

# Prospective Study of Intracranial Space Occupying Lesions in Children in Correlation with C.T. Scan

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**Abstract:** ***Aims and Objectives of the Study:** Intracranial space occupying lesions are not uncommon in children. Without early diagnosis and treatment, they cause great mortality and morbidity. Intracranial space occupying lesions in children are recognized much earlier now in the course of the disease than they were two decades ago, partly as a result of improved diagnostic neuroradiology. Furthermore the outlook for children with intracranial lesions is more hopeful because of the improvement of various therapeutic modalities. Taking the above facts into the consideration, this study is under taken to analyse the age and sex incidence, clinical features, etiology of ICSOL in children. The advantage of CT scan in making early and specific diagnosis of ICSOL especially intranomatous lesions were also studied. **Materials and Methods:** Patients presenting with signs and symptoms of ICSOL in pediatric outpatient and inpatient departments in Government General Hospital & MRI over 2 year period who showed evidence of ICSOL on CT scan were taken up for study. The patient is investigated on routine and specific lines to find out possible etiological agents like infective, parasitic, vascular, developmental, neoplastic or otherwise. All patients who showed signs and symptoms of raised intracranial tension were subjected to CT Scanning of brain (Plain / with contrast) done in all patients enrolled in the study and MRI where ever indicated. For the diagnosis of tuberculoma, clinical data, nutritional and immunization status, history of contact with tuberculosis patient in the family, extra cranial evidence of tuberculous infection, positive tuberculin or BCG test, radiological evidence of intrathoracic tuberculosis, microscopic examination of sputum and gastric aspirate, tuberculous histology of the lymphnode and CT Characteristics of the lesion were taken into consideration. A small enhancing lesion on computerized tomography (CT) is a common finding in patients with signs and symptoms of ICSOL. Cysticercus granulomas and tuberculomas are the two common conditions to be considered for the diagnosis of ICSOL. Many of non invasive tests fail to differentiate between these two pathologies, as both of these lesions can be managed conservatively; it would be ideal if an etiological diagnosis could be made without a biopsy. The specific serological tests are also not available in this institution for diagnosing above conditions. As such the diagnosis in the present study is mainly based on clinical and CT Scan criteria as the study conducted by Dr. V. Rajshekhar et al<sup>12</sup>, "Differentiating small cysticercus granulomas and tuberculomas in patients with epilepsy".*

**Keywords:** ICSOL, Clinical Features, Etiology of ICSOL, C.T Scan, Neurocysticercosis, Tuberculoma

## 1. Introduction

Intracranial space occupying lesions are not uncommon in children. Without early diagnosis and treatment, they lead to great morbidity and mortality. Intracranial space occupying lesions in children are recognized much earlier now in the course of the disease than they were two decades ago, partly as a result of improved diagnostic neuro radiology. Furthermore, the outlook for children with intracranial lesions is more hopeful because of the improvement of various therapeutic modalities.

With the help of the non- invasive C.T. scanning and M.R.I., it is now not only possible to localize but also to characterize the lesion and arrive at a presumptive diagnosis of 'ICSOL' and their response to various modalities of treatment. Recently PET & SPECT has also being used for better diagnosis of ICSOL.

The term 'ICSOL' is generally used to identify any lesion, whether vascular, neoplastic, or inflammatory in origin, which increase the volume of the intra cranial contents and thus leads to a rise in the intra cranial pressure. In the strictest sense the term intracranial tumor should be reserved for neoplasms, whether benign or malignant, primary or secondary<sup>1</sup>.

Before the twentieth century most medical writings on brain tumors were only pathological descriptions from post mortem examinations, usually illustrating the macroscopic appearance of intracranial tumors. Bressler<sup>2</sup> (1839) classified intracranial tumors according to their consistency and gross appearance such as bone tumors and blood tumors. Virchow<sup>2</sup> (1863-1865) first classified brain tumors according to their cellular constituents and introduced the term "Glioma".

The histologic schools developed by Ramon y Cajal and der Rio-Hortega this century with the use of silver and gold salts for cellular impregnation, contributed much to differentiate glial cells. Rio-Hortega and separately Bailey and Cushing<sup>2</sup>, presented the first tumor classification based upon cell types morphologically resembling the primordial cells observed during embryonic development of the nervous System.

The introduction of air into the ventricles and subarachnoid spaces devised by Walter Dandy<sup>2</sup>, the contributions of Harvey Cushing and the invention of cerebral angiography by Moniz<sup>2</sup> brought rapid advancement to localise the diagnosis. The development of Electroencephalography, the use of radioactive isotopes in the 1950s and 1960s have given the physician better diagnostic tools. The most recent technological developments, Computed Tomography (CT) and Magnetic Resonance imaging (MRI) are accurate tools for localization of intracranial masses without risk to the patient<sup>2</sup>.

