

Radiological Evaluation of Neurological Disorders in Pregnancy and Postpartum

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1. Introduction

The use of radiologic examinations in pregnant patients has increased by 107% during the past decade (Lazarus E *et al.*, 2009). Magnetic resonance (MR) imaging and computed tomography (CT) to a lesser extent have become the primary “workhorses” used to assess neurologic conditions in pregnancy. The effective incorporation of CT and MRI into evaluation algorithms facilitates maximal diagnostic efficiency while minimizing potential risks to the mother and fetus. With the use of the ALARA (as low as reasonably achievable) principle, CT can be used safely to evaluate the mother’s head and neck during pregnancy. During CT of the head and neck, the fetus is excluded from the scanning field, and thus its radiation exposure is limited to a very low scattered dose (American College of Radiology Guidelines, 2008).

CT is commonly used to diagnose acute neurologic conditions, especially in cases of trauma and suspected hemorrhage. MR imaging does not involve radiation exposure and enables excellent soft-tissue differentiation, it has better diagnostic accuracy and is considered the modality of choice for imaging in pregnant women (Tremblay E *et al.*, 2012).

MR imaging performed by using a 1.5 tesla magnet is safe for women during any trimester of pregnancy (De Wilde JP *et al.*, 2005). Intravenously administered contrast material, whether iodinated or gadolinium-based, should be used judiciously, and its use is recommended only for those cases in which it is essential for the diagnosis.

2. Material and Methods

The present study “was undertaken in the department of Radiodiagnosis and Imaging on 50 patients referred to our department for CT and MRI.

Techniques:

Antenatal period: MR imaging only

Postnatal period: CT and MR imaging

- Relevant history of the patient was obtained based on an expert’s opinion

CT imaging during the postnatal period:

- Non-contrast CT imaging of the head with dual slice CT scanner machine (SIEMENS SOMATOM Spirit Dual Slice CT Scanner).
- Post intravenous contrast-enhanced CT study of the head (if it was indicated)

Contrast dose – 1 ml / kg, iodinated contrast.

Image acquired in the parenchymal phase as routine.

Parameters

Slice thickness = 5mm.

Pitch factor = 1.

Reconstruction interval

- Infratentorial compartment 5 mm.
- Supratentorial compartment 5 mm to 7 mm.

MR imaging during both antenatal and postnatal periods

- Magnetic resonance imaging of the brain with 1.5 tesla (Siemens, Symphony).

Routine Protocol:

T1 weighted imaging - Sagittal, axial

T2 weighted imaging - Axial,

Fluid attenuated inversion – Axial, coronal,

Gradient echo images - Axial,

Diffusion-weighted images and apparent diffusion coefficient - Axial.

MR arteriogram and venogram

Contrast dose – 0.2ml/kg (0.1mmol/ kg).

