

Original research article

Magnetic Resonance Imaging in Neurological Disorders in the Postpartum Period

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Abstract

Background: Pregnancy and puerperium is a critical period where many physiological changes take place involving various systems. These changes can result in neurological and hemodynamic disturbances and may sometimes lead to serious adverse effects if prompt treatment is not undertaken.

Material and methods: Fifty post partum patients with clinical suspicion of neurological disorders referred to the Department of Medicine, AIIMS, New Delhi, from August 2019 to June 2022 underwent MRI of brain. The main source of data for the study were patients from All India institute of medical sciences, New Delhi.

Conclusion: MRI was found to be a key modality to evaluate various neurological disorders and to arrive at an accurate diagnosis. Characterization of the lesions and awareness of the common diseases during puerperium will help the clinician arrive at an informed differential diagnosis. MRI is a non-invasive imaging modality with no radiation hazard, excellent resolution and multiplanar imaging capability.

Keywords: posterior reversible encephalopathy syndrome, cerebral venous thrombosis, neurological disorders, magnetic resonance imaging.

Introduction

Pregnancy and puerperium is a period where many physiological changes involving hemodynamic, coagulation and endocrine system occur. These changes may sometimes lead to adverse effects. A series of neurological disorders may also occur during pregnancy and puerperium that are either unique to or occur with increased frequency during and just after pregnancy.¹ Evaluation of postpartum neurological pathologies is a diagnostic challenge. The common neurological disorders encountered during puerperium include eclamptic encephalopathy, ischemic stroke, cerebral venous thrombosis, intracranial haemorrhage, postpartum cerebral angiopathy and pituitary disorders like pituitary apoplexy, Sheehan syndrome and lymphocytic adenohypophysitis.² Usually when puerperal women face any abnormal symptom, these are considered to be a part of pregnancy and ignored. Symptoms and signs are non-specific and it can be difficult to diagnose based on clinical grounds alone. Some diseases such as cerebral venous thrombosis present with non-specific complaints such as headache. However, headache is a common complaint during this period and it is usually

treated as a benign headache until serious neurological complications develop.³ The advent of Magnetic Resonance Imaging (MRI) has proved to be a boon in early and non-invasive diagnosis of pregnancy related neurological complications. Magnetic resonance imaging helps in recognition of the characteristic imaging findings of various neurological symptoms.⁴ Even when imaging changes are less specific, knowledge of likely possibilities will lead to a more informed differential diagnosis to be made.² By knowing the prevalence and spectrum of neurological complications affecting our population, early appropriate treatment can be initiated thus improving maternal outcome.

Objectives

To evaluate the neurological disorders that occur during the puerperal period using magnetic resonance imaging, To identify the imaging features that characterise each of these disorders and correlate with clinical picture

Review of Literature

Puerperium is defined as the time from delivery of placenta to the first 6 weeks after delivery. It is the period immediately after delivery when the anatomic and physiologic changes of pregnancy are reversed, and the body returns to the normal and nonpregnant state. The postpartum period has been divided arbitrarily into - a) the immediate puerperium or the first 24 hours after parturition, b) the early puerperium, which extends until the first week after delivery and c) the remote puerperium, which is approximately 6 weeks.⁵ A range of physiologic, hemodynamic, hormonal and immunological variations occur in the maternal body during pregnancy.⁶ These affect all the systems in the body to adapt to the stresses related to pregnancy and include the central and peripheral nervous systems. Most of the neurologic signs and symptoms seen in post partum patients may be due to the physiologic changes that are taking place. However, many other primary and secondary neurological conditions may occur which are important to diagnose at an early stage. These include exacerbation of a preexisting medical condition such as multiple sclerosis or a seizure disorder or the initial manifestation of a primary central nervous system related problem, brain neoplasm, or acute ischemic stroke; or a neurologic problem unique to pregnancy and the postpartum period itself, such as eclampsia, postpartum cerebral angiopathy, Sheehan syndrome, and lymphocytic adenohypophysitis.⁷ The symptoms of these conditions are either nonspecific or overlap and it can be a challenge to arrive at a diagnosis clinically. Discrepant increase in plasma volume (40–50%) and red cell mass (20%) occurs during pregnancy which results in physiological anaemia of pregnancy. A lower haematocrit decreases the blood viscosity and lowers the resistance to blood flow in placental circulation. The leukocyte count also increases to around 15,000/mm³ of which a major contribution is by polymorphonuclear cells.⁸ An increased production of platelets occurs but due to enhanced destruction and haemodilution, rise in platelet count does not occur. In a minority of patients, platelet count decreases (90,000–100,000) which is physiological and termed as gestational thrombocytopenia which usually resolves in the postpartum period.⁹ Post-partum primary headache disorders are common; in a study by CL Stella et al, out of 95 patients with severe postpartum headache, 37 (39%) had tension-type, 23 (24%) had pre-eclampsia or eclampsia, 15 (16%) postdural puncture headache, 10 (11%) had migraine, three each (3%) had pituitary haemorrhage or venous sinus thrombosis and two (1%) had mass lesions.¹⁰ The infarct core shows reduction in both CBV and CBF and an increased MTT, therefore it appears as dark blue/ purple/ black on CBV and CBF maps and red on MTT maps. The ischemic penumbra, which is potentially salvageable tissue, shows reduced CBF with normal or increased CBV and increased MTT. So CBV minus CBF is equivalent to potentially salvageable brain tissue.^{11,12} They found that eclamptic encephalopathy comprised of 21% of the cases, cerebral venous thrombosis 15%, PRES 11%,

