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POSTOPERATIVE COMPLICATIONS IN FEMALE NEUROSURGICAL PATIENTS, INCLUDING GYNAECOLOGICAL COMORBIDITIES, AT A TEACHING HOSPITAL IN PAKISTAN

Original Research

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ABSTRACT

Background: Postoperative complications are a major concern in neurosurgical practice, particularly among female patients, where underlying hormonal and anatomical factors may further influence surgical recovery. Gynecological comorbidities such as polycystic ovarian syndrome (PCOS), uterine fibroids, endometriosis, and menstrual irregularities are common in women of reproductive age and may alter immune responses, coagulation profiles, and fluid balance. However, the impact of these conditions on neurosurgical outcomes remains under-investigated, especially in low-resource settings.

Objective: To evaluate the incidence and types of postoperative complications in female neurosurgical patients and to determine the influence of coexisting gynecological comorbidities on these outcomes in a tertiary care hospital in Pakistan.

Methods: A descriptive observational study was conducted at the Department of Neurosurgery, Hayatabad Medical Complex, Peshawar, from January 2024 to March 2025. Female patients undergoing neurosurgical procedures were included, while male patients, minor outpatient cases, and incomplete records were excluded. Data on demographics, surgical type, gynecological comorbidities, and complications within 30 days post-surgery were collected. Complications were categorized as surgical or systemic. Statistical analysis was performed using SPSS v26; chi-square and logistic regression analyses were applied with significance set at $p < 0.05$.

Results: Of 364 female patients, 112 (30.77%) had gynecological comorbidities. PCOS was the most common (34.82%), followed by menstrual irregularities (25.00%), uterine fibroids (23.21%), and endometriosis (16.96%). Postoperative complications were reported in 138 (37.91%) patients. Those with gynecological comorbidities had significantly higher rates of complications (54.46% vs. 30.56%, $p < 0.001$), including wound infections (16.96% vs. 9.13%, $p = 0.047$), thromboembolic events (12.50% vs. 5.56%, $p = 0.018$), electrolyte imbalances (17.86% vs. 9.92%, $p = 0.042$), and prolonged hospital stays (34.82% vs. 19.05%, $p = 0.003$).

Conclusion: Gynecological comorbidities independently contribute to a higher risk of postoperative complications in female neurosurgical patients, underscoring the need for integrated perioperative strategies.

Keywords: Electrolyte Imbalance, Endometriosis, Neurosurgical Procedures, Postoperative Complications, Polycystic Ovary Syndrome, Thromboembolism, Uterine Fibroids.

INTRODUCTION

Postoperative complications remain a significant concern in neurosurgical practice, often leading to increased morbidity, prolonged hospital stays, and elevated healthcare costs (1). While these outcomes are universally relevant across patient populations, female neurosurgical patients represent a distinct subgroup due to a unique interplay of anatomical, hormonal, and comorbid factors. Among these, gynecological conditions such as polycystic ovarian syndrome (PCOS), endometriosis, uterine fibroids, and menstrual irregularities are commonly encountered, yet frequently overlooked in perioperative planning and postoperative care (2,3). These conditions may exert a multifaceted influence on recovery through hormonal fluctuations, altered immune responses, and increased susceptibility to complications like thromboembolism (4,5). Surgical stress, anesthetic exposure, and pharmacological interventions can potentially aggravate underlying gynecological disorders, leading to symptom exacerbation or the emergence of new clinical issues postoperatively. Hormonal changes, particularly those associated with menstruation, menopause, or endocrine dysfunctions, may influence critical physiological parameters including hemodynamic stability, wound healing, and pain perception, all of which are pivotal to surgical outcomes (6). Additionally, certain gynecological comorbidities are independently associated with hypercoagulability and an increased risk of thromboembolic events, compounding the vulnerability of neurosurgical patients who are already at heightened risk due to immobility and neurological deficits (7,8).

