

Efficacy of Computed Tomography in Early Diagnosis and Follow Up of Patients with Posterior Reversible Encephalopathy Syndrome in a Tertiary Care Centre

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A B S T R A C T

Introduction: Posterior Reversible Encephalopathy Syndrome (PRES) is a condition affecting the brain parenchyma occurring due to failure of auto-regulation of posterior circulation. The clinical manifestations and the underlying pathophysiology are still being defined. There has been no conclusive evidence regarding the relationship between clinical conditions and specific imaging findings of severity or location of oedema. Current research aimed to study etiological, clinical, and radiological profile as well as outcome of PRES in south Indian population and to evaluate association of various clinical and CT parameters with final outcome in PRES.

Material and Methods: 50 patients referred to the Department of Radio-Diagnosis, with a history of neurological abnormalities, with a predisposing history favouring PRES and followed up for a period of 20-30 days.

Results: 21 patients (42%) were females. 32 patients (64%) were in the age group between 21 to 30 years. Predisposing condition; 16 (32%) presented with pre-eclampsia, 12 (24%) with post-partum status in altered sensorium, 6 (12%) with seizures, 6 (12%) with hypertension, 6 (12%) with visual disturbances, 3 (6%) with eclampsia and 1 (2%) with uraemia. Regional predominance of the lesions was as follows. Frontal lobe (40%), Parietal lobe (32%), Temporal lobe (13%) and occipital lobe (15%).

Conclusion: There are multiple clinical manifestations that can be attributed to the CT imaging findings consistent with PRES. Early and prompt MRI with diffusion weighted imaging (where ever the availability) is required for early detection of the condition and to start on appropriate therapy so that the condition can be reversed.

Keywords: Computed Tomography, Early Diagnosis, Posterior Reversible. Encephalopathy Syndrome

INTRODUCTION

Posterior Reversible Encephalopathy Syndrome (PRES) is a neuropathological state occurring secondary to the failure of posterior circulation to auto-regulate. Though the term was initially coined by Hinchey et al¹ in 1996, the clinical spectrum and the underlying pathophysiology are yet to be clearly defined.

Global incidence of posterior reversible encephalopathy syndrome is less known. The only epidemiological data is from a retrospective study of patients seen between 1988 and 2013.¹⁻⁷ PRES has been reported in patients aged 4 to 90 years, although most cases occur in young to middle-aged adults, the mean age ranging across case series from 39 to 47 years. There is an increased female predominance that may reflect some of the causes. Many patients with PRES have additional co-morbidities, which may be severe conditions, such as bone marrow or solid organ transplantation, chronic renal failure, and chronic hypertension.

Clinical manifestations of this condition includes varied spectrum - headache, seizures, encephalopathy, and visual disturbances. The frequently associated conditions include acute hypertension, pre-eclampsia / eclampsia, renal disease, sepsis, and exposure to immunosuppressant's²⁻⁵. Less commonly, this condition also has been described in patients with autoimmune disease.⁸⁻⁹

The newer neuro-imaging techniques are very much sensitive to changes in the distribution of water in the brain which makes it possible to detect white matter oedema even in early phases. Imaging wise, findings of focal reversible vasogenic oedema suggests a diagnosis of posterior reversible encephalopathy syndrome. Though the syndrome stresses on the posterior predominance of the lesions, the same on imaging are rarely isolated to the "posterior" parieto-occipital white matter and instead often involve the cortex, frontal lobes, basal ganglia, and brainstem.^{6,7}

The underlying pathophysiology of PRES is yet to be clearly defined. Several theories have been proposed, the most widely

accepted of which states that rapidly developing hypertension leads to a breakdown in cerebral auto-regulation, particularly in the posterior cerebral region (where there is a relative lack of sympathetic innervation). Hyper-perfusion ensues with protein and fluid extravasation, producing focal vasogenic oedema⁹. An alternative theory, which has been best characterised in pre-eclampsia, eclampsia, and sepsis, implicates endothelial dysfunction.^{10,11} A third theory proposes that vasospasm with subsequent ischemia may be responsible.¹²

This condition is characterised by the rapid progress of symptoms and signs. Condition is reversible if detected in early stages, so early recognition of PRES is important for timely institution of therapy, which typically consists of gradual blood pressure control and withdrawal of potentially offending agents.

Best modality for assessment of this condition is Magnetic Resonance Imaging. However, due to the disadvantages with the MRI like cost of the examination, duration for the same, non-availability in many places, CT can also be used as a useful adjunct and a valid modality for the initial detection and assessment of the same.

