

Audit of pediatric computed tomography at Aminu Kano teaching hospital, Kano, Nigeria

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ABSTRACT

Context: Computed tomography (CT) is becoming popular with advances in imaging technology, and pediatric imaging is also affected by this trend. **Aims:** This study aimed to determine the pattern of pediatric CT scanning practice and common findings at Aminu Kano teaching hospital (AKTH). **Settings and Design:** The study was conducted at the Radiology department of AKTH. It was a retrospective descriptive study. **Materials and Methods:** Patients aged between 4 days to 14 years and examined with a 4-slice Bright speed CT scanner at the Radiology department from January to December, 2011 were reviewed in this study. Information concerning the age, gender, indications for the CT scan, type of CT scan conducted, and findings were recorded. **Statistical Analysis:** Summarising indices were used (including frequencies, means, modes, and standard deviations). **Results:** One hundred and forty children (80 boys and 60 girls) were reviewed. Their ages ranged from 4.0 days to 14.0 years, with a mean of 5.64 ± 4.31 years. Brain scan was most commonly performed (88.8%), while frequency of abdominal CT was 4.9%. The most common indication for CT examination in these subjects was convulsion (21.43%), followed by trauma (15.71%) and progressive head enlargement (11.43%). About 29.2% of the scans were normal, while obstructive hydrocephalus was seen in 13.2% and general brain atrophy in 9.1% of the cases. **Conclusions:** This review shows predominance of brain CT scan in children, seizures and trauma being the most common indications. Obstructive hydrocephalus, brain infarction, and general atrophy dominate the findings. Presence of global atrophy in some of the patients is worrisome as it may adversely affect the prognosis.

Key words: Africa; brain; children; computed tomography; scan

Introduction

With advances in imaging technology, computed tomography (CT) has become more popular, and pediatric imaging is an aspect of radiology affected by this trend. Since the inception of CT in the 1970s, its use has increased rapidly with an estimated more than 62 million CT scans performed per year in the United States, of which at least 4 million are for children.^[1] In view of the volumetric imaging capabilities of CT and the rapid speed at which CT scans are now obtained, the number of clinical indications and the volume of CT scans performed have greatly increased over the recent years.^[2] Hence, there is a need to develop appropriate protocols that will guide the clinical indications and image acquisition

parameters in CT studies. These are useful in order to reduce unnecessary examinations and radiation dose to children, who are more susceptible to the adverse effects of ionizing radiation than adults.^[3]

This study aims to determine the pattern of CT studies carried out on children and common findings from such studies at the Aminu Kano teaching hospital, with particular emphasis on the commonly requested CT examinations.

Materials and Methods

Pediatric patients aged between 4 days and 14 years and examined with a 4-slice General Electric Bright speed CT scanner at the Radiology department of Aminu Kano teaching hospital from January to December 2011 were considered for the study. The request cards, stored CT images, and radiologist's reports were reviewed by the authors.

All examinations considered in this review were done using the departmental protocol for pediatric CT examinations, which included the scanogram and selection of specific pediatric options in the operating console of the machine for

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the purpose of dose reduction (by reducing exposure factors, particularly mAs), non-contrast axial slices d at 2-5 mm thickness while contrast slices were obtained following administration of low-osmolar contrast medium (LOCM) at the dose of 1 ml/kg of the 300 mg/ml of the LOCM. Furthermore, oral iodinated flavoured contrast medium was administered to some of the children for abdominal examinations. Appropriate protocols were selected depending on the region of the body under examination. To further minimize the radiation dose to the patients, lead covers were applied to shield the body parts that were not under examination. Post processing reconstructions and volumetric rendering were made (where necessary) to aid diagnosis of lesions. All images were transferred to a “stand alone” diagnostic workstation and were reviewed by at least one consultant radiologist.

The information concerning the age, gender, indication for CT examination, type of CT examination, and major findings on each of the patients were documented. Pediatric CT scans for which we could not obtain the above details were excluded. These variables were thereafter analyzed using statistical package for social sciences (SPSS) version 16.0 software. Results were expressed numerically, in tabular forms and pictorially.

