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Original Research Article

Paediatric brain lesions: a study of space-occupying conditions

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ABSTRACT

Background: Intracranial space-occupying lesions (ICSOL) in children, encompassing neoplastic and inflammatory origins, pose significant diagnostic and therapeutic challenges. Modern imaging techniques like CT and MRI have revolutionized the understanding and management of ICSOL, altering their clinical presentation. This study aimed to investigate the epidemiology, clinical presentation, etiology, treatment modalities and outcomes of ICSOL in pediatric patients.
Methods: A prospective analysis was conducted on pediatric patients diagnosed with ICSOL, utilizing medical records from a tertiary care hospital. Data regarding demographics, clinical symptoms, imaging findings, treatment modalities, and outcomes were collected and analyzed.
Results: In this study on space-occupying lesions (SOL) in pediatric patients, revealing a diverse distribution across different age groups. Arachnoid cysts were the most prevalent, followed by hydrocephalus, hematomas, and tuberculomas. Clinical presentations varied widely, with Headache, Seizures and altered sensorium in limbs being the most common symptoms. Treatment approaches ranged from surgical resection or fenestration for arachnoid cysts to specific therapies such as ventriculoperitoneal shunt placement for hydrocephalus and antitubercular therapy for tuberculomas. Outcomes varied by lesion type, with some cases showing improvement, stability or worsening post-treatment.
Conclusions: The study provides valuable insights into the epidemiology, clinical presentation, treatment, and outcomes of space-occupying lesions in children. Arachnoid cysts emerged as the predominant lesion type, while hydrocephalus, hematomas and tuberculomas were also notable. Understanding these factors is crucial for early diagnosis, effective management and improved outcomes in pediatric patients with brain lesions.

Keywords: Arachnoid cysts, Clinical presentation, Hydrocephalus, Hematomas, Space-occupying lesions, Tuberculomas, Treatment outcomes

INTRODUCTION

Space-occupying lesions of the brain in children present a complex and challenging area of study within pediatric neurology and neurosurgery. These lesions encompass a wide spectrum of pathological entities, ranging from benign tumors to malignant neoplasms, as well as non-neoplastic conditions such as abscesses, hematomas and cysts. Understanding the characteristics, diagnosis, and management of these lesions is crucial for providing timely and effective treatment to affected children. The term "intracranial space occupying lesions" is defined as any neoplasm, benign or malignant, primary or secondary, as well as any inflammatory or parasitic mass lying within the cranial cavity.[1] It also includes haematomas, different types of cysts and vascular malformations.[1] In children, intracranial space-occupying lesions (ICSOL) are frequently encountered and can result in significant morbidity and mortality if not promptly diagnosed and treated.[2] Brain tumors represent the second most prevalent malignancy in childhood, following leukemia. Among pediatric patients aged 2 to

12 years, approximately two-thirds of all brain tumors occur within the intracranial space. Notably, in infants and toddlers under the age of two, tumor distribution is evenly spread between the infratentorial and supratentorial regions.[3] Infratentorial tuberculomas are particularly common among children, with around 60% of cases localized in the cerebellum and the remainder in the cerebrum, predominantly in the frontoparietal region.[4,5] Advancements in medical imaging techniques, such as magnetic resonance imaging (MRI) and computed tomography (CT), have significantly transformed the identification and characterization of space-occupying lesions in pediatric patients.[5] These imaging modalities offer essential details regarding the location, size, shape and tissue properties of such lesions, facilitating accurate diagnosis and treatment planning.[7-9]

Moreover, the management of space-occupying brain lesions in children typically demands a collaborative approach involving various specialists, including pediatric neurosurgeons, neurologists, oncologists, radiologists and other healthcare professionals. Treatment strategies may comprise surgical intervention, chemotherapy, radiation therapy or a combination of these modalities, tailored to suit the specific features of the lesion and the unique needs of each patient. This review aims to comprehensively explore the current knowledge surrounding space-occupying brain lesions in children. It will cover aspects such as epidemiology, clinical presentation, diagnostic methodologies, treatment options, and outcomes. By critically examining existing literature, our goal is to offer insights that can enrich clinical practices and pave the way for future research endeavors in the realm of pediatric neurology and neurosurgery. This study aimed to investigate the epidemiology, clinical presentation, etiology, treatment modalities and outcomes of ICSOL in pediatric patients.

