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Retrospective Analysis of Brain Computed Tomography of Children with Neurological Disorders ina Tertiary Hospital, Abuja Nigeria

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Abstract

Background

Computed tomography is a rapid, readily available and non-invasive modern imaging technique that is used in detecting brain pathologies among children with neurological disorders, although its used has been limited in children due to high radiation effect. However management of children with neurological condition can be quite challenging and often associated with disability.

Aim

This study aimed at reviewing the radiological indication for CT examination and the findings in children who presented with neurological disorders in Abuja.

Materials and methods

This was a retrospective descriptive study conducted at radiologydepartment, University of Abuja teaching Hospital.The computed tomographic images of Children with neurological disorder aged 0- 15years usingToshiba Activion 16-slice CT scanners from January 2015–December 2018 were reviewed. Information of patients retrieved from the case note includes age, gender, indications for the CT scan and findings.

Result

There were one hundred and twenty seven CT scan images of children with neurological disorders reviewed. The male: female ratio of 1.5:1. The age range of the children was 2months to 15years with median age of 5.7years. Theindication necessitating CTexamination retrieved from case note included head trauma 41(32.3%), this was closely followed by seizures 27(21.3%) and hydrocephalus 14(11.0%). The predominant CT findings are fracture 15(11.8%), cerebral atrophy 14(11.0%) and intracranial tumour 14(11.0%).

Conclusion

Trauma, seizures, hydrocephalus and delayed developmental milestone are common indications for CT in our environment. Common CT findings were fractures,cerebralatrophy and intracranial tumour. Computed tomography imaging is a valuable tool in evaluating neurological disorders in children.

Keywords:*Computed tomography,children, neurological disorders,Abuja.*

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I. Introduction

Neurological disorders in children are common occurrence in clinical practice[1].The management of children with neurological disorders can be quite challengingespecially for the parents and the physician. Computed tomography is one of the modern imaging modality that is being employed in evaluating patients with neurological disorders and its use in children has increased over the years because its technique is rapid,non-invasive and gives a multiplanner image of the brain[2,3]. However the use of computed tomography in children should be with caution because of the high radiation dose associated with it resulting in adverse effect.

To prevent unnecessary exposure of children undergoing CT studies to radiation, a standard protocol needs to be adopted to guide the referring physician on the indications and imaging acquisition protocol should be designed in children to prevent adverse effect[2].Furthermore the cost and availability of theCT machine in the developing country mayresult in delay in detecting pathologies in the brain of children with neurological disordersthat may require surgical/medical intervention[4].The increasing availability of CT scanners in Nigeria with our centre a beneficiary of one has made neuroimaging available option in the management of children with neurological conditions. There is paucity of data in our environment on the indication, patterns of computed tomography findings and utilization of computed tomography in evaluation of children with neurological disorder. This study aimed at reviewing the radiological indication for CT examination and the findings in children who presented with neurological disorder in Abuja.

II. Materials And Methods

STUDY DESIGN: This was a retrospective cross-sectional descriptive study which span from January 2015–December 2018.

STUDY AREA: This study was carried out at the Radiology department of University of Abuja teaching hospital, Gwagwalada, (F.C.T). The Hospital is located in Gwagwalada whose geographical coordinates are 8° 56' 29" North and 7° 5' 31" East.The hospital receives patients from neighbouring states of Nassarawa, Kogi, Niger and Kaduna.

STUDY POPULATION: These comprise children aged 0-15years with neurological conditions that had a cranial CT. The indications for cranial CT were retrieved from the children case notesand the corresponding CT images of the children reviewed

All brain scans were done using ToshibaActivion 16-slice CT scanners. Serial axial slices of the brain were taken from the base of the skull to vertex at 3- 5mm. Low osmolar intravenous contrast at 1ml/Kg was given in the absence of haemorrhage. Lead shields were used to cover parts of the body which was not under examination to reduce radiation dose. The principle of ALARA(As low as reasonably achievable) was applied. Patient's age, sex and the indication for CT were recorded from the request form. The CT images and radiologist's reports were reviewed by the consultant radiologist and findings were documented

III. Data Analysis

Data were collated and analysed using SPSS 19.0 software 2010 by IBM^R USA. P-value<0.05 was taken as statistically significant. The results are presented in the form of tables and charts. Pearson correlation test was done to determine the relationship between variables.

