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Abnormal Brain Computed Tomography Findings in Children

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ABSTRACT

There is improvement in patient care as a result of advanced Radiological medical imaging. Some of these however are associated with ionization radiation; a form of energy with potentials to damage the DNA resulting to chances of developing radiation related complications including cancers. Computed Tomography (CT) scan is one of such Radiation emitting equipment and its use has increased tremendously over the last decade even in children. Children are more radiosensitive than adults are and have higher chances of developing radiation related complications with the same dose. On this premise, the principle of As Low As Reasonable Achievable (ALARA) should be employed when requesting for radiological investigations.

The study aimed to evaluate abnormal CT findings in those requests, assess if the request are justifiable, and therefore propose that many CT requests are unnecessary.

One hundred and twenty CT images and dermographic data of paediatric cases 1-18years were reviewed from the archived of the Radiology Department of the Benue State University Teaching Hospital. The major complain were head injury (33.8%), seizures (23.8%) and CNS infection (11.5%). Fourty-four (33.8%) images reviewed were normal while 86 (66.2%) were abnormal. Of the 31patients that presented with seizures, 25 had no abnormal findings in their CT scans. Seventeen patients out of the 44 with head injury had intracranial haemorrages, 15 of them were associated with skull fractures, six normal.

Paediatric CT request in our environment is justifiably. In seizures however, except there are other clinical symptoms, it may not be necessary.

Key words: Brain CT, Abnormal findings, Children

INTRODUCTION

Medical imaging has led to improvements in the diagnosis and treatment of numerous medical conditions in children and adults. There are many types or modalities for medical imaging, some use ionizing radiation to generate these images. Ionizing radiation is a form of radiation that has enough energy to potentially cause damage to DNA and may elevate a person's lifetime risk of developing cancer.[1] Computed tomography (CT) scan is one of such medical imaging modalities that use ionization radiation. National surveys generally show that this imaging technique is the dominant contributor to medical radiation exposure [2-4] and its use has significantly increased in the last two decades[5]

The number of computed tomography (CT) examinations is today increasing by 4% per year worldwide, for a total of approximately 300 million CT scans per year. About 40% of CT scans are contrast enhanced.[6] In the US alone, it's been estimated that more than 62 million CT scans are performed annually, 4 million or more of which are related to children [7,] A recent study suggests that one-third of CT scan examinations can actually be replaced by alternative method of investigation or not performed at all.[9]

In spite of all the advantages of CT scans as the golden standard in diagnosis of a large number of diseases, statistics of the dosages associated with CT are higher compared to other radiological examinations [9]. The new multidetector CT scan technology creates highly defined quality image with shorter time but expose patients to higher radiation dose than the older single-detector CT scanners[10]. Radiation dose from one abdominal CT scan is commonly reported to be equivalent to that of 100 to 250 chest radiographs[11] and a dose of about 10 mSv from a single CT thorax, abdomen, and pelvis (CT TAP) will induce fatal malignancy in one out of about 2000 patients.[12]

Use of CT scans in children to deliver cumulative doses of about 50 mGy may triple the risk of leukemia and doses of about 60 mGy may triple the risk of brain cancer[13] There is no specific threshold of radiation to induce cancer. However, children are much more radiosensitive than adults. For example, a one-year-old infant is 10-15 times more likely than a 50-year-old adult to develop a malignancy from the same doses of radiation [14.] This higher sensitivity might be due to longer life span and possession of a higher count of dividing cells in children [15].

Based on above discussion, the basic way for minimizing CT scan radiation dose is preventing unnecessary scans among children. The present study therefore aimed to investigate the frequency of abnormal findings in brain CT scans among children, determine if the CT request are justifiable investigate the frequency of abnormal findings in brain CT scans among children, determine if the CT request are justifiable, and propose the notion that many image requests are unnecessary.

