RESEARCH ARTICLE

Magnetic Resonance Imaging findings in pregnancy related neurological complications

Laila Khan, Rukhsana Aziz, Tahira Nishtar

Abstract

Objectives: To describe the various neurological complications that occur in pregnancy and puerperium using magnetic resonance imaging as the diagnostic tool.

Method: The prospective study was conducted at the Radiology Department of Lady Reading Hospital, Peshawar, Pakistan, from June 2018 to June 2019, and comprised pregnant and puerperium patients presenting with neurological symptoms who were referred for magnetic resonance imaging. Clinical records of the patients were reviewed for risk factors and neurological symptomatology. Imaging was done using a 1.5Tesla machine. Departmental routine imaging protocols for magnetic resonance imaging brain and magnetic resonance venography were used. Data was analysed using SPSS 23.

Results: There were 60 pregnant women with a mean age of 25.85±5.1 years (range: 17-40 years). Magnetic resonance imaging showed posterior reversible encephalopathy syndrome in 20(33.3%) patients and haemorrhagic infarct in 18(30%), while 9(15%) were found to be normal. Magnetic resonance venography exhibited dural sinus thrombosis in 19(31.7%) patients.

Conclusion: Magnetic resonance imaging was found to play a vital role in early diagnosis of pregnancy-related neurological complications.

Keywords: MRI, Neurological complications, MRV, PRES, DST. (JPMA 72: 2448; 2022)

DOI: https://doi.org/10.47391/JPMA.5135

Introduction

Pregnancy and the puerperium period are associated with many anatomic and physiological changes in the maternal body.[1] Each system of the human body, including the nervous system, experiences alterations in this period. Acute neurological pathologies that require hospitalisation are less common in women of childbearing age. The prevalence of certain diseases increases in this period, including preeclampsia and delivery-associated neuropathies. Few other conditions, though not directly related to pregnancy, like dural sinus thrombosis (DST), cerebral haemorrhage and ischaemic stroke, increase in frequency and result in a significant risk of mortality and morbidity.[2] Adequate provision of care during this period is crucial. Any neurological and haemodynamic disturbance found during pregnancy might have serious complications for the mother and the foetus.[3,4] Many neurological signs and symptoms presenting in pregnancy may result from physiological changes of pregnancy. Because the presentation of these conditions is usually nonspecific, it can be difficult for the clinician to pinpoint the diagnosis. Some conditions, such as preeclampsia, are diagnosed easily by obstetricians and are managed adequately. Some complications, such as DST, present with such nonspecific symptoms as headache. It is a frequent complaint in pregnancy and is often not considered serious until complications develop.[2] Radiological findings can guide the obstetrician to a specific diagnosis and management.

Recognition of the spectrum of pregnancy-related neurological complications by imaging helps in prompt diagnosis and management, and is thus very important for preventing maternal and foetal complications. The earlier diagnosis of such conditions as DST, pituitary apoplexy and eclampsia has major impact on patient outcome. With the advent of medical technologies in imaging, revolutionary developments have occurred in the diagnosis of maternal and foetal problems.[5]

Computed tomography (CT) scan and magnetic resonance imaging (MRI) are the investigations of choice for patients with neurological conditions. Generally, CT brain is ordered first due to its easy availability in almost every setup, short scanning time and cost effectiveness. However, it has been observed that CT scan cannot differentiate between potentially reversible ischaemia, as occurs in posterior reversible encephalopathy syndrome (PRES) and infarct, while, on the other hand, it can be easily differentiated on Diffusion-weighted imaging (DWI) MRI. Moreover, dural sinuses can be evaluated by coronal T2-weighted (T2W) images as well as by magnetic

Department of Radiology, Lady Reading Hospital, Peshawar.

