Afebrile Postpartum Encephalopathy: Towards An Imaging Algorithm

Poster No.: C-2454
Congress: ECR 2015
Type: Scientific Exhibit
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Keywords: Ischaemia / Infarction, Haemorrhage, Embolism / Thrombosis, Thrombolysis, Imaging sequences, Contrast agent-other, MR-Angiography, MR, CT, Neuroradiology brain
DOI: 10.1594/ecr2015/C-2454

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Aims and objectives

AIMS AND OBJECTIVES:

• To evaluate the clinical and imaging features of patients presenting with afebrile encephalopathy in the postpartum period.
• To formulate an imaging algorithm for such patients to help diagnose and distinguish the most common conditions presenting with afebrile postpartum encephalopathy.
Methods and materials

METHODS AND MATERIALS:

- Retrospective study of patients who presented with afebrile postpartum encephalopathy to a tertiary care centre between November 2009 and November 2014.
- Imaging, relevant clinical data and follow up (if available) of patients with a diagnosis of posterior reversible encephalopathy syndrome (PRES), reversible cerebral vasoconstriction syndrome (RCVS) and cerebral venous thrombosis (CVT) were tabulated and analysed.
- Clinical evaluation: We reviewed the inpatient and outpatient records of patients in the study cohort and documented the salient clinical features (viz. headache, seizures, focal neurological deficits (FND) etc). Blood pressures (BP) at presentation and during the course of hospital stay were tabulated.
- Imaging evaluation: MRI and other imaging modalities including CT and Doppler were evaluated and categorisation of patients was done into broad groups of cerebral venous thrombosis (CVT), posterior reversible encephalopathy syndrome (PRES) and reversible cerebral vasoconstriction syndrome (RCVS).
- PRES: Lesion distribution, imaging patterns, associated complications and MR angiography (if available) were looked at.
- CVT: Distribution of thrombosed venous sinuses, predominant side of involvement, cortical venous involvement, stage of thrombosis - acute (swelling, isointense on T1 and hypointense on T2) and subacute (swelling, hyperintense on T1), presence of venous infarcts (hemorrhagic or non hemorrhagic), associated complications and features of raised ICT (if any) were tabulated.
- We prepared an imaging algorithm to aid in ordering relevant and appropriate imaging modality and sequences to diagnose and distinguish conditions presenting with afebrile postpartum encephalopathy.
RESULTS:

- The study cohort consisted of 70 patients with 33 (47%) cases of PRES, 4 (6%) cases of RCVS and 33 (47%) cases of CVT (Fig. 1 on page 6).
- Onset of symptoms within one week postpartum was noted in 82% (27/33) of cases of PRES and all cases of RCVS whilst onset of symptoms was at least after one week postpartum in 79% (26/33) of cases of CVT (Fig. 2 on page 6).

PRES: 33/70

- PRES was associated with pre-eclampsia/eclampsia in 70% (23/33) of cases (Fig. 4 on page 8).
- All patients (100% - 33/33) with PRES neither presented with nor eventually developed any focal neurological deficits (Fig. 3 on page 7).
- Lesions were most commonly observed in parietal / occipital lobes (97% - 32/33) (Fig. 5 on page 9).
- Typical imaging features described in PRES were noted in most cases with superior frontal sulcus (SFS) pattern (58% -19/33) being most common, where in addition to symmetric parietal and occipital lobe involvement, there is involvement along the superior frontal sulcus. (Fig. 6 on page 10, Fig. 7 on page 11 Fig. 8 on page 12). Dominant parietal / occipital (DPO) pattern was noted in 18% (6/33) (Fig. 6 on page 10, Fig. 9 on page 13, Fig. 10 on page 14) and holohemispheric watershed (HHW) pattern was seen in 6% (2/33) (Fig. 6 on page 10, Fig. 11 on page 15, Fig. 12 on page 16) of the patients. The other common patterns were partial and or asymmetric expressions of primary patterns (PAR and/or ASY).
- All 12 patients who had an MR angiography demonstrated a normal study.
- Along with the typical findings of PRES, parenchymal microhemorrhages were noted in two patients (Fig. 15 on page 19).
- Concomitant pontine myelinolysis was noted in one patient (Fig. 16 on page 20).

RCVS: 4/70

- All the patients presented with a h/o recurrent thunderclap headaches.
- BP was normal in most (75% - 3/4) of the patients (Fig. 4 on page 8).
- Multifocal segmental intracranial arterial constriction was noted in all 4 cases of RCVS in the initial MRI study.
- Two (50%) patients had follow up MR angiography within three months of initial presentation and demonstrated complete resolution of initially documented angiographic abnormalities.
• Only one patient presented with persistent focal neurological deficits and demonstrated bilateral ACA and a left posterior external watershed infarct on imaging. This was considered as a complication of RCVS (Fig. 17 on page 21).

