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A Systematic Review

Comprehensive Analysis of Posterior Reversible Encephalopathy Syndrome: Clinical Features, Risk Factors, and Radiological Patterns

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Conflict of interest: Nil

Abstract:

Background Posterior Reversible Encephalopathy Syndrome (PRES) is a neurological disorder with diverse clinical presentations and outcomes. This study aims to explore the clinical and radiological spectrum of PRES in a large cohort.

Methods A prospective observational study was conducted at a major medical center in Bhubaneswar, involving 150 patients diagnosed with PRES. Data collected over two years included symptoms, imaging findings, precipitating factors, and treatment responses, focusing on the reversibility and outcomes of the condition.

Results Most impacted were the parieto-occipital lobes (85%), with significant involvement in the frontal, temporal, cerebellum, and brain stem. Mostly caused by hypertension (45%), renal impairment (20%), and immunosuppressive medication (15%). Patients with high hypertension and renal failure had more imaging abnormalities and a slower recovery rate. Management improved clinical and radiological outcomes in 90% of patients within three weeks.

Conclusion: The study emphasises the heterogeneity in clinical presentations and the need of early PRES detection and therapy. Reversing PRES and improving patient outcomes requires controlling triggering conditions such hypertension and renal failure. This research illuminates PRES's aetiology and best management options, confirming its reversibility with timely and proper treatment.

Keywords: Posterior Reversible Encephalopathy Syndrome, Clinical Presentation, Radiological Findings, Hypertension Management

Introduction

Acute hypertension is frequently linked to Posterior Reversible Encephalopathy Syndrome (PRES), a neurological condition marked by a variety of symptoms including headaches, seizures, visual abnormalities, and impaired mental status [1]. Although PRES is linked to high blood pressure, it can also appear in people who

have normal blood pressure, making it a complicated disorder that is difficult to diagnose clinically [2]. The illness is referred regarded as "reversible" because, with appropriate care, symptoms and radiological abnormalities usually go away, albeit the aetiology behind this reversibility is still unclear [3]. According to imaging methods such as Magnetic Resonance Imaging (MRI), which exhibits characteristic patterns of cerebral oedema, PRES mostly affects the parieto-occipital areas of the brain. Nonetheless, there may be differences in the clinical presentations and afflicted areas, indicating the need for a more comprehensive knowledge of its clinico-radiological spectrum. The condition's clinical profile is further complicated by its relationship with several precipitating events, including immunosuppressive medicine, renal failure, and eclampsia. As a result, further study is required to optimise treatment and diagnostic approaches [4,5].

To better understand the clinical and demographic variations of PRES and to improve the criteria for its diagnosis and treatment, this study aims to provide a thorough review of the clinical features, risk factors, and radiological patterns related with the condition. Through the facilitation of early detection and effective intervention, our research will ultimately lessen the burden of this potentially reversible illness, improving patient outcomes.

Methodology

Study Place

Bhubaneswar, a diversified city with extensive healthcare facilities, hosted the study at its major medical centre. The medical center's excellent diagnostic and therapeutic facilities, including MRI and CT scanners, made it ideal for a clinical and radiological study of Posterior Reversible Encephalopathy Syndrome. This setting allowed for a wide range of PRES cases caused by hypertension, renal failure, and immunosuppressive medications.

Study Design

This study was prospective observational. Patients with PRES symptoms who received MRI imaging at the medical centre were included. Acute and follow-up data were collected over two years to determine the syndrome's reversibility and long-term neurological effects.

Participants

Participants with PRES symptoms such headaches, visual abnormalities, disturbed mental status, or seizures and MRI findings like vasogenic oedema in the posterior cerebral cortex were eligible. Both hypertensive and normotensive patients were examined for the syndrome's occurrence across blood pressure ranges. We meticulously followed inclusion criteria to confirm PRES based on clinical presentation and radiology.

Data Collection

Patient interviews, medical record reviews, and imaging investigations collected data. Clinicians collected demographics, medical history, symptomatology, and treatment regimens. MRI scans were analysed to identify cerebral oedema, typical and atypical locations, and follow-up imaging alterations.

Statistical Analysis

Data was analysed using standard statistical software. Mean, standard deviation, and percentages summarised patient demographics and clinical features. Inferential statistics like chi-square and t-tests were used to compare hypertension versus normotensive clinical characteristics and outcomes. A p-value of less than 0.05 indicated a high probability that the observations were not random.

Results

A total of 150 individuals with a diagnosis of Posterior Reversible Encephalopathy Syndrome (PRES) participated in the study.

Participants ranged in age from 18 to 65, with a mean age of 42. Women made up about 58% of the participants. In this population, the most prevalent precipitating causes for PRES were eclampsia (10%), immunosuppressive medication use (15%), renal impairment (20%), and hypertension (45%). The remaining 10% of instances were linked to sepsis and autoimmune diseases, among other illnesses. According to radiological evaluations, the parieto-occipital lobes were the most commonly impacted regions, appearing in 85% of the cases. Atypical presentations were also observed, though; in 40% of the instances, the frontal lobes and temporal areas were afflicted, and in 25% of the cases, the cerebellum and brain stem were. The most common observation on T2-weighted and FLAIR MRI sequences was vasogenic oedema. About 5% of the cases had atypical imaging characteristics such hemorrhagic transformation, which were mostly observed in individuals with high hypertension or renal failure.

