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CT SCAN EVALUATION IN HYDROCEPHALUS

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ABSTRACT

Objective: To analyze hydrocephalus among patients in our city. **Design**: Role of CT scan evaluation in hydrocephalus. **Setting**: Study was conducted in the spiral CT scan in Ibn-Sena Teaching Hospital between October 2005 and October 2006. **Subjects**: One hundred hydrocephalus patients covering all age groups. **Methods**: All patients were examined by spiral CT scan (Siemens Somatom plus4). **Main results**: I- The more peak incidence of hydrocephalus is below one year of age 45%. II- 53 cases (53%) male and 47 cases (47%) female. III- 60 cases (60%) congenital hydrocephalus and 40 cases (40%) acquired hydrocephalus. IV- 81 cases (81%) obstructive hydrocephalus and 19 cases (19%) non-obstructive hydrocephalus. **Conclusion:** CT scan provides complete information for diagnosing hydrocephalus, which needs no special preparation and usually takes many seconds or just few minutes to perform, therefore it is the method of choice for diagnosis of hydrocephalus.

KEYWORDS: Hydrocephalus. Spiral CT scan.

INTRODUCTION

Hydrocephalus

It is defined as over accumulation of cerebrospinal fluid (CSF) in the ventricles and is almost always caused by obstruction to CSF flow or as an imbalance of CSF formation and absorption. It can be associated with either increased or normal intracranial pressure (ICP).[1,2,17]

Hydrocephalus is derived from Greek word hydro-water and cephalus-brain, referring to an increase in water content of the brain.[6]

Pathophysiology of CSF production-absorption-flow

CSF production is equal to 0.4 ml/minute Total volume of CSF is equal to 150 ml, 25 ml of which is within and around the spinal cord, and it is commonly held that the CSF is made almost entirely within the ventricles by the choroids plexus.[2,4,8]

Normal route of CSF

The CSF passes through the following: Choroids plexus to lateral ventricles to inter ventricular foramen of monro to third ventricle to cerebral aqueduct to fourth ventricle to two lateral foramina of luschka and one medial foramen of magendie to subarachnoid spaces to arachnoid villi to dural sinus and to venous sinuses.[4,9]

Anatomy of ventricular system

The ventricular system of the brain is made up of four ventricles.

Two lateral ventricles: they are two largest ventricles and each one has

- Frontal (ant.) horn.
- Body (atrium).
- Temporal (inf.) horn.
- Occipital (post.) horn.
- Third ventricle.
- Fourth ventricle.[4]

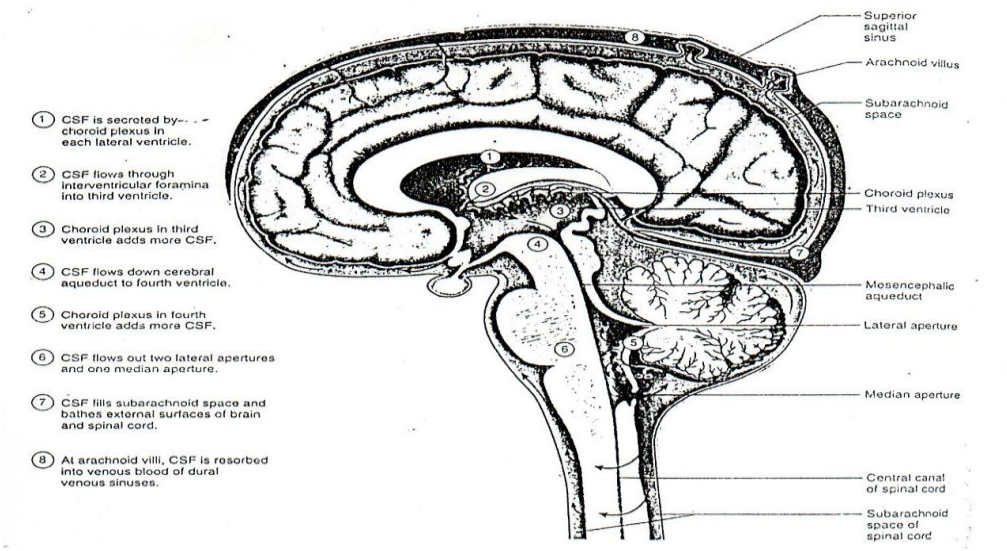


Fig. (1): Shows the Anatomy and the flow of cerebrospinal fluid.