METHODS

Study type

Prospective observational study

Study population

The study will include pediatric patients aged 0 to 14 years who are diagnosed with intracranial space-occupying lesions (ICSOLs) and admitted to tertiary care center.

Sample Size

A total 27 sample size was finalized based on the prevalence of ICSOLs at the tertiary care center.

Study Place

SMBT IMSRC Nandi hills Dhamangaon, the tertiary care center.

Study duration

The duration of the study was from June 2022 to January 2024.

Inclusion criteria

Pediatric patients aged 0 to 14 years. Patients diagnosed with intracranial space-occupying lesions (ICSOLs) confirmed by imaging studies such as MRI or CT scans.

Exclusion criteria

Patients with incomplete medical records or insufficient diagnostic imaging data. Patients with known congenital brain anomalies or pre-existing neurological conditions unrelated to ICSOLs.

The study was started after the approval from the college ethical committee. This prospective study was done among all 27 confirmed cases of space occupying lesion and satisfying inclusion and exclusion Criteria.

Data collection

Data collection was done after ethical permission from institutional ethical committee and informed consent of guardians of patients.

Relevant demographic information (age, gender), clinical characteristics, imaging findings, and treatment outcomes of eligible patients was collected.

Specific investigation was done in the form of fundus examination, skull X-ray, USG cranium, electroencephalogram, CT scan, MRI and other relevant investigations.

Statistical analysis

Descriptive statistics such as mean, median, standard deviation, and proportions will be used to summarize demographic characteristics, etiologies and clinical outcomes. Inferential statistical methods such as chi-square test or t-test may be applied to compare variables of interest between different subgroups of patients.

RESULTS

The table illustrates the demographic distribution of children diagnosed with space-occupying lesions (SOL), categorizing them by age group and gender. In children below 1 year old, there were 1 female and 2 males, collectively accounting for 11.11%. In the age group of 2-5-years, the gender distribution remains balanced, with 4 females and 5 males, representing 33.33%. In 5-10-year age group exhibits a comparable pattern, with 4 females and 6 males, comprising 37.04%. In the age group of 10-14 years, there were 2 females and 3 males, collectively constituting 5%.

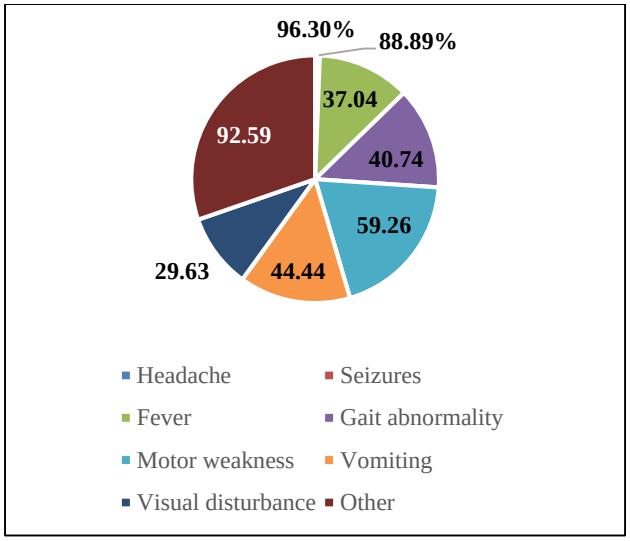

Figure 1: Clinical features of SOLs.

Clinical symptoms of SOL children

In the study of clinical symptoms observed in a group of patients, along with the corresponding frequencies and percentages. Headache was common symptom seen in 96.30% of children's. seizures were also prevalent, reported by 88.89% of the patients. Fever was reported by a third of the patients (37.04%), while gait abnormality and Motor weakness were observed in 40.74% and 59.26% of patients, respectively. Vomiting and visual disturbance were reported by 44.44% and 29.63% of patients, respectively. Additionally, a wide range of other symptoms were reported by 92.59% of the patients, suggesting a diverse clinical presentation.