IV. Result

There were 127 children with neurological disorders whose case note and CT scan result and imageswere reviewedcomprising of 71 males and 46 females ratio1.5:1. The age range was 2months to 15years with median age of 5.7years. Majority of the children examined were in 4-5years and 14-15 years age group accounting for 23.6% and 16.5% respectively. However, 8 (5.5%) had CT examination in 8-9 years age group representing the least age group. Figure 1

From the documentation in the case note of the children, medical indications for CT scan examinations during the period under review include 41 (32.3%) children having head trauma and closely followed by seizures with 27 children representing 21.3% of the indications for CT scan. Other indications includes: hydrocephalus 14(11.0%), delayed developmental milestone 12(9.4%), headache 9(7.1%), loss of consciousness 8(6.3%), focal neurological deficit 6(4.7%), Infection 5(3.9%), others 5(3.9%). Table I.

Out of the 127 children case note studied, there were 29 (22.8%) children with normal CT findings and 98(77.2%) of children had abnormal CT findings. The distribution of CT scan findings among the children reviewed was statistically significant (p=0.001). Among the children examined who had abnormal CT findings, the predominant CT findings are fracture 15(11.8%), cerebral atrophy 14(11.0%), intracranial tumour 13(11.0%) and contusion 10(7.9%). Table II.

Trauma to the head was the commonest indication for CT accounting for 41(32.3%). The computed tomography findings in children with head trauma include: fracture 15(36.6%), contusion 10(24.4%), normal findings 8(19.5%), epidural haemorrhage 5(7.3%), subdural haemorrhage3(12.2%). Table III

Among children whose indication for CT was seizures, the CT findings were normal in 13 children representing 48.1% and 14 children had abnormal CT accounting for 51.9%. Majority of the children had aferible seizures and generalised toni-clonic in nature. The abnormal findings on cranial CT were majorly cerebral atrophy 8(29.6%), intracranial tumours 4 (14.8%) and cerebral infarct 2(7.4%).The relationship between the indications (head trauma and seizure) and the CT findings among the children investigated were statistically significant (p=0.03 and p=0.001 respectively). There was a positive correlation between the indications (head trauma and seizure) for CT scan and the documented CT findings (spearman correlation= 0.769 and 0.64 respectively, Table III).

All the patients with hydrocephalus had abnormal CT. General characteristic CT findings among these children were enlarged cranium, craniofacial disproportion and dilated ventricles. Meningeal enhancement 5(35.7%), acqueductal stenosis 4(28.5%), intracranial tumour 3(21.4%) Fig 2, Daddy –Walker syndrome 1(7.1%) Fig 3, Arnold Chiari syndrome 1(7.1%) were CT findings noted in children with hydrocephalus Table III.Congenital hydrocephalus accounted for 6(42.9%) of CT scan result of children examined and was predominantly seen among children less than twenty-four months. Obstruction to CSF flow was noted more at the aqueduct of Slyius for 4(28.6%) of the patients with congenital hydrocephalus. Acquired hydrocephalus was seen ineight children representing 57.1% and was secondary to infection mainly post meningitis and intracranial tumours.

The indication in 12 children who presented in the CT suite was for delayed developmental milestone. Furthermore, all the children investigated had abnormal CT findings and the findings includes cerebral atrophy 6(50.0%), cerebral infarct 2(16.7%), premature closure of sutures 4(33.3%). The relationship between the indications (hydrocephalus and delayed developmental milestone) and the CT findings among the children investigated were not statistically significant (p=0.7 and p=0.62 respectively). There was a positive correlation between the indications (hydrocephalus and delayed developmental milestone) for CT scan and the documented CT findings (spearman correlation= 0.43; 0.74 respectively, Table III).