• Another patient had concomitant convexity subarachnoid haemorrhage (cSAH) and bilateral subdural hematomas (SDH) (Fig. 18 on page 22).

CVT: 33/70

• Unlike the other two conditions, most of the patients (79% - 26/33) presented at least after one week postpartum and had focal neurologic deficits (79% - 26/33) (Fig. 3 on page 7). These were the main clinical differentiators.

• Only 9% (3/33) of the patients had elevated BP (Fig. 4 on page 8).

• Superior sagittal sinus (SSS) was most commonly involved (76% - 25/33) (Fig. 19 on page 23) with most cases presenting in the acute stage (58% - 19/33) (Fig. 20 on page 24).

• One patient had acute on chronic thrombosis.

• Isolated cortical vein thrombosis was uncommon, being noted in only one (3%) patient.

• Venous infarcts were noted in 97% (32/33) of cases with 58% (19/33) of them being hemorrhagic and 39% (13/33) being non-hemorrhagic (Fig. 21 on page 25).
Fig. 1: Study cohort

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Fig. 2: Time of onset of symptoms

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Fig. 3: Occurrence of focal neurological deficit(s) amongst the three conditions

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Fig. 4: Elevated BP at the time of presentation

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Fig. 5: Locations of lesions in PRES
Fig. 6: PRES - Imaging patterns

SFS - Superior frontal sulcus
DPO - Dominant parietal / occipital
HHW - Holohemispheric watershed
PAR/ASY - Partial / Asymmetric
Fig. 7: PRES - Superior frontal sulcus pattern
Fig. 8: Case 1 - PRES (SFS pattern): Axial FLAIR and DWI sections, MRV showing vasogenic edema in typical superior frontal sulcus (SFS) pattern (arrows) with normal MRV; FLAIR images on follow up showing partial resolution (arrows).
**Fig. 9:** PRES - Dominant parietal / occipital pattern

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Fig. 10: Case 2 - PRES (DPO pattern): Axial MR sections (FLAIR and DWI) demonstrate vasogenic edema in bilateral parietal and occipital regions in a symmetric fashion (arrows) - typical dominant parietal / occipital pattern, no diffusion restriction.

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Fig. 11: PRES - Holohemispheric watershed pattern
Fig. 12: Case 3 - PRES (HHW pattern): Axial and coronal MR sections (FLAIR, ADC and T2W) showing vasogenic edema in a linear pattern spanning frontal, parietal and occipital lobes with mild involvement of temporal lobes and right cerebellar hemisphere (arrows). Follow up MR (FLAIR) images (bottom row) demonstrate complete resolution.
Fig. 13: Case 4 - PRES (PAR pattern): Axial MR images (FLAIR, DWI, ADC) demonstrating symmetric biparietal vasogenic edema with absence of signal intensity abnormality in occipital lobes (arrows) - partial expression of primary pattern.

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Fig. 14: Case 5 - PRES (PAR and ASY pattern): Axial MR sections (FLAIR, DWI, ADC) showing unilateral vasogenic edema in right parietal lobe (arrow) with absence of signal intensity abnormality in bilateral occipital (arrows) and left parietal lobes - partial and asymmetric expression of primary pattern. Subtle FLAIR hyperintensity is also noted in right frontal region.
Fig. 15: Case 6 - PRES WITH HEMORRHAGE AS COMPLICATION: Axial and coronal MRI images (FLAIR, SWI) demonstrate patchy vasogenic edema in bilateral cerebral hemispheres, basal ganglia, right thalamus and left cerebellar hemisphere with microhemorrhages in centrum semiovale bilaterally (arrows).

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Fig. 16: Case 7 - PRES WITH ASSOCIATED PONTINE MYELINOLYSIS: Axial MR images (FLAIR, DWI, ADC) showing patchy vasogenic edema in bilateral cerebral hemispheres and splenium of corpus callosum (arrows in top row). There is associated central pontine myelinolysis (arrows in bottom row).

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Fig. 17: Case 8 - RCVS WITH ACUTE INFARCTS: DWI and ADC images showing acute infarcts in bilateral ACA and left posterior external watershed territories (arrows). Initial MRA showing multifocal segmental vasoconstriction involving all major intracranial vessels with follow up MRA being normal.