In the distribution of space-occupying lesions in 27 pediatric patients. Arachnoid cysts are the most common (25.93%), followed by hydrocephalus (18.52%), hematomas (11.11%) and tuberculomas (11.11%). Other lesions include brain abscesses, Neurocysticercosis, brainstem gliomas, astrocytomas (each 7.41%) and porencephalic cysts (3.70%). This table details the treatment modalities for various space-occupying brain lesions in 27 pediatric patients. Arachnoid cysts (25.93%) were treated with surgical resection or fenestration. Hydrocephalus (18.52%) required ventriculoperitoneal shunt placement. Hematomas (11.11%) underwent surgical evacuation. Tuberculomas (11.11%) received antitubercular therapy. Other lesions, including brain abscesses, Neurocysticercosis, brainstem gliomas, astrocytomas and porencephalic cysts, had specific treatments based on their nature and frequency. This table summarizes the outcomes for different types of space-occupying brain lesions based on the treatments administered. In the various lesion types, the condition of the majority of children improved following treatment. The improvements were observed in most cases, with only three children experiencing worsened conditions. This shows the overall effectiveness of the treatments in managing space-occupying brain lesions in children, indicating positive therapeutic outcomes for the majority of cases.

Table 1: Age and gender distribution of SOL children.

Age in years	Female (N)	Male (N)	Total (N/%)
<than 1	1	2	3 (11.11)
2-5	4	5	9 (33.33)
5-10	4	6	10 (37.04)
10-14	2	3	5 (18.52)
Total	11	16	27 (100)

Table 2: Study of different types of lesions in children.

Types of space-occupying lesions	(N)	(%)
Arachnoid cyst	7	25.93
Hydrocephalus	5	18.52
Hematoma	3	11.11
Tuberculoma	3	11.11
Brain abscess	2	7.41
Neurocysticercosis	2	7.41
Brainstem glioma	2	7.41
Astrocytoma	2	7.41
Porencephalic cyst	1	3.70
Total	27	100

Table 3: Study of treatment received based on type of Space-Occupying Lesions in children.

Types of space-occupying lesions	Treatment received	(N)	(%)
Arachnoid Cyst	Surgical resection or fenestration.	7	25.93
Hydrocephalus	Ventriculo peritoneal shunt placement	5	18.52
Hematoma	Surgical evacuation	3	11.11
Tuberculoma	Antitubercular therapy	3	11.11
Brain abscess	Antibiotic therapy and surgical drainage	2	7.41
Neurocysticercosis	Cysticidal treatment,surgical resection and Supportive care	2	7.41
Brainstem glioma	Surgical resection and referral to higher centre	2	7.41
Astrocytoma	Referral to higher centre	2	7.41
Porencephalic Cyst	Observation or surgery if symptomatic	1	3.7
Total		27	100

Table 4: Outcome of treatment in SOL children.

Space-occupying lesion	Treatment received	Improved (N)	Stable (N)	Worsened (N)
Arachnoid cyst	Surgical resection or fenestration	2	4	1
Hydrocephalus	Ventriculoperitoneal shunt placement	3	1	1
Hematoma	Surgical evacuation	1	2	0
Tuberculoma	Antitubercular therapy	2	1	0
Brain abscess	Antibiotic therapy and surgical drainage	1	1	0
Neurocysticercosis	Cysticidal treatment and supportive care	1	1	0
Brainstem glioma	Surgical resection and referral to higher centre	1	0	1
Astrocytoma	Referral to higher centre	1	1	0
Porencephalic cyst	Observation or surgery if symptomatic	0	1	0

DISCUSSION

The term "ICSOL" commonly denotes lesions, regardless of whether they are neoplastic or inflammatory, that cause an expansion of intracranial contents, consequently elevating intracranial tension (ICT). The introduction of advanced imaging modalities such as CT and MRI have significantly transformed the presentation of ICSOL.

In the present study revealed a diverse distribution of SOL among different age groups, with the highest prevalence observed in the 5-10 years age group (37.04%), followed by the 2-5 years age group (33.33%). This suggests that children in these age ranges are more susceptible to developing SOL. Additionally, the study demonstrated a slightly higher prevalence of SOL among males compared to females, with 16 males and 11 females with a ratio of 1.45:1 diagnosed with these lesions. The identical study conducted by Prajapati N. et al in 2017 reported highest cases observed in our study in age group of 5 to 9 years (52.5%) and a ratio of M:F 1.3:1 which is identical with the present study findings. [10]

The clinical presentation of SOL in children varied, with altered sensorium (72.41%) and headache (96.03 %) being the most prevalent symptoms. Other commonly reported symptoms included seizures (88.89%), gait abnormality (40.47%), and fever (37.04%). These findings highlight the diverse manifestations of SOL, ranging from neurological deficits to systemic symptoms such as fever. The different types of space-occupying lesions found in children like hydrocephalus, hematomas, and tuberculomas, indicating a significant presence of these conditions in the pediatric population. When compared with the study by Patel J et al, several differences and similarities emerge.8 Patel J's study reported headache in 42.8% of patients, a symptom not explicitly noted in the current study, which instead emphasizes pain and weakness as more prominent complaints.8 Vomiting, reported in 70% of patients in Patel J's study as a common manifestation of increased intracranial pressure (ICP), is not mentioned in the present study. Notably, fever, found in 88.89% of patients in the current study, is absent from Patel J's symptom list. These variations could reflect differences in patient populations, types of lesions, or disease progression in each study.