Computed tomography scanning (CT) developed by a British physicist, Dr. G.N.Hounsfield<sup>9</sup>, who was awarded a Nobel Prize it, is the greatest technical aid in Neurological diagnosis. Magnetic resonance experiments were first conducted in 1940's but the technique was not medically applied till 1972, when Damadian<sup>9</sup> Explored its potential.

## 2. Classification of ICSOL<sup>14</sup>

1. Brain Tumors
2. ICSOL of Infective origin
3. Vascular lesions.
4. Congenital/ Developmental malformations
5. Miscellaneous

Brain tumors are secondary only to leukemia as the most prevalent malignancy in Childhood. Approximately two thirds of all intracranial tumors occurring in children between the ages of 2 and 12 years are infratentorial (located in the posterior fossa). In adolescents and children under the age of two years, tumor occur with equal frequencies in infratentorial and supratentorial regions.

There are two major histologic types of brain tumors in children; glial cell tumors and those of primitive neuroectodermal cell origin. Neuroectodermaltumors probably arise from a primitive, undifferentiated cell line. Some tumors are unique because they originate from embryonic remnants such as craniopharyngioma, which arises from Rathke's pouch, dermoid and epidermoid tumors originating from the invagination of epithelial cells during the closure of the neural tube and the Chordoma, which develops from traces of the embryonic notochord.

The Pathogenesis of brain tumors is complex because many factors influence their development; conditions that result from abnormalities of neural crest development have a high association with tumors of the CNS. Some patients who received radiation during childhood develop cranial tumors years later. The activation of oncogenes and the inactivation of tumor suppressor genes within neoplastic cells lead to transformation and loss of growth control.

In gliomas deletion of 17p is found at high frequency in all grades of the tumor, while in high grade glioma, an additional loss of 9p occurs. In the case of glioblastomamultiforme, the most malignant variant, an addition or loss of a portion of chromosome 10 occurs in many tumors. Other tumors are associated with random chromosome loss; the meningioma with a portion of chromosome 22 and medulloblastoma with a segment of 17p, not related to the p 53 tumorsuppressorgene.

Tuberculomas still constitute a large percentage of intracranial space occupying lesions of childhood.

It can be seen at any site. Infratentorial tuberculomas were more common in children, 60% were located in cerebellum and the rest in cerebrum. In cerebrum frontoparietal region is the commonest site. Solitary lesions are more common compared to multiple lesions which are seen in 6-10% of cases only.

Brain abscess can occur in children of any age but are most common between 4 and 8 years. The causes of brain abscess include embolization due to congenital heart disease with right to left shunt (especially tetralogy of Fallot), meningitis, chronic otitis media and mastoiditis, soft tissue infection of the face or scalp, orbital cellulitis, dental infections, penetrating head injuries, immunodeficiency states, and infection of ventriculo-peritoneal shunts. Cerebral abscesses are evenly distributed between the two hemispheres, and approximately 80% of cases are divided equally between the frontal, parietal, and temporal lobes. Brain abscesses in the occipital lobe, cerebellum, and brain stem comprise about 20% of the cases. Most brain abscesses are single, but 30% are multiple and may involve more than one lobe.

Four forms of CNS neurocysticercosis occur including meningeal, ventricular, parenchymatous and mixed. Flattened opalescent, thin walled cysts in which the scolex may be present are found in the ventricles, cisterns, and subarachnoid space. Obstructive or communicating hydrocephalus may follow adhesive arachnoiditis. Vesicles contained within the Brain parenchyma may be either solitary or multiple and are approximately 1 cm in diameter.

Vascular Lesions like arterio-venous malformation, Sturge – Weber Disease, Subdural and Epidural hematomas, VonHippel – Lindau (VHL) Syndrome are also identified.

Congenital or development Lesions like tuberous Sclerosis, neurofibromatosis, Fahr's disease, arachnoid cysts may present with headache, seizures, psychomotor retardation and raised intracranial pressure secondary to either the cysts themselves or secondary to hydrocephalus.

Miscellaneous causes of ICSOL include endocrine diseases like hyperparathyroidism, hypo - parathyroidism, pseudo hypoparathyroidism and toxic substances like Lead Poisoning, vitamin 'D' intoxication, hypercalcemia are also been explained.

ICSOL presents in many ways depending on the location, type, and rate of growth of the tumor and the age of the child. Generally, there are two distinct patterns of presentation – symptoms and signs of increased intracranial pressure and focal neurologic signs.