Correspondence: Rukhsana Aziz. Email: mahamsheikh2003@gmail.com

resonance venography (MRV). No radiation exposure and better ability of visualising pituitary gland are other advantages of MRI, which has proven to be a boon in the prompt and accurate diagnosis of neurological complications of pregnancy and puerperium.[2] By knowing the spectrum of neurological complications in pregnancy and their prevalence, appropriate treatment can be started earlier, thus improving patient outcomes.[4]

The current study was planned to explore the causes of neurological conditions in pregnancy and postpartum period using MRI and MRV as the diagnostic tools.

Patients and Methods

The prospective, hospital-based, cross-sectional study was conducted at the Radiology Department of Lady Reading Hospital (LRH), Peshawar, Pakistan, from June 2018 to June 2019. After approval from the institutional ethics review committee, the sample was raised using simple convenience sampling technique. Those included were pregnant and puerperium period patients presenting with neurological signs and symptoms, such as headache, fits, altered sensorium or neurological deficits, who had been advised MRI brain and/or MRV. Known cases of seizure disorder, psychiatric, and post-traumatic complications were excluded.

Sample size was calculated by using the formula OpenEpi version 3,[6] by putting the value of incidence of pregnancy related stroke as 30 in 100,000 as mentioned in an international survey. In addition, an informed consent was taken from patients/attendants.

Clinical record of the subjects was explored for risk factors and chief complaints, and data was noted on a predesigned proforma. They were imaged using at 1.5 Tesla strength (Toshiba 1.5T scanner). Routine departmental imaging protocol of MRI brain was adopted which included T1-weighted (T1W), T2-weighed (T2W) images, gradient recalled echo (GRE), fluid attenuated inversion recovery (FLAIR) and apparent diffusion coefficient (ADC) map (axial, coronal, sagittal). MRV was also performed in all cases. All MRI scans were reviewed by two consultant radiologists having 6 years of experience each.

Data was analysed using SPSS 23. Continuous variables were reported as means ± standard deviation and categorical variables as frequencies/percentages.

Results

There were 60 patients with a mean age 0f 25.85±5.1 years (range: 17-40 years) Of the total, 49(81.7%) patients were postnatal and 11)18.3%) were antenatal (Figure-1A). Risk factors for vascular diseases, like diabetes and high serum cholesterol levels, were found in 5(8.3%) patients (Figure-1B). History of known hypertension (HTN) was found in 1(1.7%) patient, while 24(43.3%) had a history of pregnancy-induced hypertension (PIH) (Figure-1C). Complaints included headache in 4(6.7%) patients, fits in 12(20%) and neurological deficit in 13(21.7%), while 31(51.7%) had mixed complaints (Figure-1D).

Table: Comparison of MRI and MRV findings.

Total		MRV Findings			
		Normal	DST	Hypoplastic sinus	
MRI Findings	Normal	7	0	2	9
	PRES	16	0	4	20
	Infarct	7	1	1	9
	Haemorrhage	2	1	1	4
	Haemorrhagic Infarct	0	17	1	18
Total		32	19	9	60

n = 6.
MRI: Magnetic resonance imaging, MRV: Magnetic resonance venography, DST; Dural sinus thrombosis, PRES: Posterior reversible encephalopathy syndrome.

MRI showed PRES as the highest prevalent neurological complication 20(33.3%), followed by haemorrhagic infarct 18(30%), ischaemic infarct 9(15%), and independent cases of cerebral hemorrage 4(6.7 %), while