Clinical features of infantile hydrocephalus

Infantile hydrocephalus shows head enlargement, "low set" ears and eyes, thin and glistening of the scalp, enlarged the anterior fontanel and weakness of upward gaze (the setting - sun sign).[2]

Clinical features of adult- type hydrocephalus

Adult – type hydrocephalus is characterized by evidence of nausea, vomiting, headache, parinaud's syndrome, papilledema or optic atrophy and behavioral disturbances.[2]

Types of hydrocephalus

Many types are noted

1- According to when the condition was developed

Congenital or acquired[2]

2- According to causes of reabsorption problem or a blockage

Communicating or Non-communicating[5]

3- Another types of hydrocephalus

Normal pressure hydrocephalus[2]

Congenital hydrocephalus

The prevalence of congenital hydrocephalus is between 0.48 and 0.81 per 1000 births and this can be due to:

1- Aqueduct stenosis due to gliosis, true narrowing and septum.
2- Atresia of the formina of luschka and magandie (Dandy walker cyst).
3- Pressure by intracranial mass on the pathway of the CSF like benign intracranial cyst, vascular malformation and tumors.
4- Other causes include arnold- chiari malformation, leptomeningeal inflammations, lissencephaly, cytomegalovirus and toxoplasmosis as shown in Figure (2).[2,3,5]

Acquired hydrocephalus

Acquired hydrocephalus can be due to aqueduct stenosis (gliosis), ventricular inflammation and scars, tumors, non- neoplastic masses, infection, haemorrhage and trauma.[2,10,18]

Obstructive (Non- Communicating) hydrocephalus

It is hydrocephalus which is mostly due to obstructive causes which are many. There is no dilated sulci in this case, the obstruction could be at the level of foramen of monro, third ventricle and cerebral aqueduct, or due to atresia of foramina of luschka and magendie (Dandy Walker-cyst) as shown in Figure.

Communicating hydrocephalus (non obstructive H.C.)

It may result from prior infection such as meningitis, or secondary to previous hemorrhage caused by either trauma, surgery, rupture aneurysm, subarachnoid hemorrhage. It is characterized by dilatation of the lateral ventricles, then third and fourth ventricles and dilatation of the sulci with preservation of gray-white matter discriminability. Also, it is characterized by appearance of periventricular edema as shown in Figure (4).[11,13,21]

Normal- pressure hydrocephalus (NPH)

It is defined as a state of chronic hydrocephalus in which the prevailing CSF pressure has turned to a physiologic range but in which a slight pressure gradient persists between the ventricles and the brain. In elderly patients it is presenting with the clinical triad of a gait disturbance, dementia, and incontinence as shown in Figure (5).

The etiology of idiopathic (NPH) is unknown, but can be attributed to:

- Head trauma.
- Meningitis.
- Subarachnoid bleeding.
- Arachnoiditis.
- Tumours.[2,7,14,16]

PATIENTS AND METHODS

One hundred patients in different age groups with hydrocephalus were studied in the department of radiology in Ibin-Sena teaching hospital in Mosul city between October 2005 and October 2006. All patients were examined by spiral CT scanner use which was (Siemens somatom plus 4). CT examination is done on axial section, at 8mm slice thickness and the results are assessed by two senior radiologist in CT.

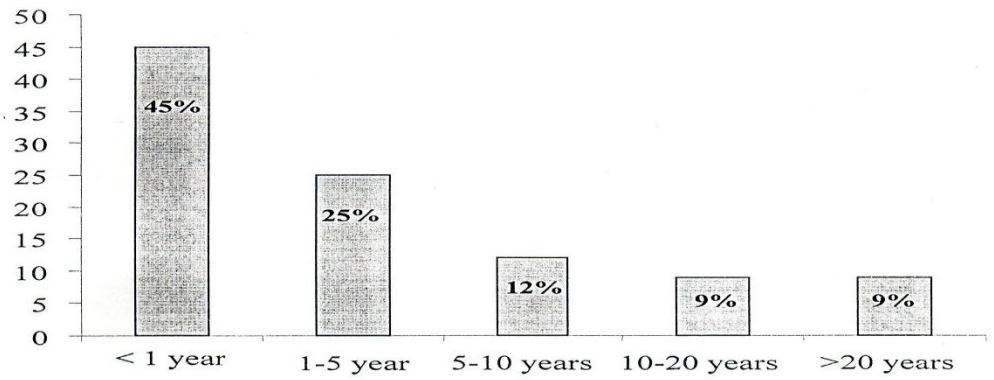
Iodine - containing solution is used for contrast enhancement as the.