## 3. Results

Children of all ages from infants to 12 years were studied. The incidence of ICSOL below the age of 5 years is quite low comprising only 3 cases (7.5%) after the age of 5 years the incidence increased very much comprising 37 cases (92.5%) No cases were found below 3 years of age. The incidence of ICSOL was maximum during 6-8 years [21 cases (52.5%)] and slightly less from 9-12 years [16 cases (40%)]. Maximum number of cases were found during 6th year (8 cases) followed by 8th year (7 cases) followed by 7th and 11th years with 6 cases each. Male and female ratio is almost equal with only a slight preponderance in females 21 cases (52.5%) compared to males 19 cases (47.5%) All three children found below 5 years of age were girls. 18 cases of

female and 19 cases of males were found between 6-12 years of age.

#### 4. Symptoms

Out of 40 cases studied, 34(85%) cases had convulsions. 31(77.5%) had headache, 16 (40%) patients had vomiting, 4(10%) had fever and four (10%) had strabismus. 14 cases (35%) presented with convulsions, headache and vomiting. 27 cases (67.5%) were presented with convulsions and headache without vomiting. Only convulsion as a presenting symptom without headache or vomiting was seen in 7 cases (17.5%).

Out of 34 cases with convulsions, 11 cases (32.34%) had simple partial seizures (S.P.S.), 13 cases (38.22%) had complex partial seizures (CPS) and 10 cases (29.44%) had generalized tonic clonic seizures (G.S.). Out of 11 patients with simple partial seizures five (45.4%) had frontal lobe lesion, two patients (18.2%) had parietal lobe lesions and two (18.2%) had fronto parietal lesions. Multiple sites were involved in 2 cases (18.2%)

Out of 13 patients with CPS, five (38.5 %) had parietal lobe and 3 (23.1%) had frontal lobe lesions. Fronto parietal and occipital lobe lesions were observed in one (7.7%) patient each. Three cases (23.1%) had multiple /other site lesions.

Out of 10 patients with generalized seizures 3(30%) patients had parietal lobe lesions and one (10%) had frontal lobe lesion. Cerebellar and parieto occipital lesions were found in two (20%) cases. Two (20%) cases had multiple / other site lesions. Out of 34 patients with convulsions, 31 patients had supratentorial lesions and two patients had infratentorial lesions. Both sites were involved in one patient.

Out of 40 cases studied 31 patients had headache. 26 cases had supratentorial and 4 cases had infratentorial lesions. Both sites were involved in one patient. Vomiting seen in 16 cases; 12 cases had supratentorial, 3 cases had infratentorial lesions and both sites were involved in one patient. Out of 4 patients with fever 3 cases had tuberculoma and one patient had brain abscess. Patients with tuberculoma had low grade and patient with brain abscess had high grade fever.

Out of 4 patients with squint, two patients had supratentorial and two patients had infratentorial lesions. In which there was 6th cranial nerve was involved. No positive neurological signs were noted in 21 cases (52.5%).

Pyramidal tract signs in the form of plantar up going and exaggerated deep tendon reflexes were noticed in 14 cases (35%). Bilateral ankle clonus was noticed in 2 cases. 10 patients had supratentorial lesions and 3 patients had infratentorial lesions. Both sites were involved in one patient. Granulomatous lesions were found in 10 patients, neoplasms in 3 patients and brain abscess in one patient.

Various cranial nerve involvements were seen in 10 cases, out of which 4 cases had 6th nerve involvement, 5 cases had 7th nerve involvement and one case had 2nd nerve involvement. Supratentorial lesions were found in 6 patients, infratentorial lesions were found in 3 patients and both sites

involvement seen in one case. Severe papilloedema with blurring of all disc margins was found in 3 cases. Early papilloedema with venous engorgement was seen in 3 cases. Out of 6 patients with papilloedema, 3 patients had infratentorial lesions, 2 had supratentorial lesions and in one patient both sites were involved.

3 patients with papilloedema had neoplasms, 2 had granulomatous lesions and one had brain abscess. Out of 4 patients in whom macewen's sign was positive, 3 patients had infratentorial lesions and one patient had supratentorial lesion.

Out of 4 patients with positive cerebellar signs, neoplastic and granulomatous lesions were found in two patients each. 7 cases (4 neoplasm, 2 tuberculoma and 1 NCC) of the study group had hydrocephalus.

Out of 40 cases studied, majority of patients had neurocysticercosis, comprising 24 cases (60%) followed by tuberculoma 8 cases (20%), 5 cases (12.5%) neoplasms, and calcified granuloma, arachnoid cyst and brain abscess were found in one patient (2.5%) each.