Despite these interrelated risks, there is a noticeable paucity of literature specifically examining how gynecological comorbidities impact postoperative outcomes in female neurosurgical patients. Most existing neurosurgical studies either disregard sex-specific variables or fail to stratify outcomes by gender, limiting the scope of understanding in this area (9,10). This gap is especially concerning in resource-limited healthcare environments like Pakistan, where access to diagnostic tools and postoperative follow-up may be constrained, further complicating the management of these patients (11,12). In response to this gap, the present study seeks to systematically assess the incidence and spectrum of postoperative complications in female patients undergoing neurosurgical procedures, with a particular focus on the role of coexisting gynecological disorders. By exploring this overlooked intersection, the research aims to deepen clinical insight into sex-specific risk factors and inform more tailored perioperative strategies in neurosurgical care.

METHODS

This descriptive observational study was conducted over a period of 15 months, from January 2024 to March 2025, at the Hayatabad Medical Complex (HMC), a major tertiary care and teaching hospital in Peshawar, Pakistan. As a national referral center, HMC serves a demographically and geographically diverse patient population, enhancing the external validity and generalizability of the findings. The study was approved by the Hospital Research and Ethical Committee of the Medical Teaching Institute (MTI), Hayatabad Medical Complex, under reference number 2435, dated 11/01/2024. Written informed consent was obtained from all participants prior to data collection, in accordance with institutional ethical standards and the Declaration of Helsinki. Female patients of all ages who underwent any form of neurosurgical intervention during the defined study period were considered eligible for inclusion. Special emphasis was placed on identifying those with coexisting gynecological comorbidities, such as polycystic ovarian syndrome (PCOS), endometriosis, uterine fibroids, and menstrual irregularities, to evaluate their impact on postoperative outcomes. Exclusion criteria included all male patients, females undergoing minor outpatient procedures that did not require hospitalization, patients with incomplete or missing medical records, and those lost to follow-up within 30 days postoperatively. This 30-day follow-up window was selected to standardize complication tracking and reflect typical postoperative surveillance. The study encompassed a wide spectrum of neurosurgical procedures, including craniotomies for tumor resection, trauma, decompression, and vascular pathologies; spinal surgeries such as laminectomies, discectomies, and spinal fusions; cerebrospinal fluid diversion procedures like ventriculoperitoneal (VP) shunt placements and intraventricular endoscopic surgeries; and other peripheral and cranial nerve interventions.

All surgeries were performed by consultant neurosurgeons or senior residents under direct supervision, adhering to institutionally standardized preoperative and postoperative care protocols to reduce procedural variability. A total of 364 female patients were enrolled using a convenience sampling strategy. Although no formal sample size calculation was performed, the sample was deemed sufficient for descriptive and exploratory statistical analysis. Data were collected retrospectively from hospital medical records, including