		Concentration	Dose
Omnipaqe (iohexol)	In adult	350 mg/ml	Total amount of iodine usually 30-60 gm
	In children	240 mg/ml Or 300mg/ml	2-3 ml/kg B.Wt. 1-3 ml/kg B.Wt.
Iopamario (iopamidol)		300-370mg/ml	0.5-2.0 ml/kg B. Wt.

Sedation was used for children under 6 years of age:
1- Diazepam I.V. dose 0.2-0.3 mg/kg or per rectally dose 5 mg or I.M.
II- Chloral hydrate in a dose 5 mg/kg I.V.
III-General anesthesia some time needed.

RESULTS

The age distribution of those patients in our series is shown in histogram 1:



In this series there are 100 patients who had hydrocephalus and therewere:

45 of them (45%) below one year of age. 25 of them (25%) between 1-5 years of age. 12 of them (12%) between 5-10 years of age. 9 of them (9%) between 10-20 years of age. 9 of them (9%) more than 20 years of age.

Sex distribution

Of 100 patients who had hydrocephalus there were 53 of them (53%) male and 47 of them (47%) female. So male to female ratio 1.13:1

Table (I): Shows sex distribution.

Sex	No. of patients	%
Male	53	53
Female	47	47
Total	100	100

Of 100 patients in our series who had hydrocephalus there were 60 of them (60%) congenital type of hydrocephalus and 40 of them (40%) acquired type of hydrocephalus.

Table (II): Shows percentages of congenital hydrocephalus to acquired hydrocephalus.

Type of hydrocephalus	No. of patients	%
Congenital	60	60
Acquired	40	40
General hydrocephalus	100	100

Of 100 patients in our series who had hydrocephalus there were 81 of them (81%) obstructive type of hydrocephalus and 19 of them (19%) non obstructive type of hydrocephalus.

Table (III): Shows percentages of obstructive hydrocephalus to non obstructive communicating hydrocephalus.

Type of hydrocephalus	No. of patients	%
Obstructive HC.	81	81
Non-obstructive HC.	19	19
General hydrocephalus	100	100

In our series the acquired obstructive hydrocephalus is more common than acquired non-obstructive hydrocephalus.

Table (IV): shows classification of acquired hydrocephalus in our series with number of cases and % of distribution.

Type of acquired	No. of cases	From acquired %	From general hydrocephalus %
hydrocephalus	22	55	22
Non-obstructive	18	45	18
Total	40	100	40

Classification of congenital hydrocephalus in our series

Aqueduct stenosis is more common cause than other types of congenital hydrocephalus.

Table (V): Shows classification of congenital hydrocephalus in our series with no. of cases and percentage of distribution.

Types of congenital hydrocephalus	No. of cases	from congenital	from general hydrocephalus %
Aqueduct stenosis	33	55	33
Arnold chiari malformation	11	18.33	11
Dandy walker cyst	8	13.33	8
Obstruction of foramina of monro	1	1.67	1
A genesis of corpus callosum	1	1.67	1
Arachnoid cyst	1	1.67	1
Obstruction of formania of luschka and magendie	5	8.33	5
Total no. of cases	60	100	60

Regarding the congenital hydrocephalus in our series

Less than one year there are 40 patients (66.67%)
From 1-5 years there are 14 patients (23.33%)
From 5-10years there are 5 patients (8.33%)
From 10-20 years there are 1 patient (1.67%)
No congenital hydrocephalus in more than 20 years of age in our series

Table (VI): Shows the comparison of the age of the patients in various types of the congenital hydrocephalus.

Types of congenital hydrocephalus	No. of cases	less than year	1-5 years	5-10 years	10-20 years	More than 20 years
Pure aqueduct stenosis	33	21	8	3	1	-
Dandy walker cyst	8	4	3	1	-	-
Obstruction foramina of Luschka and magendie	5	5	-	-	-	-
Arnold-chiari malformation	11	10	1	-	-	-
Obstruction foramina of monro	1	-	1	-	-	-
Arachnoid cyst	1	-	1	-	-	-
Agenesis of corpus callosum	1	-	1	-	-	-
Total	60	40	14	5	1	-

Types of acquired hydrocephalus

In our series 40 patients are acquired hydrocephalus

1- Obstructive hydrocephalus

22 patients are obstructive hydrocephalus in our series

Table (VII): Shows acquired obstructive hydrocephalus.

