issue of the journal and listed in the contents list.

6. The text of the retraction should explain why the article is being retracted.
7. The statement of retraction and the original article must be clearly linked in the electronic database so that the retraction will always be apparent to anyone who comes across the original article.
8. The relevant changes in the online version will be reflected through **Crossmark** icon.

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INSTRUCTIONS FOR AUTHORS

The material submitted for publication should be sent completely to the Journal of Islamic International Medical College, Pakistan. Research work that has already been reported in a published paper or is described in a paper sent or accepted elsewhere for publication should not be submitted. Duplicate submission of the same research work to another journal should be avoided as this falls into the category of publication misconduct. A complete report following publication of a preliminary report, usually in the form of an abstract, or a paper that has been presented at a scientific meeting, if not published in a full proceeding, may be submitted. Manuscripts are submitted online on the following link:
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- Processing Charges = PKR 3,000/-
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Islamic International Medical College, Rawalpindi
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MATERIAL FOR PUBLICATION

The material submitted for publication may be in the form of an original research (Randomized controlled trial – RCT, Meta-analysis of RCT, Quasi experimental study, Case Control study, Cohort study, Observational Study with statistical support, etc.), a Review Article, a Case Report, Recent Advances, New Techniques, Debates, Book/CDs Review on Clinical/Medical Education, Adverse Drug Reports or a Letter to the Editor. Survey Articles and Studies more than five years old at the time of submission are not accepted for publication in JIIMC. Non-English articles are not accepted for publication in JIIMC.

ORIGINAL ARTICLES should report original research of relevance to clinical medicine and may appear either as papers or as short communications. The original paper should be of about 2000-2500 words excluding abstract and references. The abstract should be structured of about 250 words. Three to 10 keywords should be mentioned at the end of the abstract as per MeSH (Medical Subject Headings). There should be no more than four tables or illustrations. The data should be supported with 20 to 25 locals as well as international references. More than 50% of the references should be from the last five years.

SHORT COMMUNICATIONS should be about 1000 words, with a non-structured abstract, two tables or illustrations and 5 references.

CLINICAL CASE REPORT should be of academic value and provide relevance of the disease being reported as rare or unusual. The word count of the case report should not be more than 800 words with 3- 5 key words. The abstract should be non-structured of about 150 words (case specific) with a maximum of 5 references. It should not include more than 2 figures and one table.

REVIEW ARTICLE should consist of structured overview of relatively narrow topic providing background and recent development with reference

of original literature. An author can write a review article only if he/she has written a minimum of three original research articles and some case reports on the same topic. Review articles should be of 2500 to 3000 words with a non-structured abstract of 150 words and minimum 3 key words.

LETTERS TO THE EDITOR should normally not exceed 400 words, have no more than 05 references and be signed by all the authors-maximum 3 are allowed. Preference is given to those that take up points made in contributions published recently in a journal. Letters may be published with a response from the author of the article being discussed. Discussions beyond the initial letter and response will not be entertained for publication.

OBITUARIES should be of about 250 words.

EDITORIALS are written by invitation.

DISSERTATION/THESIS BASED ARTICLE An article based on dissertation/thesis submitted as part of the requirement for a postgraduate degree (M. Phil, FCPS, MS) can be sent for publication after it has been approved by the institution's ethical review board/committee and the college/university evaluation committee/board. The data should not be more than five years old. Thesis/dissertation-based articles will be assessed by proper review process. Once accepted for publication, disclosure will be made that 'it is a Dissertation based article.'

RANDOMIZED CONTROLLED TRIALS

- When reporting the results of a randomized trial, JIIMC requires a completed CONSORT 2010 checklist and flow diagram as a condition of submission.
  - o CONSORT 2010 checklist
  - o CONSORT 2010 flow diagram
- Templates for these can be readily accessible here or on the CONSORT website, which also describes several CONSORT checklist extensions for different designs and types of data beyond two group parallel trials
- Authors should ensure that your article, at minimum, reports content addressed by each item of the checklist. Meeting these basic reporting requirements will greatly improve the value of your trial report and may enhance its chances for eventual publication.
- As per recommendation of ICMJE, Journal of Islamic International Medical College requires registration of clinical trials in a public trials registry as a prerequisite for publication of all clinical trials.
- **Clinical Trials:** Clinical Trials submitted for publication must be registered in public registry, e.g., http://clinicaltrial.gov/ , must provide registration proof & all RCTs must be based on CONSORT statement. Unregistered trials will not be published.