In children with indication of headache, 3(33.3%) of children showed no brain abnormalities while 6(66.6%) had abnormal CT findings. Among the children with abnormal CT findings, 2(22.2%) patients had Intracranial tumour and 4(44.4%) had sinusitis. Table III

Abnormal CT findings among children with primary indication as loss of consciousness include cerebral oedema 4(50.0%), intracranial tumour 3(37.5%), and cerebral infarct 1(12.5%). All the 6 patients with focal neurological deficit

were noted with abnormal CT findings. Among children with abnormal CT findings, 2(33.3%) patients had intracranial tumour, 2(33.3%) had cerebral infarct and 2(33.3%) had subdural empyema. Table III.

Two out of five children whose indication for CT was infection had normal CT findings while three had abnormal. Among children with abnormal CT findings, meningeal enhancement representing 20.1% and subdural empyema representing 40.0%. The relationship between the indications (headache, loss of consciousness and infections) and the CT findings among the children investigated were not statistically significant (p=0.09; p=0.6 and p=0.07). There was a positive correlation between the indications (headache, loss of consciousness and infections) for CT scan and the documented CT findings (spearrman correlation= 0.38; 0.91 and 0.72 respectively, Table III).

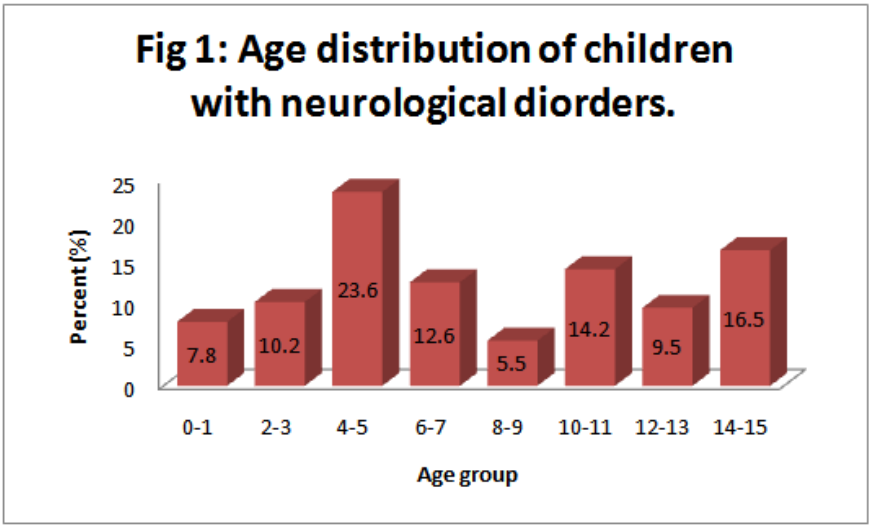

Table I: Common indications for CT among children with neurological disorders.

Indications	Freq	%
Head trauma	41	32.3
Seizures	27	21.3
Hydrocephalus	14	11.0
Delayed milestone	12	9.4
Headache	9	7.1
Loss of consciousness	8	6.3
Focal neurologic deficit	6	4.7
Infection	5	3.9
Others	5	3.9
	127	100 0

Table II: CT findings among children with neurological disorders.

Findings	Freq	%
Normal	29	22.8
Fracture	15	11.8
Cerebral atrophy	14	11.0
Intracranial tumour	14	11.0
Contusion	10	7.9
Cerebral infarct	7	5.5
Meningeal enhancement	6	4.7
Epidural haemorrhage	5	3.9
Aqueductal stenosis	4	3.2
Cerebral edema	4	3.2
Sinusitis	4	3.2
Subdural empyema	4	3.2
Premature closure of sutures	4	3.2
Subdural haemorrhage	3	2.4
Daddy Walker syndrome	1	0.8
Arnold chiari malformation	1	0.8
Others	2	1.6
	127	100.0

