

Peripartum Neurological Injuries and its Outcomes

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ABSTRACT

Aim: To study the peri-partum neurological injury and its outcomes.

Study Design: Cross sectional study

Place and duration of study: Department of Neurosurgery & Department of Obstetrics & Gynaecology, Peoples Medical University Hospital, Nawabshah from 1st July 2022 to 30th June 2023.

Methodology: Two hundred and fifty women having a high risk of neurological disorders were included. A high-risk pregnancy was defined with the one having increased threat to fetal morbidity as well as risk of disability presented through clinical symptoms of each case. Biochemical analysis using 5cc blood was conducted for testing positive free beta human-chorionic-gonadotropin in addition to neurological assessment and Doppler ultrasound. A well-designed questionnaire was adapted for extracting information regarding gravidity, parity, gestational hypertension and diabetes, complete clinical history including neurological symptoms, mortality rate mode of delivery and foetal disorders through modifying-ranking-scale of mother.

Results: The mean age, gravidity and parity of the study participants was 29.33±1.2, 2.2±1.7 and 2.1±2.0 respectively. Significant number of neurological disorders was observed in before and after pregnancy. Majority of the participants were underwent C-section (62%). Highest ratio of full-term births were reported followed by preterm and abortion. There were 20% those cases who received severe headache post delivery time, on clinical diagnosis out of those 20% cases there were 3% those having subdural hematoma formation. Congenital disorders were observed in only 1 neonate. Obstetric and neurological profile of each patient with each neurological condition was also assessed.

Conclusion: The neurological conditions were frequently reported during pregnancy. Seizures, migraine, cerebral venous and intracranial hypertension and sinus thrombosis were reported by majority of the study participants.

Keywords: Neurology, Anesthesia, Pregnancy, Neuropathy

INTRODUCTION

In 2017, Roderick and colleagues conducted a national survey in the United Kingdom to examine the practices of neurological monitoring following obstetric anaesthesia^{1,2}. Their findings revealed that out of 112 units surveyed, only 63(56%) had established monitoring policies, and the methods and schedules for assessment varied widely³.

Postpartum related chronic subdural hematoma (PCSDH) and renal aneurysm having a non traumatic origin are rarely observed in obstetrics with a 1 in 300 risk and 1 in 1000 risk respectively with neurological life-threatening complication which is presented with severe headache^{4,5}. In cases where the condition is left undiagnosed, the reason might be Chiari malformation, or even meningitis which may resemble postpartum related chronic subdural hematoma making the primary diagnosis difficult⁶.

Intrinsic obstetric palsies are conditions attributed to the process of labor and delivery itself. The incidence of these conditions has significantly decreased from 3.2% a century ago to less than 0.25% today, mainly due to a shorter second stage of labor. These conditions often involve sensory or motor issues, affecting multiple lumbosacral nerve roots, and typically resolve within 6 to 8 weeks⁷.

Data from the NAP3 report provided estimates for the incidence of permanent injuries in patients who received central neuraxial blocks (CNB). The "pessimistic" estimate was 4.2 per 100,000 cases (1:24,000), while the "optimistic" estimate was 2.0 per 100,000 (1:54,000). This report has had a significant impact on medical practice by providing more accurate risk and incidence estimates for permanent harm following CNB, which are lower than those reported in some smaller studies, providing reassurance to practitioners¹.

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The 'Safety Guideline: Neurological Monitoring Associated with Obstetric Neuraxial Block 2020,' published by the Association of Anesthetists and Obstetric Anesthetists' Association in the United Kingdom, outlined several key recommendations⁸. (i) An anesthetist should be alerted during labor if a woman cannot perform a straight-leg raise, as minor motor block is common even with modern anesthetics. Profound motor and sensory block should prompt immediate assessment by an anesthetist. (ii) After a spinal or epidural top-up, straight-leg raising should be used as a screening method to assess motor block. If a woman cannot perform this at 4 hours after the last dose of anesthetic, an anesthetist should evaluate whether urgent investigation is necessary. (iii) Women should be informed about the expected duration of neuraxial blocks and encouraged to notify staff if recovery is delayed and (iv) each maternity unit should have a policy in place to guide the escalation of care.