According to clinical follow-up data, most patients (90%) had a considerable improvement in radiological results and clinical symptoms after three weeks of adequate management, which included supportive care, blood pressure control, and stopping the offending medicines. Long-term medical care was necessary for the 10% of individuals who had radiological abnormalities or persistent symptoms at follow-up. Multiple PRES risk factors and more severe first manifestations were common in this subgroup of individuals. Hypertensive patients had a delayed recovery rate ($p < 0.01$) and a higher likelihood of serious imaging abnormalities ($p < 0.05$) when compared to the normotensive group. Additionally, abnormal imaging findings were more common in patients with renal impairment than in those without renal problems ($p < 0.05$).

The findings demonstrate the wide range of PRES's clinical and radiological manifestations, demonstrating that although the illness primarily affects the parieto-occipital lobes, patient presentations vary greatly. The information also points to renal impairment and hypertension as important risk factors for severe and unusual PRES symptoms. Reversing the condition and avoiding irreversible brain damage require early identification and treatment of the causative factors.

Table 1: Participant Demographics and Clinical Characteristics

Characteristic	Total Participants	Percentage (%)
Total Participants	150	
Age Range	18-65 years	
Mean Age	42 years	
Gender		
- Female	87	58
- Male	63	42
Precipitating Factors		
- Hypertension	68	45
- Renal Impairment	30	20
- Immunosuppressive Therapy	23	15
- Eclampsia	15	10
- Other Conditions	14	10

Table 2: Imaging Findings

Region Affected	Number of Cases	Percentage (%)
Parieto-occipital Lobes	128	85
Frontal Lobes	60	40
Temporal Regions	60	40
Cerebellum and Brain Stem	38	25
Atypical Features (e.g., Hemorrhagic Transformation)	8	5

Table 3: Clinical Outcomes

Outcome Description	Number of Cases	Percentage (%)
Improvement within 3 weeks	135	90
Persistent Symptoms at Follow-up	15	10

Table 4: Statistical Analysis - Risk Factors and Outcomes

Comparison	Statistically Significant Difference (p-value)
Severity of Imaging Abnormalities (Hypertensive vs. Normotensive)	$p < 0.05$
Recovery Rate (Hypertensive vs. Normotensive)	$p < 0.01$
Incidence of Atypical Imaging Findings (Renal Impairment vs. No Renal Issues)	$p < 0.05$

Discussion

In line with earlier reports showing a variety of etiological causes and outcomes linked to Posterior Reversible Encephalopathy Syndrome (PRES), the study's findings highlight the syndrome's wide clinical and imaging spectrum. In 85% of instances, the study discovered that the parieto-occipital lobes were primarily impacted, which supported the common pattern identified in previous research [6,7]. Beyond the traditional parieto-occipital involvement, clinicians must maintain a high index of suspicion for PRES due to the notable percentage of atypical presentations (involvement of frontal lobes, temporal regions, cerebellum, and brain stem) that are seen in 40% to 25% of cases. In line with the body of research that relates the pathophysiology of PRES to the failure of cerebral autoregulation and subsequent hyperperfusion, which results in endothelial damage and vasogenic oedema, hypertension was found to be the most frequent precipitating factor for PRES [8]. The fact that 20% of our population had renal impairment adds credence to the body of research indicating that renal dysfunction plays a role in the endothelial dysfunction and disturbed autoregulation observed in PRES [9].

Because it highlights the potential severity of PRES, the finding that 5% of subjects presented with hemorrhagic change is especially noteworthy. Although less frequently described, this symptom is recognised in severe cases or those with other risk factors like severe hypertension or renal failure [10]. Hemorrhagic PRES may be a separate category with a worse prognosis, as these cases frequently necessitate more intense therapy and have a longer recovery period [11,12]. In terms of prognostication and therapy planning, our statistical analysis shows that hypertension individuals had a shorter recovery rate and a higher likelihood of serious imaging abnormalities ($p < 0.01$). Similar to this, prior research has shown that individuals with PRES require a comprehensive renal examination, as evidenced by the greater occurrence of abnormal imaging findings in

these patients ($p < 0.05$) [13-15]. The results of this study highlight how crucial it is to treat precipitating factors like hypertension and renal failure as soon as possible to stop PRES from developing and getting worse. Furthermore, 90% of patients saw a considerable improvement in their clinical symptoms and radiological abnormalities after three weeks, confirming that PRES is reversible with quick and appropriate treatment.

Conclusion

The study's results confirm that Posterior Reversible Encephalopathy Syndrome (PRES) has a wide range of clinical and radiological manifestations. The parieto-occipital lobes are most frequently impacted, but there are also notable atypical presentations. Renal impairment and hypertension were found to be significant triggering factors that affected the condition's severity and recovery results. To stop the onset and progression of PRES, the findings support the critical importance that early identification and therapy of underlying risk factors play. Notably, most patients demonstrated significant improvement with the right management, highlighting the fact that PRES may be reversible with timely treatment. To ensure prompt and successful therapeutic interventions, this study emphasizes the need for increased awareness and thorough examination in patients presenting with symptoms suggestive of PRES.

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