



Radiodiagnosis

“EVALUATION OF ROLE OF COMPUTED TOMOGRAPHY IN HYDROCEPHALUS AND ITS ETIOPATHOLOGIC TRENDS IN CHILDREN UNDER 14 YEAR”

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ABSTRACT Aim of this prospective study is evaluation of role of computed tomography to detect & determine the cause, type, severity and etiopathogenesis of hydrocephalus in pediatric age group. Study was conducted in the department of Radiodiagnosis, Pt. J.N.M. Medical College, Raipur (C.G.). 50 consecutive cases of hydrocephalus in pediatric age group were evaluated by CT Scan. Pediatric cases who were having large head, convulsion, sign of raised intra-cranial tension, neurological deficit and evidence of ventriculomegaly by USG were taken for the study.

Result - Out of 50 cases of hydrocephalus, majority of cases were less than 5 years of age (78%). The male to female ratio was 3:2. Maximum cases were of acquired type (62%) followed by congenital type (38%). In acquired type, infective lesions were predominant with 22 case (44%) and 9 cases (18%) were of neoplastic variety. Meningitis was commonest cause of hydrocephalus in acquired variety. In congenital hydrocephalus, Aqueductal stenosis was the commonest cause (73%), followed by 4 cases (21%) of Dandy-Walker malformation and 1 case (5%) of type II Arnold Chiari malformation. Out of 50 cases there were 14 cases (28%) of communicating type and 32 cases (62%) were non-communicating and 4 cases (8%) cases of dandy walker cyst. Moderate degree of hydrocephalus were predominating being 50%.

Conclusion: Computed Tomography is a valuable tool with very high diagnostic sensitivity and it helps for early detection of hydrocephalus with its cause and severity with precision.

KEYWORDS : Hydrocephalus, Computed Tomography, Paediatric Age Groups.

INTRODUCTION

Hydrocephalus literally means water in the head and refer to accumulation of CSF in ventricle with or without a similar accumulation in the subarachnoid space. Hydrocephalus itself is not a disease process but it is a manifestation of various other disorder like over production of CSF due to tumour in choroid plexus, defective absorption of CSF by arachnoid granules, obstruction in CSF pathway.

CT scan superceded other invasive investigations like ventriculography and pneumoencephalography.

CT clearly demonstrates the size and position of the ventricle, level of obstruction and the obstructing lesion, if present. The width of the subarachnoid spaces at the base of brain and over the cerebral convexities, patho-physiological changes in brain substances, periventricular exudation, diminished density of white matter, all these changes are clearly and early perceived with Ct2.

Several measurement or indices had been utilized in assessing hydrocephalus. In present study, ventricular size index which is the ratio of transverse diameter of frontal horn: Transverse diameter of skull at inner table is used for categorized hydrocephalus.

OBJECTIVES:-

- To evaluate the etiopathogenesis of hydrocephalus in pediatric age group.
- To assess the site of obstruction in flow of C.S.F. pathway.
- To differentiate between the cases of communicating and non-communicating hydrocephalus.
- To study the congenital as well as acquired causes of hydrocephalus

MATERIAL AND METHODS:-

Inclusion criteria- Pediatric cases with large size head, convulsion, signs of raised intra-cranial tension, neurological deficit and evidence of ventriculomegaly by USG were taken for the study.

Pre-procedural work up- All cases were underwent proper history taking including birth history, general and neurological examination and then it was followed by radiological evaluation which included plain skull skigram (lateral view and posterior-anterior view) and

sonography of brain through anterior fontanelle in both coronal and sagittal planes (used equipment 400 pro series, GE mode).

Preparation of cases - Nil by mouth for 4 to 6 hours prior to procedure. Sedation was given intravenously for un-cooperative and restless cases.

Equipment-

- All the cases were studied on “Seimens somatom ESPRIT SCANNER”. This is a third generation computed tomography scanner (C.T.)
- Matrix size = 512x512
- Slice thickness = 10-8mm, 5-3mm, 1.5-1mm.
- K.V. = 18-130
- Gantry tilt – available up to 25 degree

Technique – Routine axial scan were performed taking intra-orbital meatal line as the baseline 5mm. slices for posterior fossa with 5mm table increment and 10mm slice for the supratentorial region with 10mm table increment were employed routinely. With thin slice, sagittal and coronal reconstruction were done wherever necessary. Post contrast scan were taken as and when required.