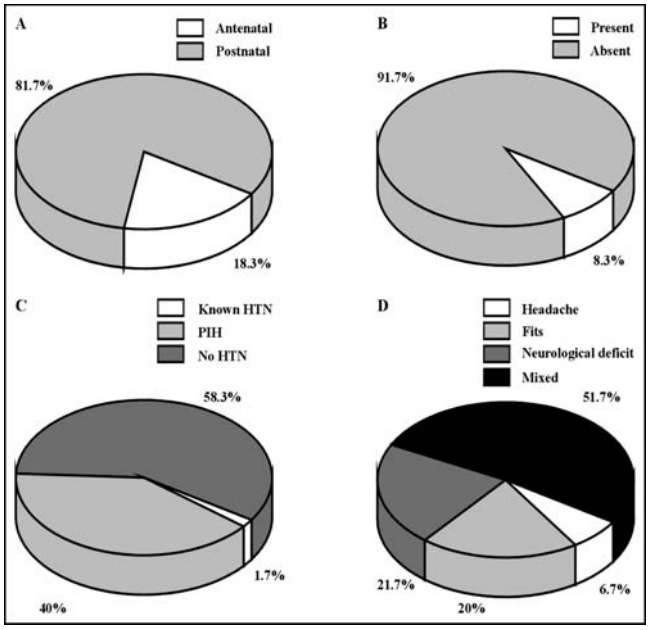

Figure-1: History and assessment criteira of the study sample. 1A: The pregnancy status of patients, demonstarting 83.3% in the postnatal and 16.6% in the antenatal phases. 1B: The risk factor for vascular disease, demonstarting a 91.7% of its absence and 8.3% of presences in the patients included. 1C: History of pre-existing hypertension marking a 43.3% possibility of pregnacy-induced hypertension (PIH). 1D: The complaints of pateints showing a significant (46.6%) component of mixed neurological complaints.

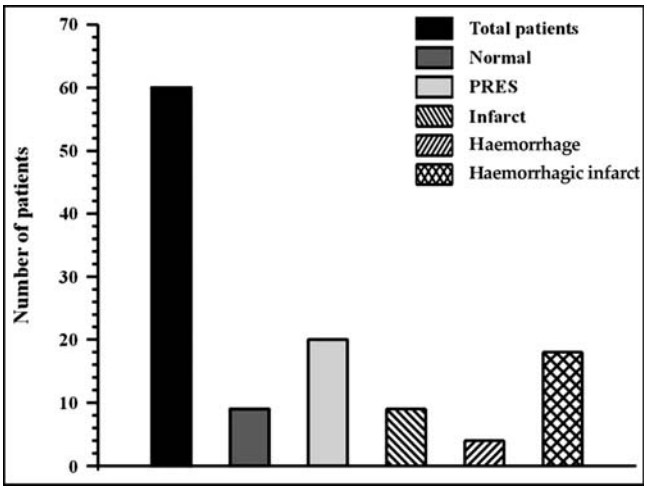

Figure-2: Magnetic resonance imaging (MRI) findings of the neurological condition of patients.

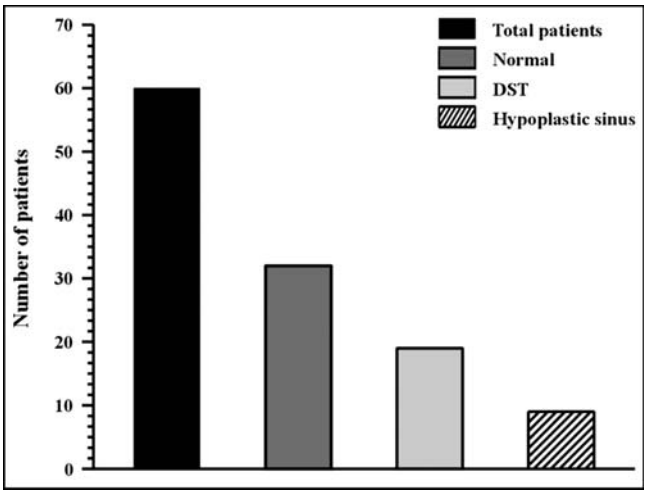

Figure-3: Magnetic resonance venography (MRV) findings of antenatal and postnatal patients. Dural sinus thrombosis (DST) was the second most prevailing neurological condition after posterior reversible encephalopathy syndrome (PRES).

9(15%) patients were normal (Figure-2).

MRV showed that DST accounted for the second most prevalent neurological complication 19(31.7%) after PRES, 9(15%) pateints exhibited hypoplastic sinus, and 32(53.3%) patients were found to be normal (Figure-3).

MRI and MRV findings were compared among patients with various condtions and compaints (Table).