ischemic stroke 8%, subarachnoid haemorrhage 4%, pituitary apoplexy 3% and pituitary adenoma 1% of the cases. An observational study was conducted by Gupta S et al. in Lady Harding Medical College between February 2004 and January 2005 on 76 pregnant and puerperal patients. They found that 60% of the patients had primary neurological disorders. Of the primary disorders 47% cases were of eclamptic encephalopathy, 26% were of CNS infections, 19.5% had cerebral venous thrombosis, 6% had arterial infarctions and 2% had cerebral haemorrhage. MR imaging, when available, remains the modality of choice for imaging pregnant women—mainly because it involves no radiation exposure and enables excellent soft-tissue differentiation and thus has better diagnostic accuracy. Relatively recent data suggest that MR imaging performed by using a 1.5-T magnet is safe for performing imaging in pregnant women during any trimester.¹³ This is same as that of spin-echo sequences, except that the echo is produced by a gradient (rather than an RF pulse), causing the components of the spin magnetization to refocus in the x-y plane. This results in production of an echo, without ‘flipping’ them over (i.e. without using a 180-degree pulse). Unlike spin-echo sequences, reduction in signal amplitude due to faster dephasing as a result of presence of magnetic susceptibility differences/localized heterogeneity is not cancelled in this technique.

Material and methods

A prospective study of 50 patients presenting to Department of medicine, at All India institute of medical sciences, New Delhi. August 2019 To June 2022 were subjected to MRI examination of brain.

Study design: Cross sectional descriptive study.

Inclusion criteria

Patients presenting within 6 weeks of delivery (postpartum period) with recent onset neurological symptoms like: Headache –Rapidly increasing headache intensity or frequency, headaches associated with seizures, sudden onset of headache thunder-clap type or sudden onset unilateral headache. Seizures – Generalised tonic – clonic type, complex seizures or focal seizures. Sensory or motor deficit – loss of sensation or motor control over various parts of body Altered sensorium – alteration in consciousness assessed by awake, verbal response, response to pain and unresponsiveness (AVPU) scale and Glasgow Coma scale (GCS). Blurring of vision or loss of vision.

Exclusion Criteria

General contraindications to MRI such as pacemakers, aneurysmal clips, cochlear implants and metallic implants or metallic foreign bodies etc. Patients with pre-existing seizure disorder or epilepsy, Claustrophobic patients, Contraindications for use of contrast agents.

The patients selected for the study were puerperal patients with history of neurological complications referred to the Department of medicine for imaging. Patients were interviewed and relevant clinical data was collected. Based on the history and examination, a clinical diagnosis was made. All patients were screened before entry into the MRI scanning room for ferromagnetic objects, cardiac pacemakers, aneurysm clips etc. Patients were examined in the supine position on the MRI machine after proper positioning, and immobilization of the head was obtained. The head coil was used for the scan. Initial topogram of the head was obtained and sequences were planned.