RESULTS

Total 50 cases comprised of neonates to 14 years of age were included. In present study 19 cases (38%) were under age of 6 months and 78% cases were less than 5 years of age when registered. Only 3 cases were above 10 years of age. 62% were male and 38% were female so the male to female ratio was found to be 3:2. (Table 1)

TABLE – 1: Age And Sex Distribution Of Cases

Age group	No. of cases	%	Sex			
			Male		Female	
			No.	%	No.	%
0-6 month	19	38	7	14	12	24
6 mth – 1 year	4	8	4	8	0	0
1-2 years	5	10	3	6	2	4
2-5 years	11	22	8	16	3	6
5-10 years	8	18	6	12	2	4
10-14 years	3	6	3	6	0	0
Total - 50	50	100	31	62	19	38

Cases were distributed according to severity of hydrocephalus in mild, moderate and severe type. Moderate degree of hydrocephalus was 50% whereas mild and severe degree of hydrocephalus were 24% and 26% respectively. (Figure 1)

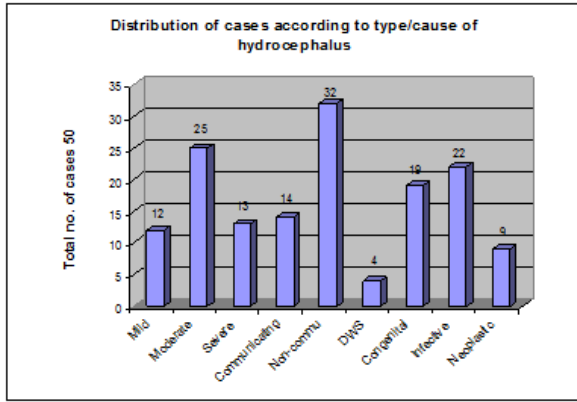


FIGURE 1

Distribution of cases according to communicating and non communicating type also done. 28% communicating, 64% non communicating type cases were found whereas 8% cases were of Dandy Walker malformation. When cases were distributed according to congenital or acquired type, 38% cases were congenital and 62% cases were of acquired origin. (Figure 1)

Most of the congenital cases were secondary to aqueductal stenosis.

two cases of congenital aqueductal stenosis and one case of DWS was associated with lumbar meningocele. In acquired cases infective lesion predominated the list. One case of hydrocephalus due to 4th ventricle outlet obstruction with intraventricular neurocysticercosis was seen in infective group. (Table 2)

TABLE – 2 : Distribution Of Cases According To Etiology

Distribution of cases	No. of patients	Percentage
Congenital causes of hydrocephalus	n=19	38
• Aqueductal stenosis	12	24
• Aqueductal stenosis + LMC	2	4
• Dandy walker cyst	3	6
• Dandy walker cyst+LMC	1	2
• Arnold chairy malformation type II	1	2
Acquired causes of hydrocephalus	N=31	62
a. Infective / Inflammatory	22	44
b. Neoplastic	9	18
Total no. of case	50	100

Various signs and symptoms related to hydrocephalus were noted. Enlargement of head, vomiting, fever, convulsion, headache, excessive irritability and impaired consciousness were the most common frequent presenting features.

All cases underwent CT examination and diagnosis was finalized. CT findings were tabulated according to related major cause of hydrocephalus. In Aqueductal stenosis, dilatation of lateral and third ventricle and normal 4th ventricle was seen in all 14 cases, 12 cases had reduced parenchymal thickness and 10 had effaced gyri and sulci. In Dandi walker cyst, there was a midline CSF density lesion in posterior fossa causing 4th ventricular compression and hypoplastic cerebellar vermis. Thinning of overlying bone seen in 50% cases of Dandy walker cyst (Table 3)

TABLE – 3: Ct Finding In Various Causes Of Congenita Hydrocephalus

S.No 1	CT finding in aqueductal stenosis	Summary cases n=14
	Dilatation of lat. & 3 rd ventricle	14
	Normal 4 th ventricle	14
	Reduced parenchymal thickness	12
	Effacement of sulci and gyri	10
	Focal parenchymal lesion	1

2	Ct finding in dandy walker cyst	Summary cases n=4
	Dilatation of lat & III ventricle	4
	Midline CSF density lesion in post fossa causing IV ventricular compression	4
	Hypoplastic cerebellar vermis	3
	Hypoplastic cerebellar hemisphere	1
	Thinning of overlying bone	2

CT findings of inflammatory / infective hydrocephalus were including presence of enhanced basal exudates, leptomeningeal enhancement and effacement of gyri & sulci with periventricular hypodensity in majority of cases. Pyogenic abscess shown rim enhancement. Communication of abscess with ventricle found in one case. (Table 4).