Discussion

In pregnancy, due to a number of physiological and anatomical modulations, the maternal body undergoes many neurological changes.[1] Although awareness about anaemia and sepsis is common, neurological conditions go unnoticed due to their subtle presentation and lack of responsiveness to potential seriousness of common symptoms, like headache.[5] These neurological conditions might occur due to pre-exisiting medical pathologies, such as seizure or multiple sclerosis.[1,2] MRI is the modality of choice for the diagnosis of neurological complications in pregnancy due to being radiation-free and having excellent soft tissue differentiation.[1,2] This not only facilitates highest diagnostic efficiency, but also has no documented hazardous effects on the foetus due to exposure to powerful magnetic fields.[1]

Causes of neurological disorders differ in Asian countries compared to European countries. Although the disease burden is quite high in this region, relatively little is scientifically reported in recent times, and the current study was planned to fill the gap.

MRI is not easily available at diagnostic centres in the country. Moreover, it is costly compared to CT scan, and, as such, majority of patients undergo CT brain for the diagnosis of neurological causes. CT scan has radiation hazards. Moreover, ischaemic changes, as evident in PRES, cannot be easily appreciated on CT scan. CT brain cannot differentiate between oedema of PRES and infarct, while MRI can easily differentiate between the two by DWI sequence. Non-contrast CT brain is therefore often non-diagnostic.[7]

Most of the patients in the current study with neurological symptoms were in their 20s and majority of them (81.7%) were postnatal, which is similar to international studies.[8,9] There was no previously known risk factor in 91.7% patients.

HTN was known in only one patient (1.67%), while 43.33% patients had PIH, and 55% had no HTN history. This signifies PIH as an important factor towards development of neurological symptoms. If it is well controlled, there may be a decrease in the disease burden. This is similar to earlier findings.[10]

Mixed symptoms were found in more than half of patients (51.7%), including headache as well as seizures or neurological deficit. Headache was the sole complaint in only 6.7% patients. This is contrary to the results of a study in which headache was the commonest symptom.[11] This may be a real difference or it may be because of poor socioeconomic status of people in Pakistan or a lack of awareness about potential seriousness of headache keeping people away from seeking radiological examination till there is an obvious neurological complication. In the current study, only 9 out of 60 patients had normal MRI as against reported finding of 49% normal MRI.[11] This again may be because of non-

affordability of MRI for many of the patients.

PRES was the most prevalent neurological condition in the current study, followed by DST. The finding is similar to studies conducted in Asian populations.[12,13] Cerebral venous thrombosis (CVT) is believed to be more common in poor countries than in high-income countries because of the higher frequency of poor nutrition, infections and dehydration.[14]

Haemorrhagic infarct was the third commonest finding in the current study (31.7%). This high rate of haemorrhagic infarct was secondary to high prevalence of DST as most of the cases of haemorrhagic infarct had DST.

PRES presents with many different symptoms like headache, fits, visual abnormalities and altered mental status, and is described by a number of clinical associations. Common predisposing conditions include hypertensive encephalopathy, preeclampsia or eclampsia, renal failure, autoimmune disorders and treatment with immunosuppressant or cytotoxic medications.[10,15,16]

The most common causes of PRES, preeclampsia and eclampsia are described as developing HTN after 20 weeks of gestation and onset of seizures in a patient with preeclampsia, respectively.[10]

The characteristic finding on MRI is diffuse oedema appearing as high signal intensity on T2W images and low signal intensity on T1-WI in the posterior cortex and subcortical white matter, and high signal intensity on FLAIR sequences.[5,16] This commonly involves the parietooccipital regions of the brain.[10]

HTN causes hyper-perfusion, and overcomes the blood-brain barrier, thus allowing extravasation of fluids and development of PRES.[10,16] The treatment for PRES includes correction of blood pressure (BP), hydration and maintaining levels of magnesium in serum.[11,17]