MATERIALS AND METHODS

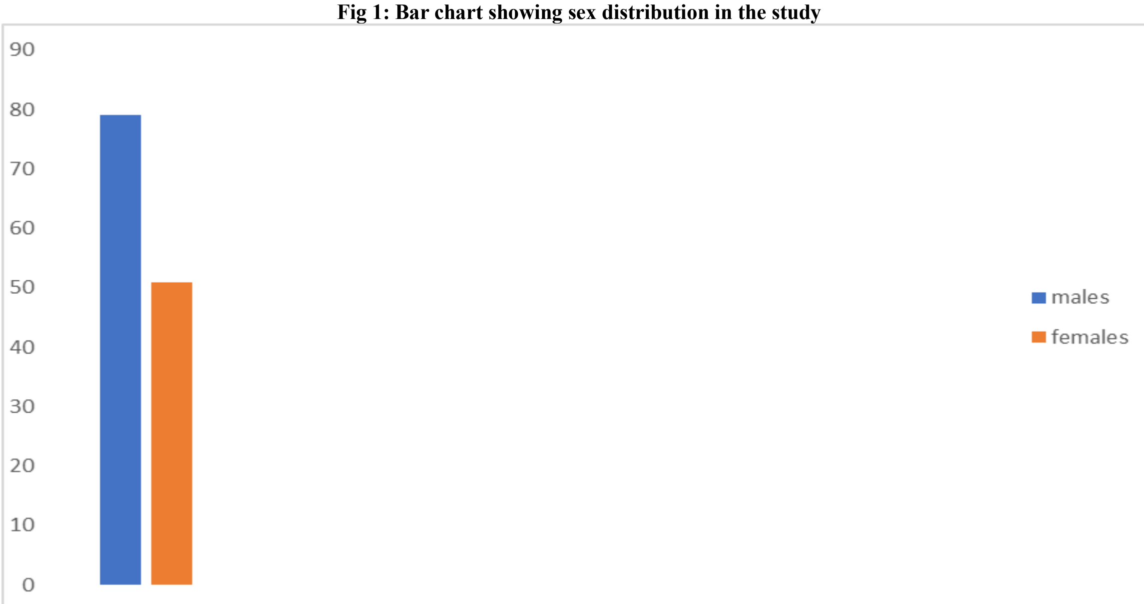
Demographic history and CT scan reports of Brain CT scans of children done at the Benue State University Teaching Hospital from January 2019 – December 2020 were retrospectively reviewed. The data is stored electronically in the archive of the institution. Children ages between 0-18 years were enrolled in the study. The clinical information was obtained from the column for indications in each patient's report. Reports with no or ambiguous clinical history were excluded from the study.

Data was analysed using the SPSS statistical software (version 26). Descriptive statistics and tables were used to express the observation results. Inferential statistics, P values, and the Pearson Chi-Square test were also utilized. $P < 0.05$ was considered statistically significant.

RESULTS

One hundred and twenty (120) brain CT images were reviewed. Among these, 79 (60.8%) were males and 51 (39.2%) female giving M: F ratio of 1:1.5 (Fig 1.). Ages ranges between 1-18 years with mean age of 2.3 ± 1.0 SD.

Fig 1: Bar chart showing sex distribution in the study



The major complaints were head injury in 44 (33.8%), seizure in 31 (23.8%) and features of meningitis 15 (11.5%). Unconsciousness, autism and cortical blindness has the lest at presentation of 1 (8.0%). There were no presentations due to parental request or routine medical checkup. In all the cases presented, males had the highest presentations though this was not statistically significant p=0.714. Head injury presented commonly at the higher age group >10 years whereas space occupying lesions which include tumours and abscesses were commoner at age group <10 years but this was statically insignificant as p=0.282. (Table 1)