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operative notes and discharge summaries. A structured proforma was utilized to record patient demographics, type of neurosurgical procedure, presence and nature of gynecological comorbidities, and postoperative complications occurring within 30 days of surgery (13). Complications were categorized into surgical (e.g., wound infection, cerebrospinal fluid leak, hematoma) and systemic (e.g., venous thromboembolism, urinary tract infection, electrolyte imbalance). Length of hospital stay and unplanned readmissions were also recorded. All data were initially compiled in Microsoft Excel 2016 and subsequently analyzed using IBM SPSS Statistics for Windows, Version 26 (IBM Corp., Armonk, NY, USA). Descriptive statistics including means, standard deviations, frequencies, and percentages were used to summarize demographic and clinical variables. The chi-square test was employed to assess associations between gynecological comorbidities and the presence of postoperative complications. To identify independent predictors, a multivariate logistic regression analysis was conducted, adjusting for potential confounders such as age and surgical category. Adjusted odds ratios (aOR) with 95% confidence intervals (CI) were reported. A two-tailed p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 364 female patients who underwent neurosurgical procedures were analyzed. The age distribution revealed that 39.01% of patients were between 20 and 39 years, 29.67% between 40 and 59 years, 21.43% were aged 60 years or older, and 9.89% were under 20 years. Craniotomy was the most frequently performed procedure, accounting for 40.38% of cases, followed by spinal surgeries (35.16%), ventriculoperitoneal (VP) shunt or intraventricular procedures (14.29%), and other interventions such as biopsies and peripheral nerve procedures (10.16%). Gynecological comorbidities were present in 112 patients, representing 30.77% of the total cohort. Among these, polycystic ovarian syndrome (PCOS) was identified in 34.82% of cases, followed by menstrual irregularities in 25.00%, uterine fibroids in 23.21%, and endometriosis in 16.96%. Postoperative complications within 30 days of surgery were observed in 138 patients (37.91%). Surgical complications included wound infections in 11.54%, hematomas in 5.77%, and cerebrospinal fluid (CSF) leaks in 4.67%. Systemic complications were recorded as electrolyte imbalances in 12.36%, urinary tract infections in 9.34%, thromboembolic events in 7.69%, and postoperative seizures in 5.22%. Furthermore, 23.90% of patients had prolonged hospital stays exceeding seven days, and 10.44% experienced unplanned readmissions within the 30-day postoperative period.

When comparing patients with and without gynecological comorbidities, those with comorbidities exhibited significantly higher rates of several complications. Specifically, 54.46% of patients with gynecological conditions experienced any postoperative complication compared to 30.56% without. Wound infections occurred in 16.96% versus 9.13%, thromboembolic events in 12.50% versus 5.56%, and electrolyte imbalances in 17.86% versus 9.92%, respectively. Prolonged hospital stays were noted in 34.82% of patients with comorbidities, significantly higher than the 19.05% in those without. Other complications such as CSF leaks, hematomas, urinary tract infections, seizures, and readmission rates did not differ significantly between groups. Chi-square analysis demonstrated statistically significant associations between gynecological comorbidities and multiple postoperative outcomes. Significant p-values were observed for any complication (<0.001), wound infection (0.047), thromboembolic events (0.018), electrolyte imbalances (0.042), and prolonged hospital stay (0.003). Borderline significance was noted for 30-day readmission ($p = 0.050$), while no meaningful differences were detected for CSF leaks, hematomas, urinary tract infections, or seizures.

Multivariate logistic regression analysis confirmed that the presence of gynecological comorbidities was an independent predictor of postoperative complications. After adjusting for age group and type of neurosurgical procedure, gynecological comorbidity remained significantly associated with an increased risk of complications (adjusted odds ratio [aOR] = 2.5; 95% confidence interval [CI], 1.6–3.8; $p < 0.001$). Neither age group nor type of surgical procedure demonstrated a statistically significant association in the final model. Subgroup analysis of the 112 patients with gynecological comorbidities revealed nuanced differences in postoperative complication patterns across specific diagnoses. Patients with endometriosis had the highest rates of any postoperative complication (57.89%), closely followed by those with polycystic ovarian syndrome (56.41%) and uterine fibroids (53.85%). Menstrual irregularities were associated with a slightly lower complication rate of 50.00%. Wound infection was most prevalent in patients with uterine fibroids (19.23%), while thromboembolic events occurred most frequently among those with endometriosis (15.79%) and PCOS (12.82%). Electrolyte imbalances were also most common in endometriosis (21.05%) and PCOS (20.51%) cases. Notably, prolonged hospital stays were highest among patients with endometriosis (36.84%) and PCOS (35.90%). These findings suggest variability in complication profiles based on the type of gynecological disorder, underlining the importance of individualized perioperative risk assessment.