Results

One hundred and forty children were involved in this study, including 80 boys (57.14%) and 60 girls (42.86%). Figure 1 shows the age distribution of the subject. Their ages range from 4.0 days to 14.0 years, with a mean of 5.64 ± 4.31 years. It also showed that majority were between the ages of 1-12 years.

Figure 2 shows the types of CT examinations performed on the children. Among the study subjects, brain examination was most commonly performed in 88.8%, while abdominal CT was done in 4.9% of the subjects. Other types of CT examinations consisted <1% of the total and included chest, neck, para nasal sinuses, and angiography.

The most common indication for CT examination in these subjects was convulsion (21.43%), followed by trauma (15.71%), and progressive head enlargement (11.43%). Other indications found in this study included headaches, complicated meningitis, and loss of consciousness as shown in Table 1. When the findings on the CT images were reviewed, 29.2% of the examinations showed normal findings while obstructive hydrocephalus was seen in 13.2% of cases. General brain atrophy was present in 9.1% and other findings are shown in Figure 3.

Discussion

This review shows that the most frequent age group who had pediatric CT examination was between 2 and 12 years, and most of the studies were brain scans. This observation may be due to

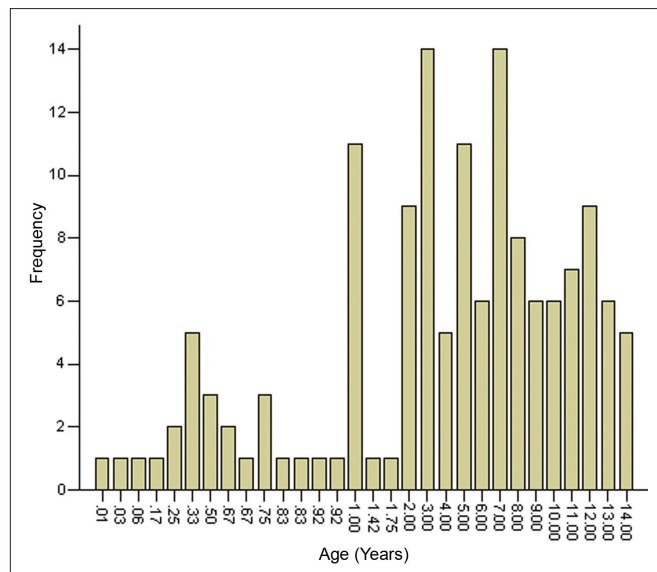


Figure 1: Age distribution of the subjects

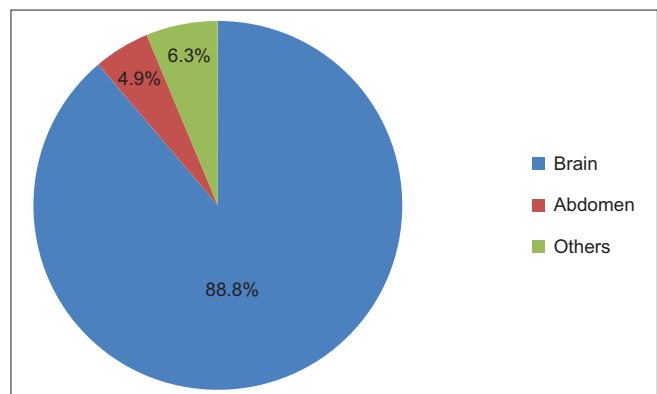


Figure 2: Types of examinations done on the subjects

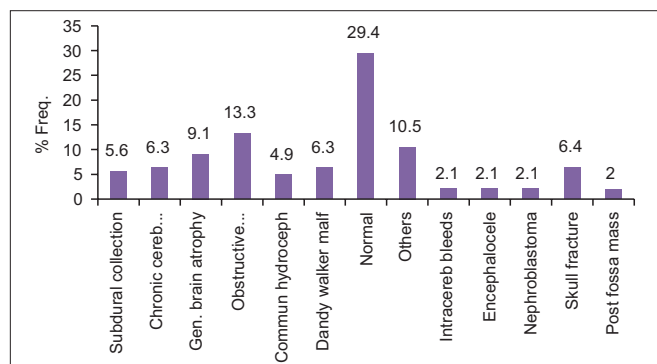


Figure 3: The common CT findings in the subjects

the fact that most of the prevalent suspected abnormalities of the pediatric brain (such as meningitis and its complications) can be reliably evaluated by ultrasound scan in much younger children before fusion of the fontanelles.^[4] Similarly, the predominance of brain CT scan over those of other parts of the body may be related to the utility of alternative cheaper imaging modalities for such sites rather than CT such as plain radiography and ultrasound, which deliver less radiation dose to

Table 1: The usual indications for CT scan in children

Indication	Frequency	Percentage
Head enlargement	16	11.41
Trauma	22	15.71
Convulsions	30	21.43
Severe birth asphyxia	8	5.71
Delayed milestones	19	13.71
Post meningitis	8	5.71
Occipital swelling	4	2.86
Head ache	7	5.00
Sickle cell disease with tia	1	0.71
Abdominal swelling	7	5.00
Proptosis	2	1.43
Loss of consciousness	10	7.14
Others	6	4.29
Total	140	100

CT – Computed tomography

children, especially for the chest and abdomen. This is important as children are known to be more radiosensitive than adults.^[1-3]