24 patients out of 40 cases of study group had neurocysticercosis. 14 (58%) males and 10(42%) females were noticed. 23 (95.8%) patients had convulsions, 14 cases had signs of raised intracranial pressure (ICP). Pyramidal signs were found in 5 (21%) and signs of meningeal irritation found in one patient (4.2%) Solitary lesions were observed in 18(75%) patients and 6 (25%) had multiple lesions. One patient had hydrocephalus. Out of 8 patients with tuberculoma, focal neurological signs were positive in two patients CSF pleocytosis was observed in 3 patients calcified lesion was seen in one patient. Ventricular enlargement seen in 2 cases. 6 patients had supratentorial lesions, one patient had infratentorial lesion and both sites were involved in one patient Multiple lesions were present in one case. History of contact with tuberculous patient was in two cases. High E.S.R. noticed in 6 cases. Out of 8 patients with tuberculoma; four patients were unimmunised and 6 patients had protein energy malnutrition. Out of 40 cases of study group, 8 (20%) patients were unimmunised out of 8 patients with tuberculoma 4 (50%) were unimmunised. 15 (37.5%) patients of the study group (n=40) had protein energy malnutrition, 6(75%) patients out of 8 cases of tuberculoma had PEM.

Intracranial neoplasms were noted in 5 cases out of 40 cases of ICSOL. 2 cases had cerebellar medulloblastoma, craniopharyngioma, brain stem gliomas and cerebellar astrocytoma ependymoma in one case each. Out of 5 cases of neoplasms, 4 cases (80%) had infratentorial lesion and one case had supratentorial lesion.

Out of all these ICSOL (40), supratentorial lesions were found in 34 cases, 5 had infratentorial and both sites were involved in one patient.

Number of cases studied 40.  
Number of cases with frontal lobe lesions-9  
Number of cases with parietal lobe lesions-10  
Number of cases with fronto-parietal lesions-4

Number of cases with temporal lobe lesion - 1  
Number of cases with occipital lobe lesion - 1  
Number of cases with cerebellar lesions - 4  
Multiple / other sites were involved in 11 cases

- a) Frontal lobe lesions: out of 9 patients with frontal lobe lesions 5 (55.5%) had simple partial seizures, 3(33.3%) had complex partial seizures and one(11.1%) had generalized seizures.
- b) Parietal lobe lesions: Complex partial seizures were found in 5 cases (50%), Simple partial seizures in 2 (20%) and generalized seizures in 3 (30%).
- c) Cerebellar lesions: Two cases with cerebellar lesion had convulsions and in both cases generalized tonic clonic seizures were noted.

Out of 40 patients with ICSOL, 15 had right sided lesions (NCC - 9, Tuberculomas 3, Calcified granuloma, Brain abscess and arachnoid cyst one each).

Left sided lesions were found in 14 cases (10 NCC; 4 tuberculomas), and bilateral lesions in 6 cases (5 NCC and one tuberculoma). Central lesions were found in 5 cases (all neoplasms) 8 cases (6 NCC, 1 Tuberculoma and 1 neoplasm) had multiple lesions and the remaining 32 cases had solitary lesions.

## 5. Discussion

ICSOL constitute one of the most important problems in infancy and childhood. When malignancies are considered in children, brain tumors rank only second to leukaemia.

Brain tumors are infrequent below the age of two years though an increasing number are being recognized and successfully treated even in this group (Pandya 1981). In our study we didn't come across any case of ICSOL below the age of 3 years which is in accordance with the study of Pandya<sup>5</sup>. We had maximum number of cases between 6 - 8 years. Matson 1969<sup>5</sup> also reported that maximum number of cases recorded between 5 and 8 years in his study. But Udani et al in their series found maximum number of cases in 10 to 15 years age group. The present study was carried in children below the age of 12 years only. So it cannot be compared with the study of Udani<sup>5</sup> et al. But in our study also, incidence of ICSOL is quite high between 10 -12 years. Matson 1969<sup>5</sup> reported peak incidence for Medulloblastoma and ependymomas below 4 years but in our study, we found only one glioma in cerebellum below the age of 4 years.

In the present study there is no definite sex predilection for ICSOL and the incidence in males 19 cases (47.5%) and females 21(52.5%) almost equal with slight preponderance in females. When brain tumors alone are considered except for cerebellar astrocytomas, other tumors occur more frequently in males than in females<sup>5</sup>. But in our study out of 5 brain tumors 4 are female and 1 male. When granulomas are taken into consideration the incidence is slightly more in males. Out of 24 cases of NCC 15 cases males, 9 cases females. Among 8 cases of tuberculomas 6 were females, 2 males.