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Table 1: Demographic and Clinical Characteristics of Female Neurosurgical Patients (n = 364)

Characteristic		Frequency (n)	Percentage (%)
Age Group (years)	< 20	36	9.89%
	20–39	142	39.01%
	40–59	108	29.67%
	≥ 60	78	21.43%
Type of Neurosurgical Procedure	Craniotomy	147	40.38%
	Spinal Surgery	128	35.16%
	VP Shunt/Intraventricular Procedures	52	14.29%
	Others (biopsies, peripheral nerves)	37	10.16%
Gynecological Comorbidities	Yes	112	30.77%
	No	252	69.23%

Table 2: Postoperative Complications Observed Within 30 Days (n = 364)

Complication Type		Frequency (n)	Percentage (%)
Any Postoperative Complication		138	37.91%
Surgical Complications	Wound Infection	42	11.54%
	Hematoma	21	5.77%
	CSF Leak	17	4.67%
Systemic Complications	Thromboembolic Events	28	7.69%
	Urinary Tract Infection	34	9.34%
	Electrolyte Imbalance	45	12.36%
	Seizures	19	5.22%
Hospital Stay and Readmission	Prolonged Hospital Stay (>7 days)	87	23.90%
	30-day Readmission	38	10.44%

Table 3: Comparison of Complication Rates in Patients with and Without Gynecological Comorbidities

Complication	With Gyn Comorbidity (n = 112)	Without Gyn Comorbidity (n = 252)	χ^2-value	p-value
Any Postoperative Complication	61 (54.46%)	77 (30.56%)	18.94	<0.001
Wound Infection	19 (16.96%)	23 (9.13%)	3.94	0.047
CSF Leak	5 (4.46%)	12 (4.76%)	0.01	0.902
Hematoma	6 (5.36%)	15 (5.95%)	0.05	0.820
Thromboembolic Events	14 (12.50%)	14 (5.56%)	5.63	0.018
Urinary Tract Infection	13 (11.61%)	21 (8.33%)	1.00	0.319
Electrolyte Imbalance	20 (17.86%)	25 (9.92%)	4.13	0.042
Seizures	8 (7.14%)	11 (4.37%)	1.04	0.306
Prolonged Hospital Stay (>7 days)	39 (34.82%)	48 (19.05%)	8.84	0.003
30-day Readmission	15 (13.39%)	23 (9.13%)	1.66	0.198

Table 4: Chi-square Analysis of the Association Between Gynecological Comorbidities and Postoperative Complications (n = 364)

Postoperative Complication	Chi-square (χ^2)	Degrees of Freedom (df)	p-value
Any Complication	18.56	1	<0.001
Wound Infection	3.94	1	0.047
CSF Leak	0.80	1	0.372
Hematoma	0.52	1	0.470
Thromboembolic Events	5.57	1	0.018

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Postoperative Complication	Chi-square (χ^2)	Degrees of Freedom (df)	p-value
Urinary Tract Infection	2.68	1	0.102
Electrolyte Imbalance	4.13	1	0.042
Seizures	1.03	1	0.310
Prolonged Hospital Stay (>7 days)	8.92	1	0.003
30-day Readmission	3.84	1	0.050

Table 5: Multivariate Logistic Regression Analysis of Factors Associated with Postoperative Complications (n = 364).

Variable		aOR	95% CI	p-value
Gynecological Comorbidity (Yes vs No)		2.5	1.6 – 3.8	<0.001
Age Group	<20 years	1.1	0.6 – 2.1	0.70
	40–59 years	1.2	0.8 – 1.8	0.40
	≥60 years	1.3	0.8 – 2.1	0.30
Type of Procedure	Spinal Surgery	1.1	0.7 – 1.7	0.65
	VP Shunt/Intraventricular	0.9	0.5 – 1.7	0.80
	Others	1.3	0.7 – 2.3	0.40

Table 6: Subgroup Analysis of Postoperative Complications in Patients with Gynecological Comorbidities

Gynecological Condition	n	Any Complication (%)	Wound Infection (%)	Thromboembolism (%)	Electrolyte Imbalance (%)	Prolonged Hospital Stay (%)
PCOS	39	56.41%	17.95%	12.82%	20.51%	35.90%
Uterine Fibroids	26	53.85%	19.23%	11.54%	15.38%	30.77%
Menstrual Irregularities	28	50.00%	14.29%	10.71%	14.29%	32.14%
Endometriosis	19	57.89%	15.79%	15.79%	21.05%	36.84%