Types of acquired obstructive HC.	No. of each type	%
Ventriculitis	5	22.72
Craniopharyngioma	5	22.72
Post. fossa tumor	6	27.27
Medullablastoma	3	13.64
Low grade glioma	1	4.55
Inter ventricular haemorrhage	2	9.1
Total no. of cases	22	100

2- Non- obstructive hydrocephalus

18 patients are non- obstructive hydrocephalus in our series.

Table (VIII): Shows acquired non-obstructive hydrocephalus.

Types of acquired non- obstructive HC.	No. of each type	%
Meningitis	10	55.55
Subarachnoid haemorrhage	3	16.67
Brain hypoxia	1	5.56
Brain abscess	2	11.11
Choroid plexus papilloma	2	11.11
Total no. of cases	18	100

In our series the level of aqueduct is more common than other types of level of hydrocephalus

Table (IX): Shows percentage of level and extent of hydrocephalus.

Level of hydrocephalus	No. of patient	%
Intra ventricular	10	10
Extra ventricular	33	33
Level of aqueduct	44	44
4th ventricle	13	13
Total no. of ceases	100	100

In our series 100 patients who had hydrocephalus there were 16 of them (16%) with shunt presentation and 84 of them (84%) without shunt Presentation.

Table (X): Shows no. of cases of hydrocephalus with and without shunt presentation.

Presence of shunt		No. of cases	%
Patient with Shunt 16 cases	patent	10	10
	occluded	6	6
Patient without shunt		84	84
Total no. of cases		100	100

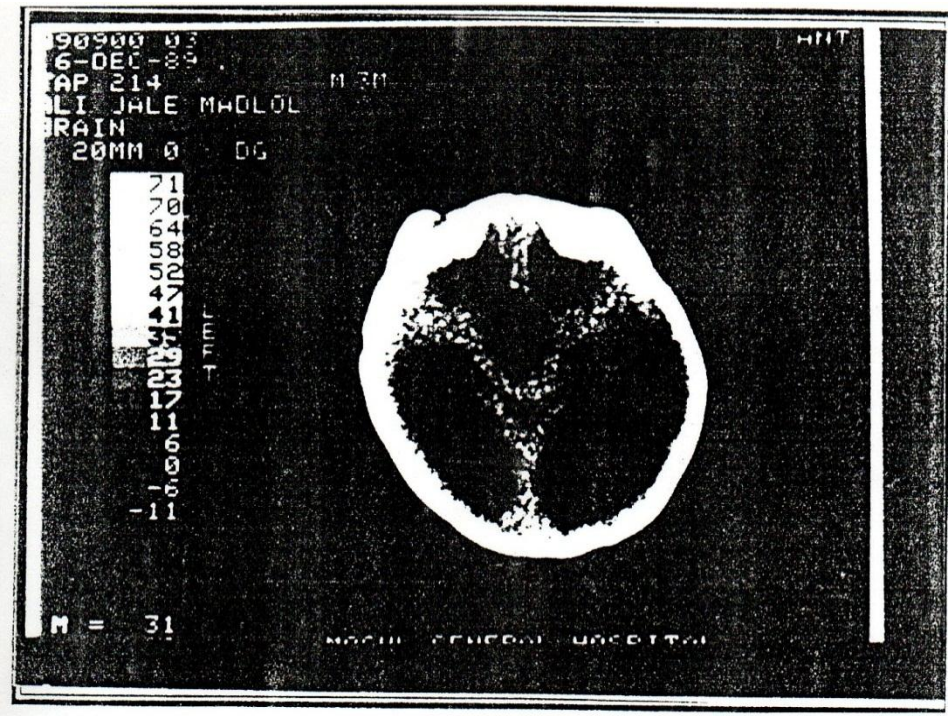


Figure (2): Shows congenital hydrocephalus (aqueduct stenosis).