TABLE III: INDICATION AND CT FINDINGS AMONG CHILDREN WITH NEUROLOGICAL DISORDERS

INDICATIONS		**CT FINDINGS**				
	FREQUECY (%)	**FREQUENCY (%)**	**FREQUENCY (%)**	**FREQUENCY (%)**	**FREQUENCY (%)**	**FREQUENCY (%)**
		NORMAL	**FRACTURE**	**CONTUSION**	**EPIDURAL HAEMORR**	**SUBDURAL HAEMORR**
TRAUMA	41(32.3)	8 (19.5)	15 (36.6)	10 (24.4)	5 (7.3)	3 (12.2)
		NORMAL	**CEREBRAL ATROPY**	**CEREBRAL INFARCT**	**INTRACRANIAL TUMOUR**	
SEIZURES	27 (21.3)	13 (48.1)	8 (29.6)	2 (7.4)	4 (14.8)	
		MENINGEAL ENHANCEM	**AQUEDUTAL STENOSIS**	**INTRACRANIAL TUMOUR**	**DWS**	**ACM**
HYDROCEPHALUS	14 (11.0)	5(35.7)	4(28.5)	3(21.4)	1(7.1)	1(7.1)
		NORMAL	**CEREBRAL ATROPY**	**CEREBRAL INFARCT**	**PREMATURE CLOSURE OF SUTURES**	
DELAYED DEVELOPE MENTAL MILESTONE	12 (9.4)	0 (0.0)	6 (50.0)	2 (16.7)	4 (33.3)	
		NORMAL	**INTRACRANIAL TUMOUR**	**SINUSISTIS**		
HEADACHE	9 (7.1)	3(33.3)	2 (22.2)	4(44.4)		
		NORMAL	**CEREBRAL INFARCT**	**INTRACRANIAL TUMORS**	**CERBRAL ODEMA**	
LOSS OF CONSCIOUSNESS	8 (6.3)	0 (0.0)	1 (12.5)	3 (37.5)	4(50.0)	
		NORMAL	**CEREBRAL INFARCT**	**INTRACRANIAL TUMOUR-**	**SUBDURAL EMPYEMA-**	**-**
FOCAL NEUROLOGICAL DEFICIT	6 (4.7)	0 (0.0)	2(33.3)	2(33.3)	2(33.3)	
		NORMAL	**MENINGEAL ENHANCEME**	**SUBDURAL EMPYEMA**		
INFECTIONS	5 (3.9)	2 (40.0)	1 (20.0)	2(40.0)		
Total	**122**					

KEYS
Epidural haemorr-epidural haemorrhage, Subdural haemorr- subdural haemorrhage,communihydrocep- communicating hydrocephalus, Meningeal enhancemen – meningeal enhancement.
DWS – Daddy Walker Syndrome

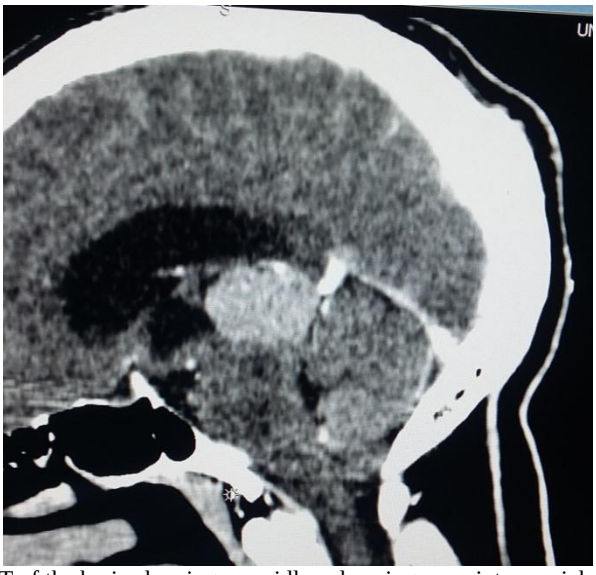

Figure 2: Contrast enhanced CT of the brain showing an avidly enhancing mass intracranial mass in the region of the pineal gland associated dilation of the lateral and third ventricles.

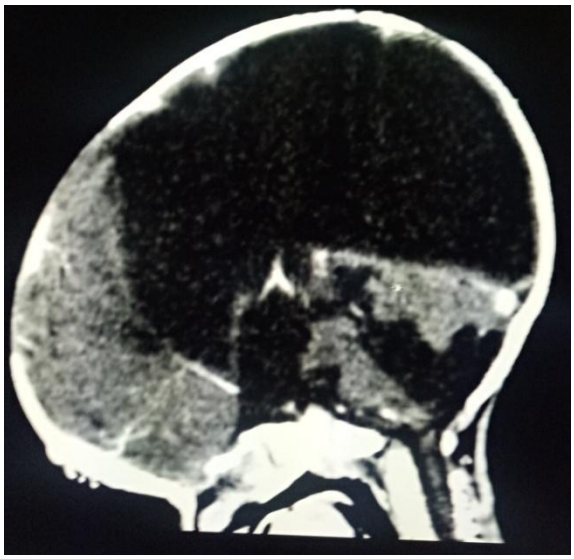

Fig 3: CT of the brain showing hypoplasia of the cerebellar hemisphere with fourth ventricle directly communicating with cisterna magna Daddy Walker syndrome