In the present study convulsion is the commonest (85%) presenting symptom. Out of total 40 cases in children in our study, 34 cases have supratentorial lesion out of which 31 cases (91.17%) presented with convulsions and 5 cases have infratentorial lesion among which 2 cases (40%) presented with convulsions. So convulsion as a presenting symptom is more common with supratentorial lesion than with infratentorial lesion. This is in accordance with age old dictum of infratentorial lesion being less commonly associated with convulsion. The total number of cases of granulomatous origin in the present study is 33 cases, out of which 32 cases presented with convulsions (97%). The total numbers of neoplasms in the present study are 5 cases, out of which 2 cases presented with convulsions (40%). So convulsions as a presenting symptom is more commonly seen in granulomatous lesions compared to neoplastic lesion. This study reveals convulsion is the most frequent presenting symptom in all granulomatous lesions.

Out of 33 granulomatous lesions in the present study, 24 are NCC and 8 are tuberculomas and one is a calcified granuloma. Epilepsy is the commonest of the clinical presentation of NCC accounting for 22 -92% cases in a large series from outside India, and accounting for 59 -94% cases in India<sup>11</sup>. Out of 24 cases of NCC in the present study 23 cases presented with convulsions (95.7%). This is in accordance with reports given by Dr. VenkataRaman<sup>11</sup>. All cases with tuberculomas presented with convulsions in the present study. Out of 34 cases presented as convulsions, 11 showed simple partial seizures (SPS), 13 had complex partial seizures (CPS) and 10 patients had generalized seizures (GS). Other type of seizures is not noted in the present study. Out of 11 cases presented as SPS, 5 cases had lesions in the frontal lobe comprising 45.4% of SPS. So lesions involving frontal lobe usually present with simple partial seizures. Out of 13 cases presented as CPS, 5 had parietal lobe lesion (38.5%) and 3 cases had lesions at multiple sites (23.1%). Though temporal lobe lesions are supposed to give rise to CPS, in the present study a good number of lesions involving parietal lobe (5 out of 10 cases) presented with CPS, which comes to 50% of parietal lobe lesions.

Headache is noted in 31 cases out of total 40 cases comprising 77.5%. Udani et al in their study also noted that nearly 80% of cases presented with headache. Out of 31 cases presented with headache 26 had supratentorial lesions and 4 had infratentorial lesions, and both sites one case? Out of total supratentorial (34 cases) 26 presented with headache comprising 76.4% and out of total infratentorial lesions (5 cases) 4 presented with headache (80%). So headache as a presenting complaint is almost equal in both supra & infratentorial lesions. When granulomatous lesions are considered 18 out of 24 cases of NCC (75%) and 7 out of 8 cases of tuberculoma (87.5%) presented with headache. Out of 5 cases of neoplasm 3 (60%) presented with headache. So headache as a presenting complaint is more common with tuberculoma and NCC than with neoplasm.

Vomiting's were noted in 16 cases out of 40 cases. Out of total 34 cases of supratentorial lesions, 12 presented with vomiting (35.3%), where as in a total 5 infratentorial lesion 3 presented with vomiting (60%). So vomiting is more

frequently associated with infratentorial lesion compared to supratentorial lesion. Out of total 24 cases of NCC, 8 presented with vomitings (33.3%), where as 4 out of 8 tuberculomas (50%) and 3 out of 5 neoplasms (60%) presented with vomiting. Vomiting is more commonly associated with tuberculomas and neoplasms compared to NCC.

Fever is noted only in 4 cases (3 tuberculomas and 1 brain abscess). Though NCC is of infective origin, fever is not noted even in a single case. So also none of the neoplasms in the present study are associated with fever.

Squint as a presenting complaint was noted in 4 cases (2 tuberculomas 2neoplasms). In all the 4 cases the squint is due to 6th nerve paralysis. None of the cases of NCC was associated with squint. So when all the symptomatology of ICSOL was taken into consideration raised intracranial tension features like headache, vomitings and 6th nerve paralysis are more commonly the presenting symptoms with tuberculomas and neoplasms whereas convulsions is the chief presenting complaint with NCC.