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**Fig. 18:** Case 9 - RCVS WITH HEMORRHAGE: MRA shows multifocal segmental narrowing in all major intracranial vessels. Initial MRI also demonstrates early subacute SDH along bilateral cerebellar hemispheres (arrows) and bilateral occipital SAH (arrowheads). There was no coexistent CVT on MRV. Follow up MRA and and T2 coronal images showing resolution of findings.

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**Fig. 19:** CVT - Distribution of sinuses

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Fig. 20: CVT - Stage of thrombosis

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Fig. 21: CVT - Focal parenchymal abnormalities
Fig. 22: Case 10 - CVT: Axial MR sections and MRV showing left frontal venous hemorrhagic infarct and thrombosis of anterior segment of superior sagittal sinus, left transverse sinus (arrows); resultant subfalcine herniation and acute left PCA territory infarct due to uncal herniation.

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**Fig. 23:** Case 11 - CVT: MRI and MRV images demonstrate subacute thrombosis of left transverse and sigmoid sinuses (arrows) with thrombus extending into the vein of Labbe on the left (arrowheads).
Fig. 24: CASE 12 - CVT: MRI and MRV images showing thrombosis of superficial (superior sagittal, bilateral transverse sinuses) and deep (vein of galen, straight sinus) venous systems (arrowheads) with venous infarcts in right cerebral white matter and thalamus (arrows). There is consequent diffuse cerebral edema with effacement of sulci and basal cisterns with flattening of superior aspect of brainstem.

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Conclusion

DISCUSSION:

The postpartum period is one when a group of acute neurologic disorders manifest. The most common of these are cerebrovascular complications. This group of disorders present with encephalopathy in the setting of eclampsia, posterior reversible encephalopathy syndrome, cerebral venous thrombosis and reversible vasoconstriction syndrome. Other conditions such as arterial infarcts and subarachnoid hemorrhage which also fall into this category do present with additional clinical features of neurologic deficits and classic imaging features\(^1\).

Posterior reversible encephalopathy syndrome (PRES) is now a recognised entity which occurs frequently with preeclampsia and eclampsia. Prompt recognition and treatment are crucial to avoid the permanent damage leading to sequelae and even mortality\(^2,3\).

Clinical and radiological features of PRES include headache, encephalopathy, seizures, cortical visual changes, and parieto-occipital white matter edema visualised on neuroimaging modalities with specific described patterns\(^2,3\).

Reversible cerebral vasoconstriction syndrome (RCVS) is to describe a group of disorders sharing cardinal angiographic and clinical features, namely, reversible segmental and multifocal vasoconstriction of cerebral arteries, and severe headaches with or without focal neurological deficits or seizures. Postpartum status has been found to be a significant causative condition other than vasoactive substances\(^6,7,8\).

Cerebral venous thrombosis (CVT) may occur anytime during the course of pregnancy and the puerperium, but the risk seems to be highest during early puerperium\(^9,10\). In India, this is exaggerated because of local traditional practice of water restriction in early puerperium.

We found that patients presenting with PRES and RCVS presented within the first week and a majority of the patients with PRES had pre-eclampsia / eclampsia. None of the patients with PRES presented with or developed focal neurological deficits.

Superior frontal sulcus (SFS) pattern was the most common primary pattern in our study, where in addition to symmetric parietal and occipital lobe involvement, there is
involvement along the superior frontal sulcus. Bartynski et al\textsuperscript{4}. too demonstrated similar results.

Two patients with PRES developed intraparenchymal microhemorrhages. Hemorrhages are a recognised complication in PRES\textsuperscript{5}. One patient with PRES had concomitant osmotic demyelination in the pons, probably due to inadvertent rapid correction of electrolytes whilst two others

As noted in two of our cases, cSAH, SDH and stroke are recognised complications of RCVS\textsuperscript{7,8}.

In contrast to PRES and RCVS, patients who had CVT presented slightly later, after the first week and 80\% had focal neurologic deficit(s) at presentation. Venous infarcts (hemorrhagic and non-hemorrhagic) were demonstrated in an overwhelming majority (97\%) of the patients.

Based on the clinical presentation and time of onset of symptoms, we had three major groups of patients with postpartum encephalopathy. We propose an imaging algorithm to be able to distinguish among the three (Fig. 25 on page 32).

CONCLUSION:

In postpartum patients, PRES and RCVS present early (less than a week) whilst CVT presents late (more than one week) with the latter condition presenting with focal neurological deficit(s) in most of the patients. Most of the cases of PRES have elevated BP.

In the setting of afebrile postpartum encephalopathy, imaging protocol must include MR angiography for patients presenting in the first week and MR venography for patients presenting after a week.
Fig. 25: Afebrile Postpartum Encephalopathy - Proposed Imaging Algorithm

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