Sample size calculation is:

$$n = (Z_{\alpha/2})^2 \times P(1-P) / d^2$$

Where, n - Sample size, $Z_{\alpha/2}$ – Standard value = 1.96 with $\alpha = 0.05$ (95% confidence interval), P – Prevalence (or proportion in a population), d – Maximum marginal error

$n = (1.96)^2 \times 0.012 (1-0.012)^2$ at $P = 12$ per 100,000 patients; $P = 0.012$, $d = 3\%$ error
 $(0.03)^2$

$n = (1.96)^2 \times 0.012 (1-0.012)^2 = 49.99$, approximately 50 patients.

Results

Table1: Age distribution of subjects in the study

		No.	%
Age	<20 years	5	10.0%
	21 to 25 years	13	26.0%
	26 to 30 years	21	42.0%
	31 to 35 years	7	14.0%
	>35 years	4	8.0%
	Total	50	100.0%

In the study majority of subjects were in the age group 26 to 30 years (42%), 26% were in the age group 21 to 25 years and others.

Table 2: Postpartum day distribution among subjects

		No.	%
Postpartum day	<48 hrs	8	16.0%
	2 to 7 days	29	58.0%
	1 to 2 weeks	4	8.0%
	>2 weeks	9	18.0%
	Total	50	100.0%

In the study duration, most of the patients presented between 2-7 days post-partum and majority within one week post-partum

Table 3: Parity distribution among subjects

		No.	%
Parity	Primigravida	25	50.0%
	Multipara	25	50.0%
	Total	50	100.0%

In the study 50% were Primigravida and 50% were multipara.

In the study 76% had headache, 58% had vomiting, 44% had seizures, 6% had left hemiparesis, 8% had right hemiparesis, 14% had GCS ≤ 10 , 6% had Focal neurological deficits, 4% had visual changes and 2% had fever and hallucination respectively. The most common symptom that patients presented with was headache, followed by seizures, hemiparesis and focal neurological deficits

Table 4: MR Angiogram findings distribution

		No.	%

MR Angiogram	Abnormal	1	2.0%
	No abnormality	49	98.0%

MR TOF angiogram was found to be abnormal only in one case of infarct in the left anterior cerebral artery and middle cerebral artery territory, which showed reduced calibre of the left internal carotid artery and non-visualisation of the anterior cerebral and middle cerebral arteries on the left side. Intraparenchymal hematoma was seen in one case in the gangliocapsular region which was iso- hypointense on T1 WI and hypointense on T2 WI with hyperintense rim on FLAIR image. DWI showed peripheral rim of restricted diffusion. Blooming was seen on SWI. No enhancement was seen on T1 W post contrast images. Tuberculomas was diagnosed in one case which showed multiple T1 hypointense, T2 hypo to isointense lesions with few showing hyperintense centre and FLAIR hyperintense lesions in bilateral frontal, occipital and parietal lobes, basal ganglia and thalami. The lesions showed extensive perilesional oedema on T2W/FLAIR images. The lesions did not show diffusionrestriction on DWI or blooming on SWI. On post contrast T1WI, lesions showed peripheral ring enhancement. Mesial temporal sclerosis was seen in one case as decreased volume of bilateral hippocampi (right>left) with loss of interdigitations. T2/FLAIR hyperintense signal was seen in bilateral hippocampi. Temporal horns of bilateral lateral ventricles appeared prominent (right>left). Right mammillary body was atrophied. No diffusion restriction or blooming was seen in the structures mentioned. Meningioma was seen as a well defined extra-axial dural based lesion along left fronto-parietal convexity. Lesion was T1 hypointense, T2/FLAIR hyperintense showing mild diffusion restriction on DWI. No foci of blooming was seen within on SWI. On T1 W post contrast image, significant homogenous enhancement was seen with presence of enhancing dural tail. Neurocysticercosis was diagnosed in one case which showed two well defined T1 hypointense and T2/FLAIR hyperintense lesions in bilateral parietal lobes. One of the lesions in right parietal lobe showed a hypointense focus within on T2WI which was suggestive of scolex.. The lesion in left parietal lobe showed focus of diffusion restriction on DWI and significant perilesional edema was seen on T2 W/ FLAIR images. Most of the patients presented in the first one week after delivery. Patients with PRES presented predominantly within the first 48 hours. No significant correlation was found between the diagnosis and the time of presentation.