DST can cause potential fatal conditions, such as haemorrhagic stroke, and accounts for 6% of maternal deaths.[18] The typical clinical symptoms are somewhat similar to those of PRES, including headache, fits, focal neurological deficits, high intracranial pressure and haemorrhage.[18,19] A number of predisposing factors contribute to DST development, but pregnant women are at higher risk due to their hypercoagulable state.[20]

The MRI shows high signal intensity in venous sinus, particularly on T1W imaging, and loss of flow void on T2W imaging. The involvement of the dural venous sinuses, their anatomic variants and tributaries of the major cerebral veins can be understood by MRV in addition to MRI.[21]

Administration of anticoagulant drugs, such as heparin and warfarin, are the first therapeutic strategy and can also be used as long-term therapy for an average of 6 months.[16,19] The use of low-molecular-weight heparin is imperative, as it does not cross the placenta. This is critical for the wellbeing of the foetus.[17,19]

Pregnancy is a risk factor for stroke and 60% of all strokes arising during pregnancy are haemorrhagic strokes.[22] Factors contributing to the manifestation of intracranial haemorrhage (ICH) during antenatal and postnatal periods are chronic HTN, PIH, preeclampsia or eclampsia.[23] Cerebral haemorrhage may be the end-stage manifestation of preeclampsia; thus preeclampsia/eclampsia become significant risk factors for cerebral haemorrhage.[24] A study reported that PIH was also associated with a significant increase in the risk of cerebral haemorrhage later in life.[25]

The findings of the present study support the use of MRI in the diagnosis of neurological complications in patients presenting with symptoms like headache and PIH in antenatal and postnatal patients. Strict control of BP in pregnancy as well as in the postnatal period, regular antenatal check-ups and radiological workup of neurological symptoms and headache are essential. Also, the causes of DST should be evaluated in young women so that preventive measures may be taken to reduce the prevalence. Finally, MRI facility should be made available free or at minimal cost at the level of basic health units (BHUs).

Limitation of study

There are a few shortcomings of this study. Sample size taken in this study is quite small. CT scans can be included in the study to compare findings of MRI and CT scans. Moreover, the patients have not been followed so impact of these neurological disorders on pregnancy and foetal outcome cannot be evaluated. Further studies are needed to explore such queries.

Conclusion

PRES and DST were the most prevalent neurological complications in women during antenatal and postnatal period.

Acknowledgement: We are grateful to Dr Rizwan ul Haq for his positive critique of the study and the manuscript.

Disclaimer: None.

Conflict of Interest: None.

Source of Funding: None.