This study is to evaluate posterior reversible encephalopathy syndrome by computed tomography with clinical correlation and to detect the clinical associations and prevalence of this condition in the study group. Also, the helpfulness of the early detection and probable benefits of the same are discussed.

MATERIAL AND METHODS

Descriptive study was done on 50 patients referred to the department of Radio-diagnosis, PES institute of medical sciences and research, a tertiary medical centre, from October 2015 to June 2017, with a history of neurological abnormalities, including altered mental function, visual loss, stupor with a predisposing history favouring PRES and followed up for a period of 20 – 30 days.

Equipment: GE Healthcare BrightSpeed Elite - 16 slice CT scanner.

Inclusion Criteria

1. Patients with clinical history of headache, encephalopathy, seizure, visual disturbance or focal deficit.
2. CT findings of focal vasogenic edema.

Exclusion Criteria:

1. Patients who are not ready to undergo computed tomography.
2. Patients with imaging findings suggestive of pathologies other than PRES and its associations.

Method of Data Collection: Brief clinical history, Consent for CT scan, CT brain – Non contrast.

Scan Range: Top of C1 lamina through top of calvarium, Topogram: AP, Lateral; 120 kV, 10 mAs.

Scan Type: Axial. Detector configuration: 16 x 0.625. SFOV: Head. kV: 120 mAs: 140.

RESULTS

21 patients (42%) were females. 32 patients (64%) were in the age group between 21 to 30 years. Predisposing condition;

16 (32%) presented with pre-eclampsia, 12 (24%) with post-partum status in altered sensorium, 6 (12%) with seizures, 6 (12%) with hypertension, 6 (12%) with visual disturbances, 3 (6%) with eclampsia and 1 (2%) with uraemia.

20 cases (40%) showed findings suggestive of posterior reversible encephalopathy syndrome on initial computed tomography examination. 30 cases showed no initial radiological evidence suggestive of posterior reversible encephalopathy syndrome. Of the 20 cases which showed computed tomographic evidence of posterior reversible encephalopathy syndrome, recovery was noted in 5 cases (10%). Persistence of findings detected on first CT was noted in 13 patients (26%).

Regional predominance of the lesions was as follows. Frontal lobe (40%), Parietal lobe (32%), Temporal lobe (13%) and occipital lobe (15%).

DISCUSSION

Posterior reversible encephalopathy syndrome (PRES) is a usually reversible neurologic syndrome which manifesting with a variety of symptoms like headache, altered mental status, seizures, vision loss and loss of consciousness.

In the current study, a total of 50 patients with predisposing history or clinical condition suggestive of possibility of PRES were evaluated with computed tomography. Hinchey et al¹¹, opines that in their study in all 12 patients in whom the first imaging study done was CT, the radiologic diagnosis of white-matter disease was apparent on the scan. Although MRI yielded a higher-resolution image, it was not necessary for the diagnosis of reversible posterior leukoencephalopathy. The only advantage of MRI was its ability to show small, focal abnormalities beyond the limits of resolution of CT. Various other studies by Schwartz et al,¹³ Fisher et al,¹⁴ Duncan R¹⁵ have suggested that Computed tomography can be used satisfactorily to diagnose PRES.

In a study by Casey et al,¹⁶ the author opines that PRES is usually diagnosed or ruled out by imaging. Typically, PRES may be suspected on the basis of history, but the clinical signs and symptoms are nonspecific. Imaging is thus an essential component of the diagnosis of PRES.

When typical clinical risk factors are not present, or when the blood pressure is not dramatically elevated, improvement on follow-up studies may also be key in the diagnosis. Though the current study emphasises on imaging as the modality for detection of PRES, clinical diagnosis is equally important for better management of the patient. This typically holds good for the centres in rural and semi-urban areas of our country, where the availability of the imaging services are far from satisfactory.

In the current study, posterior reversible encephalopathy syndrome was predominantly seen in female patients. This is in keeping with the various other studies which show predominantly female preponderance.^{1,5}

In the current study, the average age of presentation was 30.8 years (range, 1 – 63 years). The average age of presentation in the current study is relatively less, compared to other studies.^{1,5,6} This may be due to the fact that more number of patients with pregnancy associated conditions were evaluated. The main presenting features recognised in this study include:

1) Acute Hypertension, 2) Pre-eclampsia, Eclampsia, Post-partum status, 3) Seizures, 4) Visual disturbances.