Pyramidal tract signs; Pyramidal tract signs were noted in 14 cases out of total 40 cases (35%). Out of total 33 granulomatous lesions 10 showed (30.3%) pyramidal tract signs and 3 out of 5 cases of neoplasms (60%) showed pyramidal tract signs. So neoplastic lesions are more commonly associated with pyramidal tract signs than granulomatous lesions. This may be due to comparatively small size of the granulomatous lesion compared to neoplastic lesion. The other important point is that neoplastic lesions being more commonly infratentorial, the pyramidal tract involvement is more common. When NCC is considered 5 out of a total 24 cases (21%) showed pyramidal tract signs which is well correlated with the study of Puri et al<sup>18</sup> in which 25% cases showed pyramidal tract signs

Cranial nerve involvement was noted in 10 cases out of which 4 had 6th nerve involvement, 5 had 7th nerve involvement and one had 2nd nerve involvement. All the 4 cases (2 tuberculomas, 2 neoplasms) with 6th nerve involvement showed other features of raised ICT and the 6th nerve paralysis disappeared after decompressive measures, 4 cases of NCC and one tuberculoma showed upper motor neuron type of 7th nerve paralysis. Bilateral optic atrophy was noted in one case which is secondary to raised ICT in a case with cerebellar neoplasm.

Papilloedema was noted in 6 cases out of 40 cases of study group. 3 patients with neoplasms, 2 patients with tuberculoma and one patient with brain abscess had papilloedema. Out of 24 cases with NCC none had papilloedema. Thus papilloedema was more common with neoplasms (3 out of 5 cases of neoplasms 60%) followed by tuberculoma (2 out of 8 cases of tuberculoma 25%). Out of 34 cases with supratentorial lesions only 2 patients had papilloedema in contrast to 3 out of 5 cases of infratentorial lesions. Therefore papilloedema more commonly occurs with infratentorial lesions. All the cases which showed papilloedema are associated with definite signs and symptoms of ICSOL like headache, vomiting, Cranial nerve

involvement, pyramidal tract signs and motor deficits.(Table 2).

**Table 2: Papilloedema Vs Other Clinical Features**

Clinical Feature	No. of cases in The study group n=40	%	No. of cases with Papilloedema n=6	%
Vomitings	16	40	5	83.3
Cranial nerve involment	10	25	5	83.3
Pyramidal tract signs	14	35	4	66.7
Motor deficit	6	15	3	50

Positive macewen's sign noted in 4 cases, in which 3 cases had infratentorial lesions and one case had supratentorial lesions. One in 33 cases of granulomatous lesions and 3 in 5 cases of neoplasms showed positive Macewen's sign. Thus the present study showed signs of pyramidal tract involvement, cranial nerve involvement, papilloedema and positive macewen's sign were more commonly seen with infratentorial lesions than supratentorial lesions. The above signs and symptoms were more common with neoplasm than granulomatous lesions.

Hydrocephalus: 7 cases (4 neoplasms, 2 tuberculoma and 1 NCC) of this study group had hydrocephalus. The most common cause of hydrocephalus in our study is neoplasms (4 out of 7 cases).

Majority of ICSOL in the present study are of granulomatous lesions 33 cases out of 40 cases (82.5%), followed by neoplasms. 5 cases out of 40 cases (12.5%) Brain abscess and arachnoid cyst were noted in one case each.

**Table-3: Comparative study of Etiology of ICSOL**

Type of ICSOL	Mats on (1969) Boston %	Ramamurthy (1977) (Madras) %	Roose & Miller 1971 %	Dastur & Laltha %	Present Study %
Neoplasms	93.7	54.7	85	52.8	12.5
Tuberculoma	0.1	43.6	1.0	40.0	20.0
Others	6.2	1.7	14.0	7.8	67.5

Most of the studies (Table 3) outside India showed neoplasms the most common lesion in ICSOL. In Matson's (1969) study neoplasms accounted for 93.7% and other lesions 6.3% of ICSOL and in Roose & Miller study neoplasms 85% and others 15%. In contrast, in the present study granulomatous lesions (tuberculoma and NCC) accounted for nearly 82.5% and neoplasms only 12.5%. This difference may be due to low incidence of granulomatous lesion of infective origin in developed countries and high prevalence of tuberculosis and other infections in India.

Ramamurthy et al in their study in India, found that all neoplasms accounted for 54.7% and tuberculomas alone accounting for 43.6% of ICSOL.

Dastur et al found neoplasms contributing to 52.8% and tuberculoma 40.0%. In the present study tuberculoma

accounted for 20% of ICSOL and NCC 60%. From the above statistics it is evident that this incidence of ICSOL of granulomatous origin is quite high in this region compared to neoplasms. Surprisingly, in the present study NCC contributed for 60% of ICSOL- This is in contrast to a study in AIIMS<sup>11</sup> where NCC formed only 2.5% of all ICSOL<sup>11</sup>. This shows high prevalence of NCC in this region.