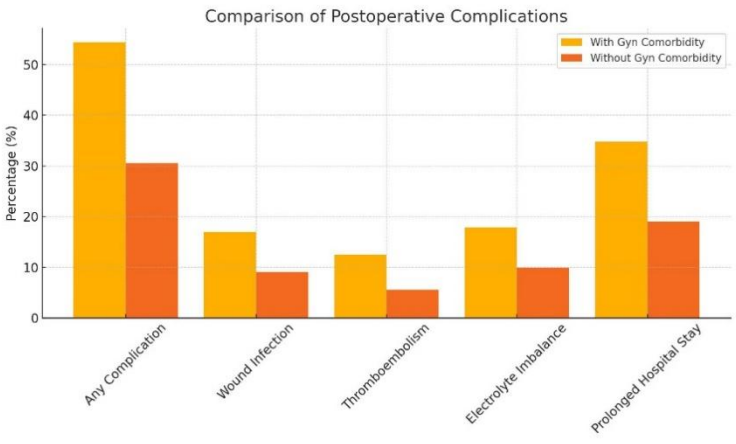

Figure 1 Comparison of Postoperative Complications

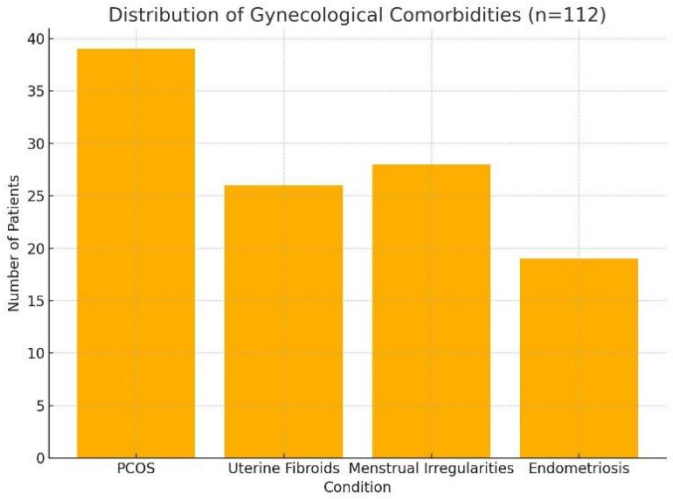

Figure 2 Distribution of Gynecological Comorbidities

DISCUSSION

This study evaluated the influence of gynecological comorbidities on postoperative complications among female patients undergoing neurosurgical procedures, revealing critical insights into the interplay between reproductive health and surgical recovery. The overall 30-day complication rate was 37.9%, with wound infections, electrolyte imbalances, and thromboembolic events being the most

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prevalent. These findings align with previous literature documenting similar complication rates in neurosurgical populations (14). The elevated incidence of systemic complications in this cohort may be attributed to the physiological stress inherent in neurosurgery, compounded by sex-specific factors such as hormonal fluctuations and reduced postoperative mobility, which are known contributors to electrolyte disturbances and thrombotic risks (15,16). Approximately 31% of patients in this study presented with gynecological comorbidities, primarily polycystic ovarian syndrome (34.8%), menstrual irregularities (25.0%), and uterine fibroids (23.2%). These proportions are consistent with epidemiological data in the general female population, where such conditions are known to affect 20–30% of women of reproductive age (17,18). Notably, the presence of gynecological comorbidities was associated with a significantly higher incidence of postoperative complications (54.5% vs. 30.6%, $p < 0.001$). This pattern underscores the role of chronic gynecological disorders in modulating surgical outcomes, likely through hormonal imbalances, vascular changes, and systemic inflammation—mechanisms previously suggested in surgical and endocrine research (19).