  A clinical trial is any research study that prospectively assigns human participants or groups to one or more health-related interventions to assess their effects on health outcomes. These interventions can include drugs, surgical procedures, devices, behavioral treatments, dietary changes, and modifications in care processes. Health outcomes encompass any biomedical or health-related measures collected from patients or participants, including pharmacokinetic data and adverse events. Purely observational studies (those in which the assignment of the medical intervention is not at the discretion of the investigator) do not require registration.

GENERAL ARCHIVAL INSTRUCTIONS

The manuscript should be typed in MS Word. Each manuscript should include a title page (containing email address, cell numbers, institution, and postal address of the corresponding author), abstract, key words, text, acknowledgements (if any), references, tables (each table, complete with title and footnotes) and legends for illustrations and photographs. Each component should begin on a new page. Sub-headings should not be used in any section of the script except in the abstract.

TEXT ORGANIZATION

All manuscripts except Short Communication and Letter to the Editor should be divided into the following sections.

ABSTRACT

Abstracts of original article should be in structured with following sub-headings:

- Objective
- Study Design
- Place & Duration of Study
- Materials & Methods
- Results
- Conclusion

Four elements should be addressed: "why did you start?", "what did you do?", "what did you find?" and "what does it mean? ".” Why did you start?" is addressed in the objective. "What did you do?" constitutes the methodology and could include design, setting, patients or other participants, interventions, and outcome measures. "What did you find?" is the 'results', and "what does it mean?" would constitute the conclusions. Please label each section clearly with the appropriate sub-headings. Structured abstract for an original article, should not be more than 250 words. At least 3 key words should be written at the end of the abstract. Review articles, case reports and others require a short, unstructured abstract. Commentaries do not require an abstract.

INTRODUCTION

Write this section with references as per following instructions:

1. Give background information about the subject matter and the issues your study intends to address. Only strictly pertinent references should be cited, and the subject should not be extensively reviewed.
2. Describe what is known (in the literature) and what is not clear about the subject with reference to relevant literature thus identifying the literature gap.
3. You write the rationale (justification) of your study.
4. Finally, you mention the objective of your study

MATERIALS AND METHODS

Methodology is written in past tense.

Follow this sequence **without headings:**

- Study design
- Place and Duration of Study
- Sample size
- Sampling technique
- Mention about permission of the ethical review board and other ethical issues addressed.
- Inclusion and Exclusion Criteria
- Data collection procedure-
- Type of data: parametric or nonparametric
- Data analysis: including Statistical Software used, and statistical test applied for the calculation of p value and to determine the statistical significance. Exact p-values and 95% confidence interval (CI) limits must be mentioned instead of only stating greater or less than level of significance. All percentages must be accompanied with actual numbers.

RESULTS

These should be presented in logical sequence in the text, tables, and illustrations. All the data in the tables or illustrations should not be repeated in the text; only important observations should be emphasized or summarized. No opinion should be given in this portion of the text.

DISCUSSION

This section should include the author's comments on the results. Write in present tense, active voice except for results, which are written in past tense. It should be written in following sequence:

- First, very briefly summarize, Interpret and discuss main results and don't merely repeat the results.
- Discuss key studies relevant to your study.
- Compare your work with other's work.
- Describe limitations of your study.
- Suggest future work if necessary.

CONCLUSION

Conclusion should be provided under a separate heading. It should be in congruence with the objective. No recommendations are needed under this heading.