3. Observations and Result

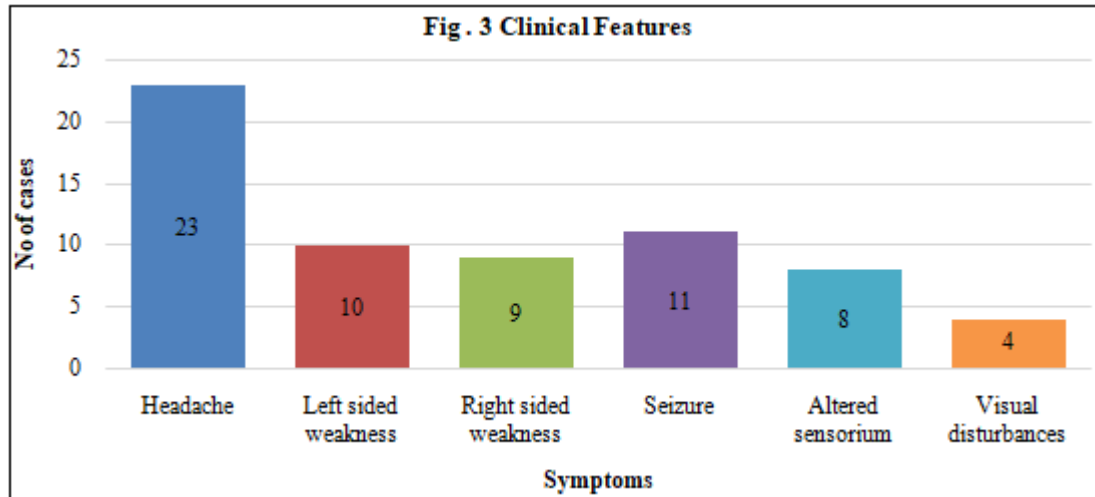
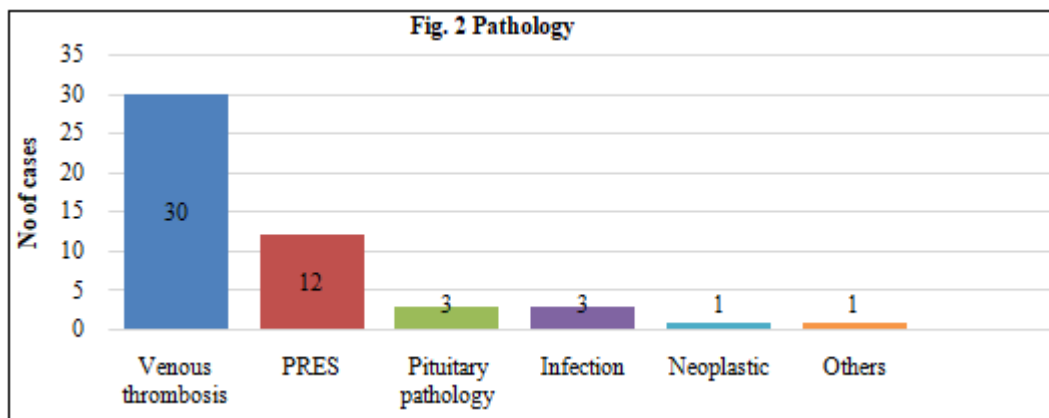
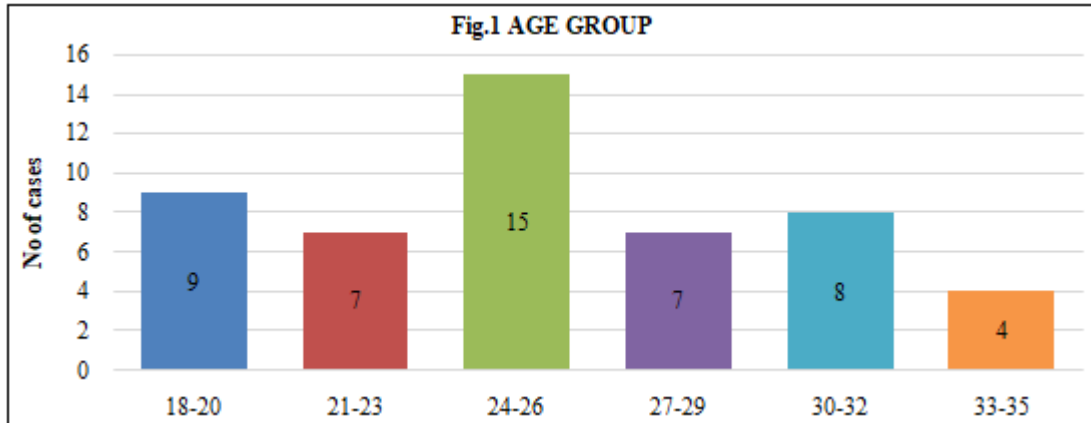
In the present study, the age of the patients ranged from 18 years to 35 years. The majority of the patients were in the age group of 24 years to 26 years (30%).