TABLE – 4: Ct Finding Of Inflammatory / Infective Hydrocephalus

S.No. 1	CT finding of meningitis	Summary cases n=18
	Dilatation of lat. & 3 rd ventricle	18
	Normal 4 th ventricle	12
	Effacement of sulci & gyri & cisterne	15
	Abnormal leptomeningeal enhancement	13
	Periventricular hypodensity	11
	Focal parenchymal lesion	11
S.No. 2	Ct finding of meningitis with pyogenic abscess	Summary cases n=3
	Dilatation of lat & III ventricle	3
	Dilatation of IV ventricle	1
	Rim Enhancing lesion	3
	Enhancement of sulci & fissure	2
	Enhancement of ventricular lining	1
	Communication of abscess with ventricle	1

Tubercular meningitis was predominating pathology among infective cases. Out of 22 cases of infective hydrocephalus, 12 cases (24%) were having tubercular meningitis which was confirmed by CSF analysis. 5 cases shown presence of tuberculoma on CT.

Intracranial tumours with hydrocephalus shown variety of CT findings depending on their basic character but dilatation of lateral & 3rd ventricle and mass effect was a constant feature. 4 cases shown compression of 4th ventricle, 6 cases shown contrast enhancement and 4 cases had calcification within tumour from which 2 were craniopharyngioma, 1 case of cerebellar astrocytoma and 1 case of ependymoma. (Table 5)

TABLE – 5: Ct Finding In Neoplastic Lesion

S.No. 1	CT finding	Summary cases n=9
1	Dilatation of lat. & 3 rd ventricle	9
2	Compression of 4 th ventricle	5
3	Density Cystic	2
4	Density Hypo	4
5	Density Hyper	3
6	Mass effect	9
7	Enhancement	6
8	Edema	1
9	Calcification	4

Out of total 9 cases of neoplasm, 3 were supratentorial, rest were infratentorial in location. Density of lesion varied, 2 being cystic, 4 were hypodense, 3 were hyperdense. Mass effect was observed in all 9 cases (100%).

Clinical correlation between congenital hydrocephalus and milestones was also taken into account and it was found that 50% cases with aqueductal stenosis, and all cases of Dandy walker cyst and Arnold Chiari type 2 malformation had delayed milestones. In acquired hydrocephalus, the picture was variable in this respect. Majority of cases with infective cause had either delayed milestones or regression in milestone. In contrast majority of cases with neoplastic lesion had shown normal milestones.

CT FINDINGS IN DIFFERENT CLINICAL ENTITIES IN HYDROCEPHALUS

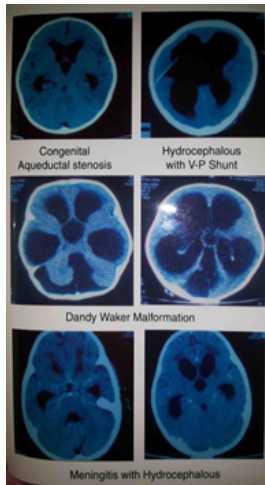


FIGURE 2

CT FINDINGS IN SOME NEOPLASTIC LESIONS WITH HYDROCEPHALUS

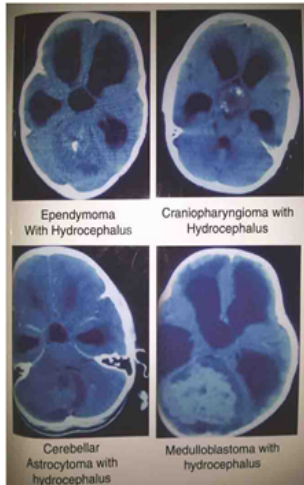


FIGURE 3

DISCUSSION

Computed tomography has changed the direction of the investigation of hydrocephalus. Computerized axial tomography provides not only an opportunity to diagnose and treat but perhaps more significantly to observe and study a disease entity during its evolution and post therapeutic progression also. It is safe and reliable technique for the study of children with increased head circumference.³

There is a rise of concern of the parents for early treatment so majority of the cases come for it in early age. In present study, 19 cases (38%) were under age of 6 months. 78% cases were less than 5 years of age. In the study of Abdullah & Naing et al⁴ age range was 1 day to 13 years and they found 30% cases between 0-30 days. O' Tuncer et al² also found majority of their cases between 3 months and 3 years.