NCC is the commonest parasitic disease of central nervous system and is being diagnosed with increasing frequency after the advent of computerized tomography (CT). In our study majority of ICSOL is due to cysticercosis comprising 60% (24 out of 40) of ICSOL, with male preponderance (15 males, 9 females). All but one case were presented with convulsions. 5 out of 24 NCC cases showed pyramidal tract signs. 14 cases had signs of raised intracranial tension, signs of meningeal irritation noted in one case. All the clinical signs and symptoms are well correlated

**Table 4:** Comparative study of neurocysticercosis with respect to clinical and CT Characteristics

Characteristics	Present Study		Puri et al 18	
	n	%	n	%
Total cases	24	100	27	100
Male	15	62.5	13	48.1
Female	9	37.5	14	51.9
Seizures	23	95.8	21	77.7
Features of raised ICT	14	58	15	55.5
Pyramidal signs	5	21	7	25.9
Signs of meningeal irritation	1	4.2	4	14.8
Solitary lesions	18	75	2	7.4
Multiple lesions	6	25	25	92.6
Hydro cephalus	1	4.2	5	18.5

With the study of Puri et al 18. In our study 18 out of 24 cases (75%) of NCC had solitary lesions in contrast to the study of Puri et al where 92.6% were multiple lesion as shown in the table. (Table 4)

In this study, of 24 cases of NCC history of pork eating is present only in 3 cases. All the other cases maybe due to food contamination with eggs of *T. solium*. It is worth mentioning that tuberculomas still constitute a large percentage of ICSOL of childhood in most series reported from India. [Dastur (1967) 46.4%, Ramamurthy (1970) 44%, Rao (1970) 30.6%, Bagchi (1965) 17.5%] In northern India, the incidence is comparatively much lower [Tandon et al (1970) less than 6%]. (Table 5).

**Table 5:** Incidence of Brain Tuberculomas as Percentage of ICSOL in Children in Different Centres

	Total cases of ICSOL	No. of Tuberculoma Cases	% of Tuberculoma
1. Dastur et al Bombay (1966)	252	117	46.4
2. Dastur and Lalitha (1973)	127	39	30.7
3. Institute of Neurology Madras (1970)	100	44	44
4. Bagchi, Calcutta (1965)	63	11	17.5
5. Present Study	40	8	20

In our study incidence of tuberculoma is 20% (8 cases out of 40 cases of ICSOL). In our study out of 8 cases of tuberculomas 6 were females (75%)

**Table 6:** Comparative study of intracranial tuberculoma with respect to clinical and CT Characteristics

Characteristics	Present Study	Margaret A. Whelan et al 17
Sample Size	8	8
Focal neurological signs present in	6	6
+ve Mantoux test	2	7
CSF pleocytosis	3	3
Calcified lesions	1	0
Ventricular enlargement	2	5
Cerebral edema	6	7
Supratentorial lesions	6	7
Infratentorial lesions	1	1
Both sites	1	0
Multiple lesions	1	2

The above table shows the clinical and CT characteristics are well correlated with the study of Margaret A. Whelan et al<sup>17</sup>. In our study only two cases showed positive response to mantoux test. This may be due to malnutrition. In our study out of 8 cases with tuberculomas, 4 were unimmunized and 6 had protein energy malnutrition and 2 had history of contact with tuberculosis. Thus tuberculomas are commonly associated with PEM and unimmunisation.

Intracranial neoplasms were noted in 5 cases out of 40 cases of ICSOL. 2 cases had cerebellar medulloblastoma, craniopharyngioma, brain stem glioma and cerebellar astrocytoma/ependymoma in one case each. In our study the incidence is more in females (4 females, 1 male). Out of 5 cases with neoplasms 4 cases (80%) had infratentorial lesion which is the commonest site for childhood tumors and the only supratentorial lesion is craniopharyngioma, which is the commonest supratentorial lesion in children. Only one case (medulloblastoma), out of 40 ICSOL, presented with only vomitings without any positive neurological signs.

In the present study, an 8 year girl with congenital cyanotic heart disease was presented with high fever and left hemiparesis. Later CT revealed brain abscess in the right fronto - parietal region which is the commonest site for brain abscess. A ten year old boy admitted with complaint of chronic headache without any other signs and symptoms of ICSOL. In this case CT revealed arachnoid cyst in the right sylvian fissure.

In our study supratentorial lesions were more common than infratentorial lesions (Table 7). 34 cases (85%) had supratentorial lesions out of 40 cases.

**Table 7:** Comparative study of ICSOL in children

Type of ICSOL	Dastur et al					Present Study				
	Total Cases	Supra tentorial	%	Infratentorial	%	Total Cases	Supra tentorial	%	Infratentorial	%
Neoplasms	124	56	45	68	55	5	1	20	4	80
Tuberculomas	115	40	34.8	72	62.6	8	6	75	1	12.5
Other lesions	5	3	60	2	40	27	27	100	-	-

In our area the incidence of granulomatous lesions is more than neoplasms. Most of granulomatous lesions, 31 out of 33 cases (97%) were presented as supratentorial lesions. Majority of neoplasms are infratentorial; 4 out of 5 cases (80%). Thus the commonest site for granulomatous lesions is supratentorial region where as in neoplasms it is infratentorial region.