REFERENCES

References must be written in Roman Number and in the Vancouver Style only. References should be numbered in the order in which they are superscripted in the text. At the end of the article, the full list of references should give the names and initials of all authors (unless there are more than six when only the first six should be given followed by et al). The author's names are followed by the title of the article; title of the journal abbreviated according to the style of the Index Medicus (see “List of Journals Indexed”, printed yearly in the January issue of Index Medicus); year, volume, and page number, e.g., Hall, RR. The healing of tissues by C02 laser. Br J. Surg: 1970; 58:222-225. References to books should give the names of editors, place of publication, publisher, and year. The author must verify the references against the original documents before the article. References to papers accepted but not yet published should be designated as “in press” or “forthcoming”; authors should obtain written permission to cite such papers as well as verification that they have been accepted for publication.

TABLES AND ILLUSTRATIONS

Tables and illustrations should be merged within the text of the paper, maximum number of tables and illustrations should not exceed four, and legends to illustrations should be typed on the same sheet. Tables should be simple and should supplement rather than duplicate information in the text; tables repeating information will be omitted. Each table should have a title and be typed in double space without horizontal and vertical lines on an 8 ½" x 11' paper. Tables should be numbered consecutively with Roman numerals in the order they are mentioned in the text. Page number should be in the upper right corner. If abbreviations are used, they should be explained in footnotes and when they first appear in text. When graphs, scattergrams, or histograms are submitted, the numerical data on which they are based should be supplied. All graphs should be made with MS Excel and be sent as a separate Excel file even if merged in the manuscript. For scanned photographs the highest resolution should be used.

S.I.UNITS

System International (SI) Unit measurements should be used. All drugs must be mentioned in their generic form. The commercial name may however be mentioned within brackets, if necessary.

PHOTOGRAPHS AND FIGURES

Figures and Photographs should only be included when data cannot be expressed in any other form. Figures and photographs must be cited in the text in consecutive order. Legends must be typed on the same paper. Legends for photomicrographs should indicate the magnifications, internal scale, and method of staining. Figures should be numbered in Arabic numbers.

OBLIGATORY FILES

Obligatory supporting documents for all types of Manuscripts except the letter to editor, without which JIIMC will not accept the manuscript for initial processing.

- Cover Letter
- JIIMC Checklist
- JIIMC Conflict of Interest Performa
- JIIMC CopyRight and Undertaking Agreement
- IRC Certificate
- Bank draft as initial processing fee (Original bank draft send in JIIMC office)

Template of these files is available in the download section.

CONFLICT OF INTEREST

Any funding source for the research work must be informed at the time of submitting the manuscript for publication in JIIMC. Any associations that might be construed as a conflict of interest (stock ownership, consultancies, etc.) shall be disclosed accordingly. Examples of financial conflicts include employment, consultancies, stock ownership, honoraria, paid expert testimony, patents or patent applications, and travel grants, all within 3 years of beginning the work submitted. If there are no conflicts of interest, authors should state that. All authors are required to provide a signed statement of their conflicts of interest as part of the author's declaration.

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- Author is supposed to declare the funding source as acknowledgement at the end of the manuscript.
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- If there is no Methodology section, the role of the funding source should be stated as an acknowledgment.
- The corresponding author should confirm that he/she had full access to all the data in the study and had final responsibility for the decision to submit for publication.
- JIIMC publishes FINANCIAL DISCLOSURE & ROLE OF THE FUNDING SOURCE statement for each article.

AUTHORSHIP CRITERIA

All those designated as authors should meet all four criteria for authorship as stated in *ICMJE recommendations (http://www.icmje.org/icmje-recommendations.pdf).* According to ICMJE recommendations authorship is based on the following four criteria:

1. Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data; and
2. Have been involved in drafting the work or

revising it critically for important intellectual content; and

3. Have given final approval of the version to be published; and
4. Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content. We strongly discourage gift or ghost authorship. Mere supervision, collection of data, statistical analysis and language correction do not grant authorship rights. To avoid any dispute regarding authorship authors are advised to consult COPE guidelines to avoid authorship problems.

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