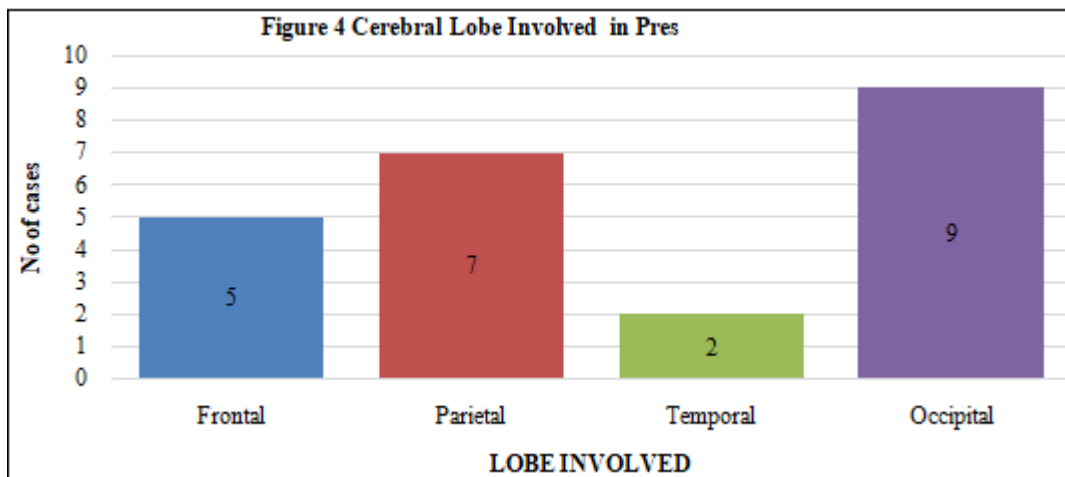
In our study, the most common presentation was headache (n=23) followed by unilateral weakness (n=19), seizure (n=11), altered sensorium (n=8) and visual disturbances(n=4).

Venous thrombosis predominated the study. With 60% of the study population showing evidence of CVT.24% population had PRES, 6% had pituitary pathology, 6% had infections, while the rest had neoplastic or other pathologies 2% each. The majority of patients in our study were multigravida (62%).The vast majority of patients in our study population belonged to the postpartum group (92%). Antepartum cases made a very small fraction of the studied patients. Most of the patients in our study group presented during the first week of postpartum, with the highest frequency being on the 4th day of postpartum.

Most cases of venous thrombosis were related to thrombosis of a dural sinus with only 23% having isolated cortical vein thrombosis. Superior sagittal sinus was most commonly involved sinus in cases of cerebral venous thrombosis (n=13) followed by transverse sinus (n=15) and sigmoid sinus (n=11). The majority of cases of venous thrombosis (83%) were associated with the hemorrhage. In PRES the most common lobe involved was Occipital lobe followed by parietal lobe. Among patients with pituitary pathology, one

had apoplexy, Sheehan syndrome and lymphocytic hypophysitis each.





4. Discussion

Pregnancy creates alterations in maternal physiology which predispose to unique neurologic disorders. Pre-eclampsia, eclampsia, certain types of ischemic and hemorrhagic stroke, reversible cerebral vasoconstriction syndrome, posterior reversible encephalopathy syndrome, and thunderclap headache all appear to share a common origin from vascular endothelial dysfunction, with overlapping clinical presentations.

Cerebral Venous Thrombosis

Cerebral venous thrombosis (CVT) refers to the occlusion of venous channels in the cranial cavity, including dural venous thrombosis, cortical vein thrombosis, and deep cerebral vein thrombosis.

Cerebral venous thrombosis was the most common finding among our study population of pregnant and postpartum women with neurological symptoms that were referred to our department. In the general population, CVT is a rare diagnosis, but it is one of the most common cerebrovascular complications in pregnancy, affecting 11.6 per 100,000 deliveries **Saposnik G et al., (2011)**. Headache was the most common symptom in our patients with CVT. **Zhou Q et al., (2010)** noted similar findings among 24 CVT cases of whom 22 (92%) suffered from a headache. Superior sagittal sinus was the most common sinus involved in this study in patients with CVT. This is similar to a study done by **Kashkoush AI et al., (2017)** which noted that involvement of the superior sagittal sinus in 67% of cases, the transverse/sigmoid in 64%, and of the deep venous system in 15% of cases.