When assessing a patient with abnormal neurological signs or symptoms during the peri-partum period, a thorough history and examination are crucial. Factors such as obstetrical history, the second stage of labor's onset and duration, patient positioning during labor (especially the second stage), and the need for instrumental or operative delivery should be considered. Anesthetic factors, including the choice of neuraxial technique, any difficulties during placement, block duration, and additional doses or adjuncts administered, are also important. Other factors to consider include a history of pre-existing back pain, scoliosis, back surgery, or any pre-existing neurological conditions.⁹

Regular motor block assessments are recommended for women receiving neuraxial labor analgesia, and after surgery with neuraxial anesthesia (e.g., following a caesarean delivery), all women should be tested for the ability to perform a straight-leg raise 4 hours after the last dose. Additionally, the Modified Bromage scale is a standardized method for assessing motor function after neuraxial analgesia or anesthesia.

Most nerve palsies that occur in postpartum patients are related to obstetric factors, such as pressure during labor and

delivery or direct pressure from the fetus. These issues can affect central, lumbosacral roots, or peripheral nerves. Risk factors for obstetric neuropathy include being a first-time mother, positioning during labor, a prolonged second stage of labor, instrumental delivery, and a large fetal head^{10,11}.

The most common intrinsic obstetric palsy is lateral femoral neuropathy¹². Palsies of the femoral, obturator, sciatic, common peroneal, and lumbosacral plexus have all been reported. In some cases, femoral and obturator nerve injuries may occur bilaterally, leading to potential confusion with intra spinal lesions. Femoral nerve dysfunction can manifest as hip flexion palsy (resulting in difficulties with stair climbing), diminished patellar reflex, and sensory loss in the femoral nerve's distribution. Obturator nerve neuropathy can lead to weakness in hip adduction and internal rotation, along with decreased sensation on the inner aspect of the thigh.

Nerve damage can occur due to direct needle injury or intra neuronal injection, resulting in paresthesia, sensory loss, and/or motor weakness within the affected nerve's distribution. Preventive measures include needle withdrawal upon patient-reported paresthesia during insertion, followed by needle redirection before local anesthetic injection¹³⁻¹⁵.

Pregnant women with pre-existing neurological conditions require a multidisciplinary approach involving neurology, obstetric medicine, and anesthesiology. A comprehensive evaluation should monitor potential pregnancy-related complications, and a tailored plan for labor and delivery should be established.¹⁶⁻¹⁹ Following a thorough history and examination, which should be clearly documented, patients with prior back surgery or injury and/or pre-existing neurological conditions should be informed about the risks, benefits, and alternative options for neuraxial analgesia or anesthesia before undergoing such procedures. Risk levels can vary significantly among individual patients, making pre assessment, informed consent, and counselling in a controlled pre labor or pre surgery setting preferable.

Neuraxial labor analgesia is a generally safe and effective pain relief method. However, there are specific contraindications, such as coagulopathy or elevated intracranial pressure, which may preclude its use.²⁰ In cases where neuraxial procedures are contraindicated, an alternative approach could involve opioid-based patient-controlled intravenous analgesia (e.g., remifentanyl) for labor analgesia or general anesthesia for surgical procedures (e.g., cesarean delivery).

MATERIALS AND METHODS

This cross sectional study was conducted in the Department of Neurosurgery & Department of Obstetrics & Gynaecology, Peoples Medical University Hospital, Nawabshah from 1st July 2022 to 30th June 2023. After getting permission from IRB, informed consent retrieval from the specific patients the enrolment based on clinical symptoms and history was performed in peripartum women. Those women having a high risk of neurological disorders were included in this study. The women were assessed by the presence of clinical neurological symptoms either during pregnancy or within 6 months of delivery. A Total 250 cases were enrolled after calculating the sample size through online available calculator based on EpiInfo software using 95% CI and 5% margin of error with 80% power of test. A high-risk pregnancy was defined with the one having increased threat to fetal morbidity as well as risk of disability presented through clinical symptoms of each case. Biochemical analysis using 5cc blood was conducted for testing positive free beta human-chorionic-gonadotrophin in addition to neurological assessment and Doppler ultrasound. A well-designed questionnaire was adapted for extracting information regarding gravidity, parity, gestational hypertension and diabetes, complete clinical history including neurological symptoms, mortality rate mode of delivery and foetal disorders through modifying-ranking-scale of mother. Each patient was followed up till 6 month post-delivery and any related neurological alterations in pregnant

women or neonate were recorded. The data was entered in excel and analysis was performed after completion of the study. The analysis of data was based on SPSS-26.