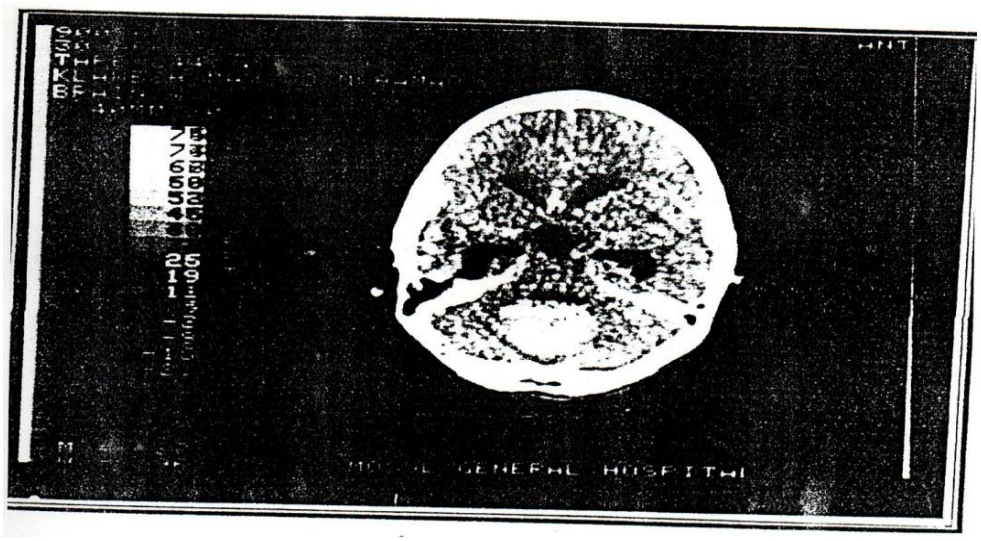


Figure (3): Shows obstructive hydrocephalus due to posterior fossa tumor (medulloblastoma).

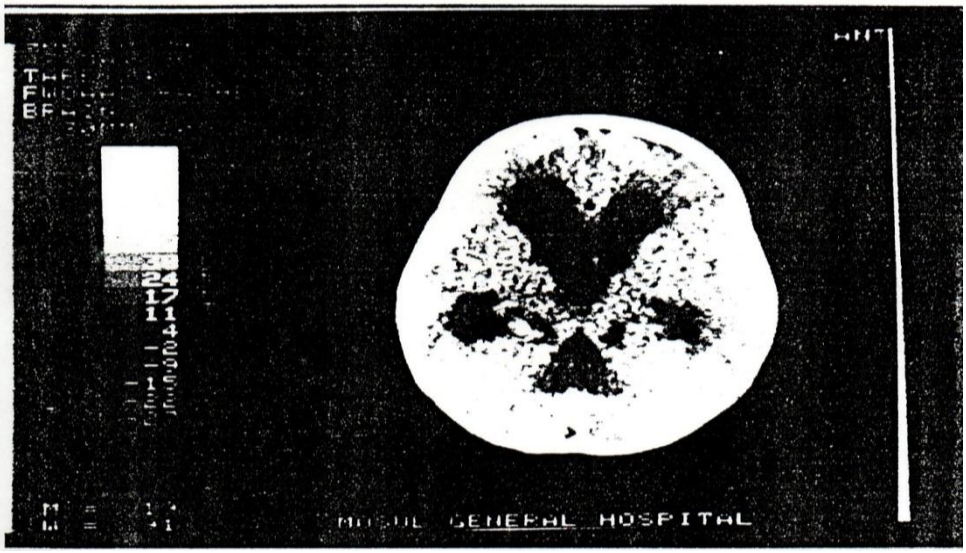


Figure (4): Shows Communicating Hydrocephalus.