Regarding sex distribution of cases, there was male preponderance. Out of 50 cases, 31 (62%) were male while 19 (38%) were females. Similar observations were found in study of O' Tuncer et al². Abdullah & Naing et al⁴ also observed male preponderance with 3:1 male female ratio. Kumar et al⁶, found 5.25:1 male female ratio but they have taken the cases of hydrocephalus shunt revision only.

Sign and symptoms are the main guiding force to the parents of the hydrocephalic child for seeking medical advice. Enlargement of head, vomiting, fever, convulsion were most common feature. In study of Kumar et al⁶ clinical presentation was quite similar with present study. Severity of hydrocephalus is an important aspect for treatment and prognosis so cases were categorized in to mild, moderate and severe type according to ventricular size index. 24% mild, 50% of moderate and 26% severe hydrocephalus was seen. The results were in accordance with Martis et al⁷

Hydrocephalus develops either due to obstruction in out flow or diminished absorption or over production of CSF, and thus divided in to obstructive and non-obstructive hydrocephalus. Further it is divided into communicating variety where the communication between all ventricles remain intact and into non-communicating variety which is caused by intraventricular obstruction of CSF flow.

In present study, all cases of congenital hydrocephalus secondary to congenital aqueductal stenosis and Arnold-Chiari malformation type II had non-communicating hydrocephalus while acquired group showed different pattern regarding communication. Hydrocephalus secondary to neoplasm presented as a non-communicating type in all 9 cases (100%).

In present study, 19 cases (38%) were of congenital variety and 31 cases (62%) were of acquired causes. Study of Kumar R et al⁶ was in accordance with present study. Abdullah & Naing⁴ found higher incidence of hydrocephalus with congenital variety (61%) but in that study cases only for V-P shunt were taken while we have included all patients whether shunt is required or not.

Tubercular meningitis is the most common cause of communicating hydrocephalus in India⁷. Bhargava et al⁸ also suggested that hydrocephalus is a common entity with CNS tuberculosis, accounting for about 83% cases. and basal exudates and meningeal enhancement are common findings on CT^{6,8}.

In present study, incidences of tubercular meningitis as a cause was 24% which was similar to Kumar et al⁶ who had found 20% cases and Martis et al⁷ suggested 32% cases.

In present study, most cases of TB meningitis presented with vomiting (83%), fever (76%), and headache (34%). 6 cases of non tubercular meningitis also presented with fever, cough and convulsions. On blood picture as well as in CSF examination, polymorphs were seen predominantly in non tubercular meningitis. All the cases were under severe category of hydrocephalus. Broad spectrum antibiotic coverage with ventriculo peritoneal shunt done in almost all cases.

Chung-Hua-I, Tsa-Chi Taipei et al⁹ also noted similar clinical picture. CT findings of all cases of meningitis were in accordance to many other authors.

Hydrocephalus with different types of neoplasm could be diagnosed with precision by CT scan. Out of 9 cases 4 cases were of astrocytoma (44.5%), 2 cases of craniopharyngioma (22.2%), 2 cases of medulloblastoma (22.2%) and one cases of ependymoma (11.2%). Astrocytoma was most common neoplasm. Ketan Desai et al¹⁰ also suggested the same. In present study, out of 4 astrocytoma, 2 were located in vermis and 2 in cerebellar vermis. 2 were hypodense and 2 were of cystic density. Our results were similar with study done by C Viano et al¹¹.

In present study, there was 2 cases of medulloblastoma. Both of them arose in vermis and hyperdense in nature. This was in accordance with Bourgoies et al¹².

2 cases of craniopharyngioma were suprasellar in location, showing hypodense lesions with contrast enhancement. Calcification seen in both cases (100%). According to Zimmerman et al¹³ calcification in the solid or wall portion of the cyst is common in craniopharyngioma.

There was only one case of ependymoma which was infratentorial and located in forth ventricle, was hyperdense with contrast enhancement. Calcification was present. Swartz et al¹⁴ reported 73% of ependymoma to be infratentorial in forth ventricle. 50% cases exhibit calcification.

It clearly appears that CT is extremely powerful investigative modality for the diagnosis, management and follow up assessment of development of any complication and also can predict the prognosis of the case¹⁵ By CT alone or with ventriculography and radionuclide CSF flow studies, the type and cause of hydrocephalus can usually be diagnosed¹⁶

CONCLUSION

Computed tomography is a non-invasive readily available, early to perform, non-operator dependent modality with superb spatial resolution and ability to detect calcium & bone density discrimination. Therefore CT is a valuable tool with very high diagnostic sensitivity which helps in early detection of hydrocephalus with more precision of clinicopathological causes and hence its management. It also gives additional information during follow-up.

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