Arachnoid cysts, being the most prevalent lesion. Are primarily managed through surgical resection or fenestration. Hydrocephalus, is another common condition, often requires ventriculoperitoneal shunt placement, accounting for about 18.52% of cases. Hematomas and tuberculomas, each representing 11.11% of cases, typically involve surgical evacuation and antitubercular therapy. Brain abscesses, neurocysticercosis, brainstem gliomas, and astrocytomas each constitute around 7.41% of cases. Brain abscesses, for instance, typically necessitate antibiotic therapy and surgical drainage, highlighting the importance of both medical and surgical interventions in managing infectious brain lesions. Neurocysticercosis often requires surgical debridement alongside supportive care to manage the necrotic tissue effectively. Treatment approaches also reflect the complexity of managing pediatric brain lesions and the importance of individualized treatment plans based on factors such as lesion type.

When compared to the study by Jindal N et al there are notable differences. In Jindal N's study, the majority of patients (76.2%) had neoplastic lesions, while only 23.7% had non-neoplastic lesions.[11] Among the neoplastic lesions, metastases (20%) and astrocytomas (15%) were the most common, followed by meningiomas (10%), pituitary adenomas (8.7%), glial tumors (7.5%) and schwannomas (5%). Non-neoplastic lesions in Jindal N's study included arachnoid cysts (10%), abscesses (8.7%), hydatid cysts (2.5%), tuberculomas (1.2%) and cavernomas (1.2%).

The primary difference between the two studies is the higher prevalence of neoplastic lesions in Jindal N's study, whereas the current study emphasizes non-neoplastic lesions like arachnoid cysts and hydrocephalus. In Jindal N's study, astrocytomas were more common (15%) compared to the present study, where they accounted for only 7.41%. Tuberculomas, a

notable cause in the current study (11.11%), were relatively rare in Jindal N's study (1.2%).[11]

Overall, the present study reflects a higher incidence of non-neoplastic lesions, particularly in pediatric cases, while Jindal N's findings indicate a predominance of neoplastic lesions in their patient population. This variation could be due to differences in patient demographics, age groups, or geographical factors influencing the types of space-occupying lesions encountered.

Arachnoid cysts, the most prevalent lesion in this present study, were primarily treated with surgical resection or fenestration. The outcomes show that while 2 cases improved, 4 remained stable, and 1 worsened post-treatment. Hydrocephalus, another common condition, often required ventriculoperitoneal shunt placement. Here, 3 cases improved, 1 remained stable, and 1 worsened. Hematomas led to improvement in 1 case and stability in 2 cases, with no cases worsening. Antitubercular therapy for tuberculomas resulted in improvement in 2 cases and stability in 1 case. Antibiotic therapy and surgical drainage for brain abscesses led to improvement in 1 case and stability in 1 case. The complexities involved in managing pediatric space-occupying brain lesions and emphasizes the importance of individualized treatment approaches.

Overall, the study provides valuable outcome into the epidemiology, clinical presentation, types, treatment, and outcomes of SOL in children. Understanding these factors is crucial for early diagnosis, effective management, and improved outcomes in pediatric patients with brain lesions.

CONCLUSION

The study of space-occupying lesions (SOL) in pediatric patients, revealing a higher prevalence in the 2-5 years and 5-10 years age groups, with slightly more cases observed in males. Clinical presentations varied widely, with Headache Seizures and altered sensorium being the most common symptoms. Arachnoid cysts emerged as the predominant lesion type, often managed through surgical resection or fenestration. Hydrocephalus, hematomas, and tuberculomas were also notable, each requiring specific treatment approaches. These findings emphasize the complexity of managing pediatric SOL and highlight the importance of individualized treatment plans in each patient's unique circumstances. This study provides valuable insight into the epidemiology, clinical presentation, treatment, and outcomes of SOL in children, facilitating early diagnosis, effective management, and improved outcomes in pediatric patients with brain lesions.

Limitation of the study was that the sample size of the study population is limited, potentially impacting the findings to pediatric populations.

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