References

1. Jamieson DG, McVige JW. Imaging of neurologic disorders in pregnancy. Neurol Clin 2020;38:37-64. doi: 10.1016/j.ncl.2019.09.001.
2. Jamieson DG, McVige JW. Neuroimaging during pregnancy and the postpartum period. Obstet Gynecol Clin North Am 2021;48:97-129. doi: 10.1016/j.ogc.2020.11.007.
3. Roth J, Deck G. Neurovascular disorders in pregnancy: A review. Obstet Med 2019;12:164-7. doi: 10.1177/1753495X19825699.
4. Zak IT, Dulai HS, Kish KK. Imaging of neurologic disorders associated with pregnancy and the postpartum period. Radiographics 2007;27:95-108. doi: 10.1148/rg.271065046.
5. Wang N, Shen X, Zhang G, Gao B, Lerner A. Cerebrovascular disease in pregnancy and puerperium: perspectives from neuroradiologists. Quant Imaging Med Surg 2021;11:838-851. doi: 10.21037/qims-20-830.
6. Sullivan KM, Dean A, Soe MM: Open Epi: a web based epidemiologic and statistical calculator for public health. Public Health Rep 2009;124:471-4. doi: 10.1177/003335490912400320.
7. Edlow JA, Caplan LR, O'Brien K, Tibbles CD. Diagnosis of acute neurological emergencies in pregnant and post-partum women. Lancet Neurol 2013;12:175–85. doi: 10.1016/S1474-4422(12)70306-X.
8. Zambrano MD, Miller EC. Maternal stroke: an update. Curr Atheroscler Rep 2019;21:33. doi: 10.1007/s11883-019-0798-2.
9. Camargo EC, Feske SK, Singhal AB. Stroke in pregnancy: an update. Neurol Clin 2019; 37:131-48. doi: 10.1016/j.ncl.2018.09.010.
10. Wen Y, Yang B, Huang Q, Liu Y. Posterior reversible encephalopathy syndrome in pregnancy: a retrospective series of 36 patients from Mainland China. Ir J Med Sci. 2017;186:699-705. doi: 10.1007/s11845-017-1567-2.
11. Roy S, Rohatgi R. A Prospective Study of Neurological Disorders during Pregnancy and Puerperium in a Tertiary Care Center. Int J Sci Res 2017;6:2553-5.
12. Sattar W, Jatoi K, Shoukat S. Diagnosis of acute neurologic emergencies in pregnant and postpartum women using MRI as robust diagnostic tool, experience from a public sector tertiary care hospital. Pak J Rad 2017;27:294-298.
13. Gul P, Rehan B, Anwar S, Aziz MU. Radiological findings in peri-partum neurological emergencies: experience from a tertiary care hospital. Pak J Neurol Sci 2014;9:27-30.
14. Wasay M, Kaul S, Menon B, Dai A, Saadatnia M, Malik A, et al. Asian study of cerebral venous thrombosis. J Stroke Cerebrovasc Dis 2019;28:104247. doi: 10.1016/j.jstrokecerebrovasdis.2019.06.005.
15. Parasher A, Jhamb R. Posterior reversible encephalopathy syndrome (PRES): presentation, diagnosis and treatment. Postgrad Med J 2020;96:623-8. doi: 10.1136/postgradmedj-2020-137706.
16. Fischer M, Schmutzhard E. Posterior reversible encephalopathy syndrome. J Neurol 2017;264:1608-16. doi: 10.1007/s00415-016-8377-8.
17. Marcoccia E, Piccioni MG, Schiavi MC, Colagiovanni V, Zannini I, Musella A, et al. Postpartum posterior reversible encephalopathy syndrome (PRES): three case reports and literature review. Case Rep Obstet Gynecol 2019;2019:e9527632. doi: 10.1155/2019/9527632.
18. Ferro JM, Aguiar de Sousa D. Cerebral venous thrombosis: an update. Curr Neurol Neurosci Rep 2019;19:74. doi: 10.1007/s11910-019-0988-x.
19. Bousser M, Ferro J. Cerebral venous thrombosis: an update. Lancet Neurol 2007; 6:162-70. doi: 10.1016/S1474-4422(07)70029-7.
20. Roeder HJ, Lopez JR, Miller EC. Ischemic stroke and cerebral venous sinus thrombosis in pregnancy. Handb Clin Neurol 2020;172:3-31. doi: 10.1016/B978-0-444-64240-0.00001-5
21. Bonneville F. Imaging of cerebral venous thrombosis. Diagn Interv Imaging 2014; 95:1145-50. doi: 10.1016/j.diii.2014.10.006.
22. Aoyama K, Ray JG. Pregnancy and risk of intracerebral hemorrhage. JAMA Network Open 2020; 3:e202844.
23. Meeks JR, Bambhroliya AB, Alex KM, Sheth SA, Savitz SI, Miller EC, et al. Association of primary intracerebral hemorrhage with pregnancy and the postpartum period. JAMA Netw Open 2020;3:e202769. doi: 10.1001/jamanetworkopen.2020.2844.
24. Liang Z, Lin L, Gao W, Feng L. A clinical characteristic analysis of pregnancy-associated intracranial haemorrhage in China. Sci Rep 2015;5:9509. doi: 10.1038/srep09509.
25. Lin L, Tsui K, Cheng J, Cheng J, Huang W, Liou W, Tang P. Increased risk of intracranial hemorrhage in patients with pregnancy-induced hypertension. Medicine (Baltimore) 2016;95:e3732. doi: 10.1097/MD.0000000000003732.