Most of the cases presented between the 3rd and 5th-day postpartum in our study. Similar findings were noted by **Kashkoush AI et al., (2017)** where the mean day of presentation was 5.9 days. Also in a study by **Bansal BC et al., (1980)** signs and symptoms appeared in most of the cases (72 cases) during the first 7 days of the postpartum period.

In our study patients ranged from 18 to 35 years of age with most falling between the ages of 21-29. This is similar to the study group of **Demir CF et al., (2013)** where the mean age was 27.5 years.

The majority of patients in our study were multiparous (62%). **Bansal BC et al., (1980)** in their study also noted that the majority of the patient (111) from their pool of 136 cases were multiparous.

Cortical vein thrombosis was found in 23% of cases with venous thrombosis. **Ferro JM et al., (2004)** in a multicenter, multi-country study reported similarly that ~10.9% of patients with CVT exhibit deep venous system involvement, 17.1% exhibit cortical vein involvement

Hemorrhage was seen in 87 % of the cerebral venous thrombosis cases in our study.

Five stages of evolution of hematoma can be recognized using MRI characteristics on T1 & T2 weighted images. They are

- 1) Hyperacute - <24 hrs
- 2) Acute - 1 to 3 days
- 3) Early subacute - 3 to 7 days
- 4) Late subacute - 7 to 14 days
- 5) Chronic - > 14 days

Dural sinus thrombosis was the far more common (77%) cause of cerebral venous thrombosis in our study. While a minority of cases (23%) had isolated cortical vein thrombosis.

Posterior Reversible Encephalopathy Syndrome

PRES is a clinico radiological diagnosis. The severity of clinical presentations varies among cases. MR and CT findings will also vary among the cases according to the severity. Common symptoms of PRES are altered sensorium, seizures, severe headache, blurred vision, vomiting, and focal neurological deficit. Posterior reversible encephalopathy syndrome was the second most common neurological disease in our study population (n=12).

The most common area of involvement in PRES was the occipital area of the brain in our study. **Fugate JE et al., (2010)** in the review of 115 cases (109 patients) for which magnetic resonance imaging findings were available, found that the parieto-occipital regions were the most commonly involved (n=108 [94%]).

There are usually four types of radiological presentation of PRES

1) Holohemispheric watershed pattern.

Vasogenic edema in parieto occipital and frontal lobe white matter. Temporal involvement is rare in this type of presentation. This was seen in three of our patient

2) Superior frontal sulcus involvement pattern

Mainly edema occurs in the superior frontal sulcus of frontal lobes. This was seen in two of our patient

3) Predominant parieto occipital involvement

Mild to severe edema in the posteriormost parts of the parietal and occipital lobe. This was seen in five of our patients

4) Asymmetric presentation of the primary pattern

There will not be any edema in the parietal or occipital lobes. Common involvement in the frontal lobe. The unilateral presentation can also occur. This was seen in two of our patients

Mean systolic blood pressure in cases of PRES in our study was 157 mm Hg. **Hossain N et al., (2015)** identified Thirty-four women, with eclampsia. Neuroimaging was done in 22 women. Posterior reversible encephalopathy syndrome was recognized in 9 (22) patients. The mean systolic blood pressure was 161(\pm 11) mm Hg, and the mean diastolic blood pressure was 111(\pm 10) mm Hg.

The most common symptom among patients with PRES was a seizure in our study. **Fugate JE et al., (2010)** in their study had a clinical presentation of seizures in 74 % (n=84) cases.

Unilateral PRES is an uncommon finding and was found only in one patient in our study. **Lee VH et al., (2008)** also had a low incidence of unilateral lesions among the PRES cases amounting to 5%.

All the PRES cases which were seen in this study period eventually recovered completely.

Pituitary Apoplexy

Pituitary apoplexy is defined as acute hemorrhagic infarction in an existing pituitary adenoma or otherwise physiologically enlarging pituitary gland. There is a predominant insufficiency of the adrenal hormones. Pituitary apoplexy is a rare condition during pregnancy that manifests with clinical features that include severe headache, vomiting, and visual disturbances including visual field defects and restricted eye movements.