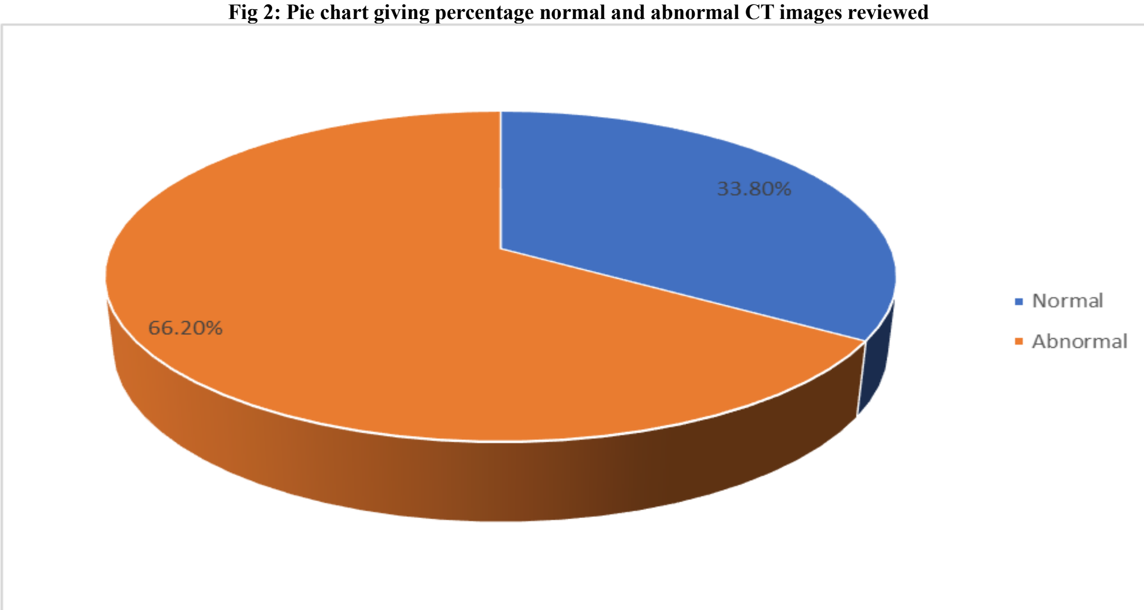
Table 1: clinical presentation with sex and age distribution.

Clinical Presnt.	Menig.	HI	seizure	ICSOL	Haem.	Dev. delay	CP	Uncon	Psy.	PR	p-value
Freq.	15 11.5%	44 33.8%	31 23.8%	15 11.5%	10 7.7%	4 3.1%	2 1.5%	1 .8%	2 1.5%	0 0%	
Sex											
Male	11	30	19	8	3	3	0	1	2	0	
Female	4	14	12	7	7	1	2	0	0	0	
Total	15	44	31	15	10	4	2	1	2	0	0.714
Age											
0-5	6	9	7	6	0	3	1	0	1	0	
6-10	4	11	7	5	6	1	1	0	0	0	
11-15	4	12	11	3	3	0	0	1	0	0	
16-20	1	12	6	1	1	0	0	0	1	0	
Total	15	44	31	15	10	4	2	1	2	0	0.282

Key:
Clinical presnt: clinical presentation
Menig: meningitis
HI: head injury
ICSOL: Intracranial space occupying lesion
Haem: haemorrhage
Dev. Delay: developmental delay
CP: cerebral palsy
Uncon: unconscious
Psy: psychiatric disorder
PR: parental request

Forty-four (33.8%) images reviewed were normal while 86 (66.2%) were abnormal (Fig 2). Of the abnormal 53 were males and 33 females. Abnormal brain malformations were more in females than males, however this was not statistically significant (p=0.884). Similarly, abnormal results were more at age group 0-5 years (28patients) whereas the age groups 11-15 had more normal results (16 patients). Table 2

Fig 2: Pie chart giving percentage normal and abnormal CT images reviewed



The commonest abnormal findings were cerebral haemorrage in 19 (14.6%), skull fractures in 15 (11.5%), and intracranial space occupying lesion in 14 (10.8%). Brain atrophy and meningitis were the least findings with 2 (1.5%) and 3 (2.3%) respectively. Cerebral haemorrhage was common at age ≤10 years whereas hydrocephalus and brain malformations, which include arnord Chiari malformation, sturge webber were higher at lower age of ≤ 5years however this was not statistically significant as p=0.562 (table 2).