Discussion

The patients belonged to reproductive age group ranging from 18 to 40 years. The majority of the patients (about 42%) belonged in the age group ranging from 26 to 30 years. 58 % of the patients presented between 2nd to 7th post-partum day. A study by TJ Mathews et al and Hosley MD et al showed that increasing age of pregnancy (24.6 to 27.2) in past 30 years has led to increase in complications associated with pregnancy.¹⁴ Out of fifty test subjects in the study, 44% were found to be normal and 56% had findings on MR imaging. Study conducted by Chandrashekeran et al showed 41.6% of patients to have findings among the study group which was similar to our study¹⁵. Study conducted by Mugadeeswaran et al showed Eclamptic encephalopathy to be 21% of cases, 15% was cerebral venous thrombosis, 8% was ischemic stroke, 4% was subarachnoid haemorrhage, 3% was pituitary apoplexy and 1% of cases were pituitary apoplexy. An MRI study by Kavthale S et al. involving 40 postpartum patients found that posterior reversible encephalopathy syndrome (PRES) was the most common condition with 60% patients showing its features, followed by cerebral venous thrombosis (CVT) seen in 25% of patients. Present study showed PRES to be most common finding and represented 22% of the cases. Most common clinical diagnosis made was that of intracranial haemorrhage followed by cerebrovascular accident. PRES was associated with infarct in 4% of the cases and

haemorrhage in 4% of the cases. Study by Kavthale et al found 24% of patients to have PRES, where 16.6% had infarct and 4.1% had subarachnoid haemorrhage. Cerebral venous thrombosis was seen in 10% of the cases in our study. Among the dural sinuses involved, most commonly thrombosed was the superior sagittal sinus (60%) followed by transverse and sigmoid sinus (20% each). Study by Chandrashekar et al found cerebral venous thrombosis to be the most common neurological complication of post-partum period at 29.1% of the cases. Sagittal sinus was involved 45.7% of the time followed by transverse sinus (25.7%), sigmoid sinus (17.1%) and straight sinus (11.4%). Kavthale et al found cerebral venous thrombosis in 24% of the patients in the study, out of which superior sagittal sinus was the commonest to be involved (70%) followed by the transverse sinus (60%). The most common clinical symptom associated with CVT in our study was headache, seen in 100% of the cases and associated with vomiting and seizures in 60% of the cases. This was similar to a study conducted by Naveen Thota et al in Journal of Evidence Based Medicine and Health care, where most common symptom was headache (43%) followed by papilloedema. Our study showed cerebral venous thrombosis to be associated with T2/FLAIR hyperintense lesion which indicated venous infarct. None of the cases showed diffusion restriction indicating that they were secondary to vasogenic oedema. Blooming was seen in one of the cases indicating haemorrhagic transformation. Study done by Naveen Thota et al showed haemorrhagic infarct in 50% of the cases. Restricted diffusion was seen in 18% of the cases. No parenchymal lesion was found in 18% of the patients.¹⁶

Table 5: Parenchymal abnormality in CVT in present study vs literature

Imaging findings	Present study (n=5)	Naveen Thota et al (n=50)
Lobar haemorrhage	10%	50%
Restricted diffusion	0%	18%

Our study showed infarcts in 12% of the cases. Out of these 28.6% showed haemorrhagic transformation. A study done by Skidmore et al found 58.3% had ischemic stroke, 30.5% had haemorrhagic stroke and 11.1% patients had venous infarcts.¹⁷

Table 6: Comparison between incidence of ischemic vs haemorrhagic stroke in present study and literature

Imaging findings	Present study (n=6)	Skidmore et al (n=40)
Ischemic stroke	71.4%	58.3%
Haemorrhagic stroke	28.6%	30.5%

Conclusion

MRI is an excellent modality for detection of pathology and characterisation of the neurological disorders in the post partum period. Posterior reversible encephalopathy syndrome was the most common disorder seen, followed by infarcts and cerebral venous thrombosis. MRI was helpful in describing the features and to diagnose various conditions.

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