RESULTS

The mean age, mean gravidity and mean parity are 29.33±1.2, 2.2±1.7 and 2.1±2.0 respectively. Gestational diabetes and gestational hypertension was recorded in only 10% and 19.2% of the participants respectively. Significant number of neurological disorders was observed in before and after pregnancy (Table 1).

Majority of the participants were underwent C-section (62%) whereas normal vaginal delivery was observed in only 32.4% of the patients. On the other hand, abortion was also recorded in 4% of the patients. Highest ratio of full-term births were reported followed by preterm and abortion. Congenital disorder was observed in only 1 neonate (Table 2).

History of neurological injury was reported in 18% of the participants. Headache was recorded in highest number of the patient's upto 56% followed by epilepsy, CVST and MS (Fig 1). Out of the total cases of headache, there were 20% those cases who received severe headache post-delivery time. There were 3% those having subdural hematoma formation and 4% aneurysm (Fig. 2).

Obstetric and neurological profile of each patient with each neurological condition was also assessed. More than majority of the patients experience headache pre and post-pregnancy period, however, seizures was mostly the cases reported. C-section delivery mode was adopted for those patients who had the history of brain tumor (Table 3).

Table 1: Characteristics and neurological profile of study participants (n=250)

Parameter	No.	%
Age	29.33±1.2	
Obstetric profile		
Gravidity	2.2±1.7	
Parity	2.1±2.0	
MRS	0.2±0.1	
Eclampsia	12	4.8
Gestational diabetes		
Yes	25	10.0
No	184	73.6
Unavailable	41	16.4
Neurological disorders		
Before pregnancy	59	23.6
First trimester	32	12.8
Second trimester	33	13.2
Third trimester	45	18.0
Peri-partum	4	1.6
Post-partum	55	22
Unavailable	22	8.8
Gestational hypertension		
Yes	48	19.2
No	157	62.8
Unavailable	45	18.0

Table 2: Delivery mode in study participants

Pregnancy outcome	No.	%
Delivery mode		
NVD	81	32.4
C/S	155	62.0
Abortion	10	4.0
Unavailable	4	1.6
Fetus/Neonate		
Abortion	13	5.2
Stillbirth	3	1.2
Preterm	21	8.4
Term	201	80.4
Congenital disorders	1	0.4
Unavailable	10	4.0
Maternal mortality	1	0.4

Table 3: Obstetric/neurological profile and pregnancy outcome of study participants with each neurological condition

Parameters	Headache	Epilepsy	Stroke	CVST	ICH	MS	Brain Tumor	GBS	MG	Eclampsia
Age	29.9	28	29.4	29.5	28.5	30.1	34.5	31.2	27.3	26.5
Gravidity	2.7	2.5	1.75	2	2	2.5	4.5	1	1.5	1.87
Parity	2.2	3.3	1.5	2.2	2.4	2.4	2.5	1.3	1.5	2.1
Gestational diabetes	15 (60%)	3 (12%)	-	1 (4.1%)	2 (8.1%)	-	1(50%)	-	-	1 (4.1%)
Gestational hypertension	30(62.5%)	6(12.5)	1 (2%)	1 (2%)	1 (2%)	1 (2%)	-	-	-	8 (16.6%)
Previous neurological disorder	7 (11.8%)	35(59.3%)	-	-	-	4(23.7%)	-	-	3(5%)	-
NVD	39 (48.1%)	32 (39.5%)	4 (4.93%)	2 (2.4%)	-	-	-	-	-	1 (1.25%)
C/S	91 (58.7%)	18(23.5%)	1 (0.6%)	10 (6.4%)	12 (7.7%)	2(1.29%)	1(0.6%)	-	1(0.6%)	10 (6.4%)
Abortion	8 (80%)	2 (20%)	-	-	-	-	-	-	-	-
Stillbirth	1 (33.3%)	-	2 (66.6%)	-	-	-	-	-	-	-
Preterm	12 (57.1)	3 (14.2%)	-	-	-	1(4.7%)	-	-	-	3 (14.2%)
Congenital disorders	-	-	-	-	1 (100%)	-	-	-	-	-
Term	119(52.8%)	68 (30%)	5 (2.2%)	1 (0.4%)	2 (0.8%)	9 (4%)	0	0	0	6 (2.6%)
Maternal mortality	-	-	1(0.4%)	-	-	-	-	-	-	-