V. Discussion

The brain CT of 29(22.8%) children with neurological disorders showed normal findings during the study period. This was lower than what wasreported by Islam et al[5]; (46%) and Anas*et al*[6]; (30%), but higher than what was reported by Inah*et al*[7]; (17%). The reported low proportion of children with normal computed tomographic findings in this study suggest a good selection by the referring physicians. Also the use of ultrasound in the younger age group with patent anteriorfontanelleto diagnose brain pathologies may have contributed to the small proportion of children of less than 2years in the study as our reviewed showed aged 4-15 years, the most frequent aged who had a brain CT.Nzeh*et al*[8]demonstrated that ultrasound can revealed suspected brain pathologies in younger children before the closure of thefontanelle.

Trauma was the commonest indication for brain CT in this study and similar occurrence was reported by Islam *et al*[5]. However our findings differ from what was obtained by Anas*etal*[6] where convulsion(21.4%) was the predominate indication for brain Ct.Head trauma has been shown to be the most common and leading cause of permanent disability and death in children[5,9]. Trauma was seenmore in older age group 4-15years. The high incidence of trauma in this study is quite alarming and requires urgent steps in cubing this menace. Majority of the head trauma cases were due to RTA followed by falls. The high increase of head trauma among children presenting for brain CT in our environment maybe due to deplorable

condition of Nigerian roads with children being exposed to accidents from reckless motorist and commercial motorcyclists because of the attendant increased of child hawking and begging.

Seizures, hydrocephalus and delayed development milestone were the common indications for CT brain in the younger age group in this study between 0-2years. Cerebral atrophy and infracts were common CT findings amongst children with delayed development milestone. This may akin to the fact that these conditions are usually associated with high incidence of birth asphyxia, neonatal infection and jaundice which can be attributed to poor obstetric history in the developing world[1,6]. Normal CT findings were highest among children with seizure in our study. This implies that proper evaluation of seizures in children clinically willgo a long way in stratifying those who will benefit from neuroimaging to prevent unnecessary radiation to the child.

Hydrocephalus, delayed development milestone, loss of consciousness and focal neurological deficithad the highest yield of abnormal CT findings as all children in this group had abnormal brain CT.Acquired hydrocephalus was the most common cause of hydrocephalus in our study majorly due to complications from meningitis and intracranial tumour similar to reports of Anand*et al*[10]. Most of the congenital hydrocephalus was due to obstruction at theacqueductal stenosis which was also reported by other studies[10,11,12].

Headache as an indication for brain CT in this studyyielded high abnormal CT findings as six (66.6%) out of nine children had abnormal brain CT. Headache is a nonspecific symptom and children will need to be adequately evaluated clinically and selection for CT should be based on the type of headache, chronicity and presence of neurological signs to prevent unnecessary exposure of the child to radiation. Maytal*etal*[13] indicated in their study that in evaluating headache in paediatric patients without clinical evidence of underlying structural lesion , the role of imaging in such cases are usually limited.

Among children with abnormal CT findings, fractures, cerebral atrophy and intracranial tumour were the predominant findings. Fracture was predominantly seen among children with head trauma which was similar to what was reported in other studies[5,6].Cerebral atrophy was predominantly seen among patients with seizures and developmental milestones likely from damage to the brain in-utero or from severe birth asphyxia.

VI. Conclusion

Computed tomography imaging is a valuable tool in evaluating neurological disorders in children and trauma was themost common indications for CT in children in our environment. Others include seizures,hydrocephalus, delayed developmental milestone and headache. However,the use of computed tomography in children should be with caution in view of the high radiation dose and possibility of adverse effect.

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