The brain normally is protected from extremes of blood pressure by an autoregulation system that ensures constant perfusion over a wide range of systemic pressures. In response to systemic hypotension, cerebral arterioles dilate to maintain adequate perfusion, whereas vessels constrict in response to high pressures. Above the upper limit of autoregulation, hypertensive encephalopathy occurs.

Hypertension is one of the important causes of posterior reversible encephalopathy syndrome.^{13,17}

In a study by Bartynski et al,⁵ the authors found out that normotensive patients demonstrated the greatest degree of vasogenic oedema, whereas severely hypertensive patients demonstrated less brain oedema. This is in keeping with the present study, where degree of oedema was higher in normotensive patients.

There were cases of eclampsia progressing to develop posterior reversible encephalopathy syndrome in the study. Although, CT findings suggestive of posterior reversible encephalopathy was not present in these clinically suspected cases of posterior reversible encephalopathy syndrome, clinical evidence of recovery were documented in all the cases following appropriate and prompt institution of therapeutic measures. This can be attributed to the modality that was used for the diagnosis of the same. Computed tomography, although being the most common modality used and having advantages of easy availability and less time taken for evaluation of a patient, fails miserably in detection of the subtle early changes of posterior reversible encephalopathy syndrome. As demonstrated by this study, computed tomography can be normal in many cases in which clinical features of posterior reversible encephalopathy syndrome are present. In these types of clinical situations, appropriate therapy should be started and further imaging by MRI may be advocated. Our study correlates with the study of Garg R K et al²⁹.

This study raises an important question as to whether all patients with a classical clinical presentation of eclampsia routinely undergo imaging studies, given that the results may or may not affect their treatment. The current practice of confirming the diagnosis of eclampsia on the basis of the clinical presentation is sufficient and imaging to be reserved for patients with atypical presentations, such as those who develop seizures after delivery. In addition, the reversibility of clinical signs and radiologic abnormalities may argue against neuro- imaging of patients at risk of PRES. Thus it can be concluded that imaging is crucial for patients with an uncertain diagnosis, in whom timely imaging and a diagnosis of PRES may lead to more appropriate decisions regarding treatment of hypertension, thus preventing the possible development of permanent neurologic deficits.

Most cases with visual disturbances having spontaneous recovery may in fact be cases of PRES.^{1,18}

Posterior reversible encephalopathy syndrome can also be seen in the setting of uraemia.^{19,30}

The regional predominance of the lesions was varied and was noted most commonly in frontal lobes followed by parietal, occipital and temporal lobe. In the current study, the

predominance of the lesion was in anterior circulation.¹⁶

The predilection for involvement of posterior circulation territories is generally accepted to result from the relatively sparse sympathetic innervation of the vertebrobasilar circulation.²⁰ In a healthy subject, cerebral autoregulatory mechanisms that have both myogenic and neurogenic components maintain constant brain perfusion. The effectiveness of the neurologic component of autoregulation is directly proportional to the degree of sympathetic innervation.²¹ In patients with PRES, the myogenic response is blunted by either passive over distention of the vessel due to elevations in blood pressure^{22,23} or direct toxic effects on the endothelium.²⁴ Because autoregulatory mechanisms are thus more dependent on the neurogenic response, the more poorly innervated areas in the posterior circulation are most vulnerable. The result is the leakage of fluid into the interstitium and vasogenic oedema.

In this study, there is no difference in location of the lesion based on suspected aetiology. This is similar to a study done by Fugate et al,²⁵ who also found no difference in location based on suspected aetiology.

In a study by Stott VL,²⁶ the findings of the focal parenchymal changes were not completely reversible in 3 of the cases their study. This is seen similar to the current study, wherein 13 patients showed no reversibility of the lesions and progressed to develop permanent neurological deficit. The likely causative mechanism could likely be delayed diagnosis as well as delayed treatment for the same.

The study of S. Bansal²⁸, showed the usefulness of MRI in PRES. The statistics of the study matches with our CT study. Reversibility is rarely the spontaneous evolution of PRES. However, if this is true for most patients, it is not a rule and some patients have an unfavourable outcome, in spite of a prompt correct therapy.²⁷

Limitations

- Sample size
- Evaluation of white matter oedema by CT has its limitations.
- Selection bias.

CONCLUSION

There are multiple clinical manifestations that can be attributed to the CT imaging findings consistent with PRES. Early and prompt MRI with diffusion weighted imaging (where ever the availability) is required for early detection of the condition and to start on appropriate therapy so that the condition can be reversed.

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