In our study, one case of pituitary apoplexy was seen. Magnetic resonance imaging (MRI), consisting of a T2-weighted image in the axial plane and a T1-weighted image in the midsagittal plane, revealed an intrasellar mass with suprasellar extension and fluid levels denoted recent bleeding into the macroadenoma. These findings are the hallmark of pituitary-tumor apoplexy. Intrasellar hemorrhage may not be visualized on imaging in some patients with pituitary apoplexy.

Sheehan Syndrome

Sheehan syndrome also called Simmond syndrome is due to ischemic necrosis of the pituitary gland. It is a clinical state

of panhypopituitarism that ensues following pituitary infarction. The anterior pituitary gland has a distinctive circulation in the form of a low-pressure portal venous system. During pregnancy, there is a diffuse and nodular enlargement of the lactotrophs of the anterior pituitary under the influence of estrogen secreted by the placenta.

Nevertheless, there is no compensatory increase in the blood supply. So the anterior pituitary gland is much vulnerable to a hemorrhagic episode attributing to ischemia and necrosis. The posterior pituitary is mostly not involved due to its direct blood supply. Due to deficiency of pituitary hormones, depending on the extent of tissue destruction patients eventually present with chronic fatigue, dizziness, postural hypotension, cold intolerance, hypopigmentation, myxedema, loss of pubic and axillary hair, decreased libido, breast atrophy, and amenorrhea.

The case encountered in our study presented with inability to lactate, cold intolerance, chronic fatigue. On Mri imaging of the brain revealed empty sella of normal size. Combined with clinical features and imaging findings diagnosis of Sheehan syndrome was made.

Lymphocytic Adenohypophysitis

Lymphocytic hypophysitis was first described by Goudie and Pinkerton in 1962. **Gagneja H et al., (1999)** One hundred and fifty-two cases have been reported and there is a marked female predilection, with 129 cases described in women of which 55% were related to pregnancy. It is thought to be an autoimmune disease, with humoral and cell-mediated components destroying the pituitary gland. The autoimmune process is generally confined to the anterior pituitary and leads to hypopituitarism and a pituitary mass.

Case encountered in our study showed evidence of normal pituitary gland on MRI with thickened enhancing infundibulum. Post-contrast T1 weighted images showed homogenous enhancement of the pituitary and thickened infundibulum.

Primary Intracranial Tumors

Pregnancy augments the growth of meningioma. About 70% of meningiomas have progesterone receptors and 30% have estrogen receptors. Serial imaging reveals that the size of the meningiomas deteriorates after delivery. One patient was diagnosed with glioma for the first time during pregnancy. The patient had a heterogeneous T2/FLAIR hyperintense mass in the right frontotemporal region, which showed irregular peripheral enhancement with elevated Choline to NAA ratio and decreased NAA, suggestive of likely high-grade glioma.

Multiple Sclerosis (MS)

One patient was diagnosed with multiple sclerosis. The patient was 32 Years of age and presented with tiredness, urinary dysfunction, and lower limbs paraparesis. Ct scan did not show any abnormality. Subsequently MRI brain with the spine was performed. which showed there were lesions in the brain and spinal cord. The lesion in the brain was seen in deep white matter, callososeptal interface, and the

lesions in the spinal cord were short segments and involving less than two-thirds of the circumference of the cord.

Multiple sclerosis is a neuroinflammatory disorder that involves a defective myelination process. The disease may manifest with both motor and sensory deficits, loss of coordination, altered sensation visual symptoms that include double vision and nystagmus. The first and second trimesters seem to be more susceptible phases for relapse. When there is an episode of relapse of multiple sclerosis in pregnancy, they present with tiredness, restless legs, and urinary dysfunction.

5. Conclusion

From our study, it could be concluded that CT and MRI are effective imaging modalities in the diagnosis of various pathologies associated with neurological symptoms in pregnancy and postpartum. Early diagnosis of these conditions has a positive effect on the management of many patients as they help in early and in most cases definitive diagnosis in patients with pregnancy and postpartum related neurological symptoms.