The subgroup analysis offered further granularity by demonstrating that patients with endometriosis and PCOS had particularly high rates of wound infections and electrolyte disturbances. These findings are congruent with literature linking systemic inflammatory responses and endocrine dysfunction to impaired immune regulation and fluid-electrolyte balance (20,21). Wound infections were notably higher among patients with gynecological disorders (16.96% vs. 9.13%, $p = 0.047$), possibly reflecting immunomodulatory effects associated with chronic pelvic inflammation. Likewise, thromboembolic events were significantly more frequent in this group (12.5% vs. 5.56%, $p = 0.018$), consistent with the established hypercoagulable state observed in conditions such as PCOS and fibroids, where estrogen-driven vascular reactivity and platelet aggregation are elevated (22). Electrolyte imbalances were markedly more prevalent in patients with gynecological comorbidities (17.86% vs. 9.92%, $p = 0.042$), a finding that may be linked to endocrine disruptions and altered renal responses during perioperative stress. These imbalances can contribute to delays in recovery and increased risk of systemic complications, particularly in the neurosurgical context where fluid and neurological balance are critical (23). Although no significant differences were observed for complications such as hematoma, CSF leak, or seizures, the extended hospital stays among patients with gynecological conditions (34.82% vs. 19.05%, $p = 0.003$) reflect the overall clinical burden imposed by these comorbidities. This prolonged hospitalization not only indicates delayed recovery but also highlights increased healthcare utilization and associated costs, a concern particularly relevant in resource-limited settings.

One of the key strengths of this study lies in its focus on an underexplored patient population—female neurosurgical patients with gynecological comorbidities. The relatively large sample size and systematic data collection enhance the reliability of observed associations. Conducted at a tertiary care facility serving a demographically diverse patient base, the findings are reasonably generalizable to similar clinical environments. Moreover, the application of multivariate logistic regression provides robust evidence for gynecological comorbidity as an independent predictor of postoperative complications, even after adjusting for age and surgical type. Nevertheless, several limitations must be acknowledged. The observational design restricts the ability to infer causality, and the use of convenience sampling may have introduced selection bias. The absence of formal sample size estimation limits the statistical power for subgroup comparisons. Additionally, the study did not assess hormonal profiles, medication use (such as hormonal contraceptives or anticoagulants), or the clinical severity of the gynecological disorders, all of which could have enriched the analysis and clarified pathophysiological pathways. Furthermore, follow-up was limited to 30 days, potentially underestimating the long-term impact of these comorbidities on recovery trajectories and complication recurrence. Future studies should incorporate prospective designs with detailed endocrine and inflammatory profiling to explore causal relationships between gynecological health and surgical outcomes. Stratified analysis based on hormonal status (e.g., premenopausal vs. postmenopausal) and comorbidity severity could further delineate risk profiles. Emphasis should also be placed on evaluating tailored perioperative strategies, such as thromboprophylaxis protocols and preoperative optimization of endocrine function, which may mitigate complications in this high-risk subgroup. Ultimately, the integration of gynecological assessments into neurosurgical care pathways could enhance personalized medicine approaches and improve patient outcomes, especially in healthcare systems facing resource constraints.

CONCLUSION

This study concludes that gynecological comorbidities play a significant and independent role in increasing the risk of postoperative complications in female neurosurgical patients. Conditions such as PCOS, uterine fibroids, menstrual irregularities, and endometriosis were closely linked to poorer surgical outcomes, highlighting the need for these factors to be systematically addressed in preoperative evaluations. The findings emphasize the importance of adopting a multidisciplinary care model that integrates gynecological assessment

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into neurosurgical planning. By proactively identifying and managing these comorbidities, healthcare providers can enhance surgical safety, optimize recovery, and improve overall outcomes for women undergoing neurosurgical interventions.

AUTHOR CONTRIBUTION

Author	Contribution
Riffat Shaheen	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Zia ur Rehman*	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Noreen Mehsud	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Muhammad Shafiq	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

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