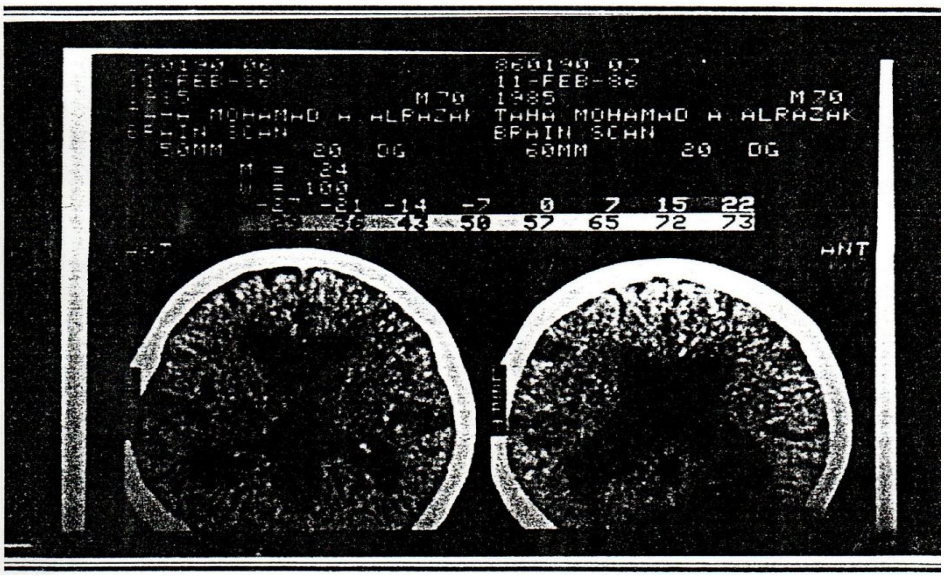


Figure (5): Shows Normal Pressure Hydrocephalus

DISCUSSION

Regarding the sex, in my series 53 patients out of 100 patients (53%) were male and 47 of them (47%) were female by ratio 1.13**:**1, in comparison with Thanh G. Phan, et al. 2000[15] who found male 57% and female 43% by ratio 1.33**:**1.

Aqueduct stenosis was the commonest cause in my series which was 33% of all cases of hydrocephalus, in comparison with the study of Arno H. Fried, M.D. et al. 2005[19] who found that the aqueduct stenosis was 40% of all cases of hydrocephalus.

Regarding medulloblastoma, in my series 66.67% of cases of medulloblastoma occur under 16yeas, which is in agreement with the study of Arnolfo De Carvalho Neto, et al. 2003[12] 70% of the cases occur under 16 years of age.

Neoplasm in my series causing 68.18% of obstructive hydrocephalus similar to study of Aziz M. Ulug et al. 2003[21] the neoplasm causing 71.4% of obstructive hydrocephalus.

Regarding Arnold Chiari malformation in our series was 18.33% of all congenital causes of hydrocephalus in comparison with Williams and Wilikin (1985)[23] who found the result 10.8%, this is explained probably due to the number of my cases which is usually below one year.

Regarding the craniopharyngioma and glioma, in my series craniopharyngioma occurring between 16 and 18 years, and by comparison with David Sutton, seventh edition 2002[5] it was mentioned to occur between 6-10 years, and the glioma in my series present at age 11 year but in the study of David Sutton 2002[5] it has a peak incidence of 1-6 year, the cause in both cases can be attributed to delay in diagnosis in our patients, possibility is due to lack of health education, or due to CT scan equipment deficiency in our country.

Regarding choroids plexus papilloma. In my series it is found at 2nd year of age, but in David Sutton, 2002[5] study it was common in 1st year of age. This is due to delay in the diagnosis.

Arachnoid cyst was present in my series at 2nd year of age in comparison with that of David Sutton 2002[5] who found that it can be present in adults but more usually it can be present in infants.

Regarding shunt presentation CT scan provides more detailed information on v-p shunt presentation and functioning, in my series 16 patients (16%) of all cases of hydrocephalus are present with v-p shunt, 10 cases of them (10%) are patents and 6 cases of them (6%) are occluded, which is due to disconnection, catheter malposition, or valve pressure incompatibility.

CONCLUSIONS

Computed tomography (CT) scan provides more information on diagnosis and types of hydrocephalus, in my series the most common peak frequency of hydrocephalus is below one year of age, the cause can be attributed to most of these cases is congenital hydrocephalus and diagnosed at the time of the delivery or even intrauterine diagnosis or due to early clinical diagnosis of the hydrocephalus by the neurosurgeons, the role of CT scan in the early diagnosis of hydrocephalus gives better chance for successful management of hydrocephalus.

RECOMMENDATIONS

1. I recommend that any suspected fetus with hydrocephalus diagnosed during intrauterine life should be exposed after delivery to careful US examination of the head and assessed by CT scan.
2. To increase the number of CT scan unit in our town for better services.
3. To plan for increasing the number of good trainee in the CT scan field.

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