The commonest site for ICSOL in the cerebrum is parietal lobe 10 cases (25%) followed by frontal lobe 9 cases (22.5%) in our study. Both frontal and parietal lobes were involved in 4 cases (10%)

The commonest presentation of frontal lobe lesions is simple partial seizure (5 out of 9 cases) 55.5% followed by complex partial seizures (3 out of 10 cases) 33.3%. Most of the patients with parietal lobe lesions were presented with complex partial seizures 50% (5 out of 10 cases) followed by generalized seizures 30% (3 out of 10 cases). Majority of patients with infratentorial lesions were presented with signs and symptoms of raised intracranial tension (3 out of 5) 60%, and 2 cases (40%) with generalized seizures.

The present study showed almost equal distributions in left, and right sides (14 left sided lesion, 15 right sided lesions). Midline lesions were found in 5 cases, all are neoplasms. In the present study majority of multiple lesions were due to cysticercosis (6 out of 8 cases) 75%, next being tuberculomas 1 out of 8 (12.5%).

## 6. Conclusions

The incidence of ICSOL below 5 years is very low. After 5 years, the incidence is high between 6-8 years and 10-12 years. There is no sex predilection as the incidence is almost equal in male and female children. Convulsion is the commonest presenting symptom of ICSOL more so with Granulomas. Symptoms of raised ICT like headache, vomiting, and squint are more commonly seen in neoplasms compared to granulomas.

Neurological signs like pyramidal tract involvement, 6<sup>th</sup> cranial nerve paralysis and papilloedema are more commonly seen in neoplasms compared to granulomatous lesions. Frontal lobe lesions mainly present with simple partial seizures where as parietal lobe lesions present as complex partial seizures or generalised seizures. The incidence of granulomatous lesions is very high in this region. The incidence of brain tumor as ICSOL is quite low. Neurocysticercosis is the commonest granulomatous lesion seen in this region followed by tuberculoma. Most of the cases of NCC present with convulsions (95.8%). Cases of NCC are less commonly associated with features of raised ICT and focal neurological deficit compared to tuberculoma and neoplasms. More than pork eating, probably food and

water contamination with of *T. solium* is the important source of NCC in this region. CT scan is the most important tool for the diagnosis of NCC

The incidence of tuberculoma is as a percentage of ICSOL has come down in the recent times, but is a still considerable number. Tuberculoma is occurring more commonly in an immunized and children with PEM. Granulomatous lesions occur more commonly insupratentorial lesions whereas neoplasm in infratentorial lesions. Frontal and parietal lobes are the common sites of involvement in supratentorial lesions. Granulomatous lesions involve both sides almost equally. Most of the midline lesions are neoplastic in origin. Multiple site involvement is more common with NCC.

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Figure 2: Midline Medulloblastoma

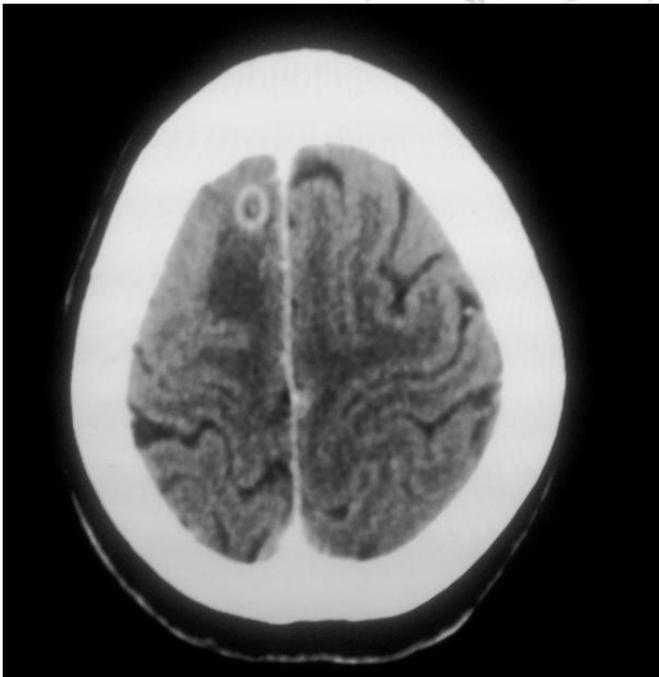


Figure 1: Neurocysticercosis with surrounding oedema