MS: Multiple sclerosis; MG: Myasthenia gravis; CVST: Cerebral venous sinus thrombosis; C/S: Cesarean section; GBS: Guillen-barre syndrome; NVD: Normal vaginal delivery; ICH: Intracranial hemorrhage

Fig 1: History and neurological condition of study participants

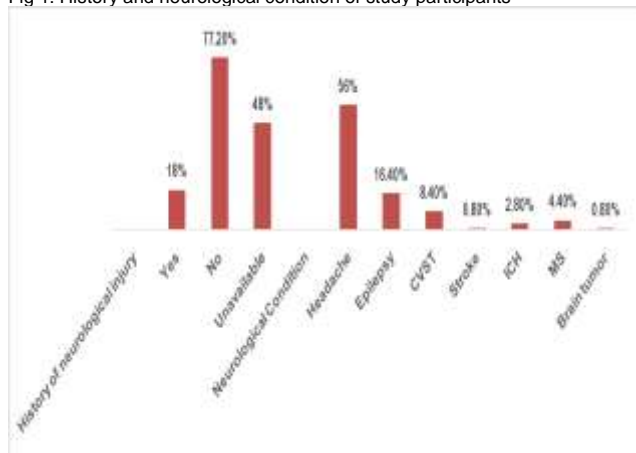
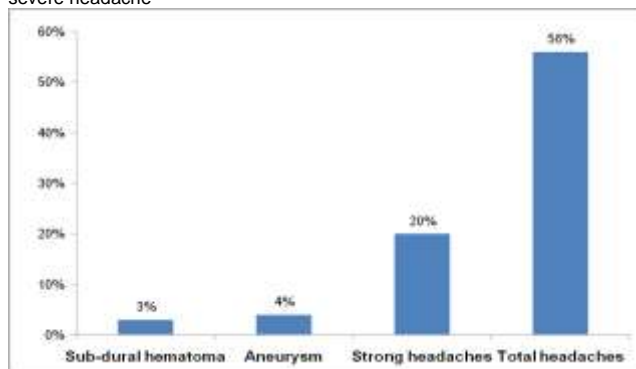


Fig. 2: Incidence of sub-dural hematoma and aneurysm among cases with severe headache



DISCUSSION

In this study, major neurological complaints were categorized as including headaches, seizures, unilateral neurological symptoms, multiple sclerosis, neuromuscular disorders, and brain tumors⁷. Among mothers in the Shiraz health centers, headaches were the most prevalent neurological symptom, with two-thirds of cases being primary headaches which shows better results with minimal interventions. Secondary headaches are also common in pregnant females were mainly attributed to infections and preeclampsia. It's worth noting that on one hand, primary headaches completely diminish during pregnancy period but it also gets worse in certain cases⁷.

In the present study no case of renal aneurysm was noted however one cases of sub-dural hematoma was observed with severe headaches and preeclampsia history. Literature reports that sub-dural hematoma is difficult to diagnose with sharing similar features as post-dural puncture-headache.^{8,9} In the current study as well the diagnosis was made after a complete clinical and radiological examination and similar protocol was observed in each patient for preventing any miss or undiagnostic. Consistent with prior research, migraine emerged as the most common primary headache associated with hormonal changes during pregnancy^{7,9}. Primary and secondary both types of headache can be manifest during pregnancy and can be caused by number of conditions including brain tumors, vasculitis, hemorrhage, arteriovenous malformations, pre-eclampsia, and eclampsia^{9,11}. In this study, preeclampsia and infections are also identified as the main cause of secondary headaches.