The above trend (of patients between the age of 2-12 years and the predominant brain scans over other exam types) is also reflected in the pattern of various indications for CT scan found in this study, most of which are related to the brain. In particular, convulsions, delayed milestones, trauma, and head enlargement are the predominant indications. Furthermore, delayed milestones and convulsions are more common in much younger children, while trauma is more common in children between 8 and 14 years. This scenario is related to high activity of older children outside home environments, making them more susceptible to head trauma, especially the boys. Furthermore, the high incidence of unsafe behavior by children may be a cause of both pedestrian injuries and those caused by bicycle collisions in some places.^[5] Similar pattern was also observed by Islam *et al.*,^[6] on their review of 689 pediatric brains by CT in Bangladesh, where trauma was found to be the most common indication (38.6%), followed by headache (27.3%), convulsion (11.5%), focal neurologic deficit (9.1%), fever (3.5%), developmental delay (2.9%), and increasing head size (1.5%). The high incidence of head trauma as indication for CT in children is worrisome and corroborates with the study by Graham,^[7] who documented that head injury in infancy and childhood is the single most common cause of death and permanent disability.

On the other hand, delayed milestones and convulsions (which also constitute significant proportion of our patients in this review) are consequent to severe peri-natal asphyxia, complicated meningitis, and febrile illness. This may be attributed to poor obstetric care, inadequate immunisation, and poor hygiene as well as malnutrition. These are common problems of the lower socioeconomic class of the population.^[8] Equally, it may also be associated with poor antenatal care program.^[8] Seizure disorders are particularly

an important group of indications for CT in children. In these patients febrile seizures form cerebral malaria, meningitis, epilepsy and other complications of birth asphyxia.^[9]

Close to 30% of the CT scans in this study showed normal findings. This is less than that reported by Islam *et al.*, (45%)^[6] and Fenton *et al.*, (54%).^[10] Among those with detectable abnormalities on CT scan, obstructive hydrocephalus is the most common, constituting 13.3% of the entire patient population. This is followed by global brain atrophy and skull fracture. Out of these, most of the cases with hydrocephalus are the patients who had complicated meningitis with aqueduct stenosis, whereas those with global brain atrophy were related to severe peri-natal asphyxia.

In conclusion, pediatric CT imaging is an important diagnostic tool with lots of potentials and flexibility. However, it should be used with appropriate caution as stipulated by the “as low as reasonable achievable” (ALARA) principle. Therefore, utilisation of multi-modality imaging (with non-invasive modalities such as magnetic resonance imaging and ultrasound) is an important adjunct in complementing the diagnostic potentials of CT scan.

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