Of the 31patients that presented with seizures, 25 had no abnormal findings in their CT scans. Of the 6 with abnormal findings, two(2) had cerebral abscess , one had hydrocephalous, one was a sickle cell patient with intracranial haemorrhage, one a case of brain malformation and 1 had meningitis.

Seventeen patients out of the 44 with head injury had intracranial haemorrages, 15 of them were associated with skull fractures, six normal. These findings were statistically significant with p=0.000 (table 2).

Table 2: CT findings in sex and age groups

findings	Normal	ICSOL	Haem.	Hydr.	Oed.	Cong.m	atrophy	Infec.	Infar.	#	p-value
	44	14	19	11	5	8		3	6	15	
sex											
Male	26	7	11	9	2	3	2	2	3	12	
Female	18	7	8	2	3	5	0	1	3	3	
Total	44	14	19	11	5	8	2	3	6	15	0.884
Age											
0-5	9	3	5	7	0	5	1	1	2	4	
6-10	10	5	7	1	2	2	0	22	2	3	
11-15	16	4	3	2	2	1	0	0	1	4	
16-20	9	2	4	1	1	0	1	0	1	4	
Total	44	14	19	11	5	8	2	3	6	15	0.562

KEY:
ICSOL: Intracranial space occupying lesion
Hydr: hydrocephalus
Oed: oedema
Cong. M-congenital malformations
Atrop : atrophy
Infec: infection
Infar: infarction
#: fractures

DISCUSSION

In most radiological investigations involving the cerebral nervous system (CNS) system, CT scan is the next preferred method of investigations after ultrasonography, which is preferred in infancy, moreover, it is offered as the first choice in emergency and acute clinical diagnoses[16]. With CT, Studies in some centers have demonstrated low prevalence of abnormal findings in brain CT scans among children, implying; unjustifiable reasons for brain CT scan requests.

A similar retrospective study conducted by Haghighi M et al in Iran showed that only about 12% of the brain CT scans were abnormal,[9] this is at variance with this study, which showed a prevalence of 86% of abnormal findings of the images. This variance could be because of difference of accessing health services between the study areas. Unlike in their study where health insurance funds health care services, unjustifiable request may be made for investigations, even family member insisted for CT investigation, similar to study by Rho et al in Japan[17]. In this environment, helth care services are paid out of pockets by patients/caregivers and they must really see reason(s) for the investigations.

In this study, head injury was the major complain (44 of 130 patients, 33.8%). Abnormal finding among those patients includes cerebral haemorrhages 17, cerebral oedema 4 and 15 were associated with fractures only 6 of the images were normal. Unlike the study by Haghighi et,[9] head injury was the most common major complaint after headache (14 of the 120 patients, 11.5%). Among those patients, abnormal findings were detected in only one case (7.1%). This variance in the image findings could be attributed possibly to the severity of the impact on our bad roads following trauma.

Seizures was the next commonest complains in this study and most do not show abnormal findings on CT scan. Those with CT findings usually had other constitutional symptoms associated with the seizures including headache, fever, vomiting or sickle cell habitus. It can therefore be postulated that if there are no other clinical symptoms associated with seizures, CT scan may not be necessary. Similar findings was published by Gaillard et al[18] who then emphasized that in the absence of a history of localization-related seizure, abnormal neurological examination and abnormal EEG (electroencephalography), significant abnormality in the image are rare in patients with seizures.

CONCLUSION

Head injuries, seizures, features of ICSOL and infections were the commonest presentation. Majority of the CT findings were abnormal thereby justifying the need for CT scan investigation in this environment. In patients with seizures, however abnormal CT findings were only seen if there were other clinical symptoms as majority of the images were normal. This demands proper evaluation of patients with seizures before ordering Brain CT to avoid unnecessary imaging thereby minimizing associated complications.

Declaration by Authors

Ethical Approval: Approved

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Conflict of Interest: The authors declare no conflict of interest.

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