The postpartum period showed a notably high prevalence of headaches, likely associated with the significant drop in estrogen levels following pregnancy¹³. Furthermore, gestational hypertension and diabetes are also very prominent in pregnant females with complain of headaches. It is also important to address those higher chances hypertensive disorders are reported during pregnancy¹⁷.

No significant difference was observed in patients with and without headaches in compliance with mode of delivery and they were full term deliveries^{15,16}. Seizure disorder, migraines and epilepsy are common implications and patient with seizures during pregnancy had previous history of seizure attacks^{18,20}.

Studies have documented 0.3 to 0.5% of seizures attack during pregnancy.¹⁷ Present study also highlights that pregnant women with neurological complications were presented with seizures. Various hormonal and physiological changes occur during period of pregnancy that might influence seizure attack. Reduction in albumin level, higher activity of CVP50 enzymes, increased renal blood circulation which all contribute to alter drug concentration and absorption that will eventually lead to seizures²⁰.

Drug reaction, epilepsy, thrombosis and haemorrhage were the most prominent causes of seizures during pregnancy.^{18,19} Various studies have proved that females that already had history of seizures have higher chances of hypertension and neonatal complications during pregnancy when compared to the general population²¹⁻²³. However, contradictory findings have been reported, with some studies showing no considerable relation between pregnancy complications and seizures²⁴⁻²⁶. Present study also showed that approximately a quarter of patients with seizures during pregnancy also had hypertensive disorders, decreased consciousness and instances of coma were not uncommon among mothers experiencing seizures. Additionally, mothers with seizures had higher rates of cesarean section, abortion, preterm birth, and stillbirth.

Notably, most women experienced seizures during the postpartum period in this study, and the incidences of seizures increased with advancing gestational age. These findings underscore the importance of monitoring patients for seizure attacks during the postpartum period. Implementing seizure prophylaxis measures appears crucial to enhancing obstetrics and neonatal outcomes in seizure patients especially during last trimester of pregnancy²⁷⁻³⁰.

Most of the cases with neurological symptoms appeared in post-pregnancy period. Progesterone and oestrogen both hormones are quite high during pregnancy and start to decline when pregnancy period is over. Thus, it also provides positive effect on multiple sclerosis resulting less severe relapses especially during last trimester of pregnancy when concentration of both these hormones is very high. However, MS relapse rates tend to increase during the first three months after delivery. In our study, all MS patients were diagnosed during the first trimester, and no MS symptoms were reported in the second and third trimesters. While several studies have not reported significant increases in obstetric and neonatal complications in patients with MS compared to healthy controls³⁰, we observed 20% rate of abortion in mothers with MS, necessitating advisement regarding the associated risk of abortion.

Carpal tunnel syndrome (CTS) and Bell's palsy, both commonly associated with soft tissue edema and fluid retention during pregnancy, were not observed in our study population²⁸. Guillain-Barré syndrome (GBS) and myasthenia gravis (MG), which are autoimmune disorders theoretically expected to improve during pregnancy because of the positive effect of estrogen and progesterone. A study also reports that MS disease even worse during pregnancy but the symptoms remain normal. GBS patients showed exacerbated symptoms during follow up period³¹. Both MG and GBS carry potential risks for fatal maternal and neonatal complications, highlighting the importance of multidisciplinary care.

Though brain tumours are rarely reported during pregnancy, fluid retention and hormonal changes may contribute to tumor enlargement. Our study identified two cases of brain tumors, with no maternal complications other than gestational diabetes.

CONCLUSION

The neurological conditions were frequently reported during pregnancy. Seizures, migraine, cerebral venous and intracranial hypertension and sinus thrombosis were reported by majority of the study participants. Therefore, management of neurological disorders during pregnancy needs to be properly considered and requires appropriate multidisciplinary team.

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1. Conception and design of or acquisition of data or analysis and interpretation of data.
2. Drafting the manuscript or revising it critically for important intellectual content.
3. Final approval of the version for publication.

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