Pattern of Cut Selection in Brain Computed Tomographic Scan using Non-Helical CT in Kano, Nigeria

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ABSTRACT

Background: Most centres in the developing world are still using non-helical computerized tomographic (CT) scanners, that can take only direct axial and occasionally coronal section of the brain, while sagittal sections could only be obtained on reconstruction with its attendant loss of image quality. Prior knowledge of the type of additional cuts needed beyond the routine axial cuts for a given clinical diagnosis, could assist the CT Radiographer in pre-scan planning with optimal utilization of scanning time.

Objective: To determine those types of brain CT scan requests that needs extra protocol beyond the routine axial section using non-helical CT scanner.

Methods: The CT Scan of 610 patients done between January 2004 to June 2006 at Aminu Kano Teaching Hospital were analyzed retrospectively. All the scans were done using 3rd generation, non-helical CT scanner (Siemens Somatom ART). Information obtained from their records include age, sex, clinical diagnosis, CT diagnosis and the type of cut adopted for each patient.

Results: Head injury, seizure disorder and cerebrovascular accident need no extra cuts beyond the routine axial sections. Whereas, brain tumours and congenital anomalies of the brain require extra coronal and coronal/sagittal cuts respectively.

Conclusion: Prior knowledge of the additional cuts needed for a suspected brain lesion, could help CT Radiographers in the planning of a protocol be to be adopted ahead of the procedure when using non-helical spiral CT scanner.

Keywords: Non-Spiral Computerized Tomography, Protocol.

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INTRODUCTION

Computed Tomography (CT), originally known as computerized axial tomography (CAT scan) or body section roentgenography employs digital geometry processing used to generate three dimensional x-ray images taken around a single axis of rotation .The first commercially available CT was invented by the late Sir Godfrey Hounsfield in Hayes England at Thorn EMI Central research laboratory using x-rays in the year 1967 and publicly announced in 1972.[1-4]

The first two designs or generations of CT scanners used an x-ray tube with a narrow fan shaped beam, and a number of detectors mounted on the opposite side, which moved around the patient in a translate–rotate movement. Both generations requires relatively long scan time. Whereas, third generation uses a rotate-rotate principle with an arc of detectors coupled to an x-ray tube. The whole system rotates through 360 degrees around a patient with resultant reduction of scan time to 1-3 seconds. Fourth generation scanners uses a circular array of detectors and an x-ray tube rotating within the array.[5] Spiral (helical) scan is the latest development in CT technology, which enables rapid acquisition of data with patient traveling through a continuous rotating beam of x-rays effectively giving a volume scan.[6]

The utility of CT scan in clinical practice has spanned almost all the anatomical parts of the human body.[7] The conventional direct axial slices obtained on CT scan often suffice to make diagnosis in most anatomical parts. However, in few instances, such as in CT of the sinuses and some brain lesions, further sections employing different orientations, such as sagittal, coronal or even volumetric scan are necessary in order to obtain optimum diagnosis.

Most centers in developing countries use non-helical CT scanners that take only direct axial and occasionally coronal sections, with sagittal section obtained only by reconstruction, with its attendant loss of image quality. This trend is bound to continue for years to come in these countries, more so the helical scanners apart from being expensive to the developing world, it is also more difficult to maintain than the non-helical ones.

Therefore, prior knowledge of the additional cuts needed while using non-spiral CT for a given clinical diagnosis on the part of CT Radiographer could go along way to improve the quality of care to patients in terms of pre–scan planning with eventual proper time utilization. This study was undertaken to review the pattern of brain CT scan cuts selection retrospectively in Aminu Kano Teaching Hospital Kano, Nigeria, using non helical 3rd generation CT scanner.

MATERIALS AND METHODS

This retrospective study covers from January 2004 to June 2006. Previous records of all the brain CT scan performed at the Department of Radiology, Aminu Kano Teaching Hospital, Nigeria, using 3rd generation CT scanner (Siemens, Somatom AR.T) were analyzed.

Information derived from patient records include, age, sex, clinical diagnosis, diagnosis on CT and the type of cuts obtained in each patient (either direct axial, coronal or sagittal reconstruction) during scanning. The following variables were then correlated, age and clinical diagnosis on one hand and the type of cuts obtained on the other hand. Patients with incomplete records were not included in this study.

RESULTS

A total of 610 brain scans were performed within the period, consisting of 386 males and 224 females. Their ages range from 7 months to 86 years (mean age of 34.2 years). Full patient records were obtained in only 348 and 331 patients in the clinical diagnosis versus type of CT cut and patients age versus type of cut respectively (Tables I and II).

TABLE I

Clinical Diagnosis Versus Cut Selection

CLINICAL DIAGNOSIS	AXIAL	SAGITTAL	CORONAL	TOTAL
Head Injury	104	Nil	Nil	104
Seizure Disorder	41	Nil	Nil	41
Congenital Anomalies	8	1	1	10
Tumour Disorders	48	Nil	4	52
Cerobrovascular Accidents	40	Nil	Nil	40
Others (e.g Headaches)	94	Nil	7	101
TOTAL	335	1	12	348

Table I shows that, all patients (100%) presenting with history of head injury, seizure disorder or cerebrovascular accident (CVA) needed no extra cuts beyond axial section. Whereas, those presenting with congenital anomalies and tumour disorders, in addition to the usual axial section, also required extra coronal / sagittal and coronal sections respectively.

Sixty-nine percent 69% (9 out of 13) of the total additional cuts were obtained in those aged below 30 years of age (Table II) and brain tumour as a single entity required additional cuts when compared with the other single entities (Table I).

TABLE II
Patients Age Versus Cut Selection

AGE (YRS)	AXIAL	SAGITTAL	CORONAL	TOTAL
0-5	29	Nil	1	30
6-10	18	1	1	20
11-15	19	Nil	2	21
16-20	17	Nil	1	18
21-25	22	Nil	2	24
26-30	21	Nil	1	22
31 and above	192	Nil	4	196
TOTAL	318	1	12	331

DISCUSSION

More males (386 out of 610) presented for brain CT scan than women in this study. This is explained by the fact that about one-third (29.9%) of those scanned (104 out of 348), were referred on account of head injury (Table I), which previous studies confirmed to involved more men than women.[8]

Immediately after the invention of CT scanner by Godfrey Hounsfield a brilliant neuroradiologist, James Ambrose demonstrated its wide clinical significance in the nervous system, particularly the brain.[4] Patients presenting with head injury, seizure disorder and the cerebrovascular accident (CVD) were among the initial beneficiaries of CT scan. The rapid examination time in CT enables surgical intervention to be determined in such patients.[8,9]

CT helps to determine the nature and characteristic of intracranial lesions such as intra cranial heamorrhage (Fig.1) and contusion in head injury,[8] structural abnormality in seizure disorder[10] and ischeamic infarcts or subarachnoid heamorrhage in CVA.[11] These three categories of lesions (seizure, head injury and cerebrovascular accident) most often present as emergencies. The rapidity with which diagnosis is made goes to determine the outcome of the management intervention initiated. This may perhaps explain the finding in this study of 100% axial cuts in these lesions, to the extent that once the lesion is identified, no time is wasted in trying to obtain additional further cuts (Table I).

FIGURE 1

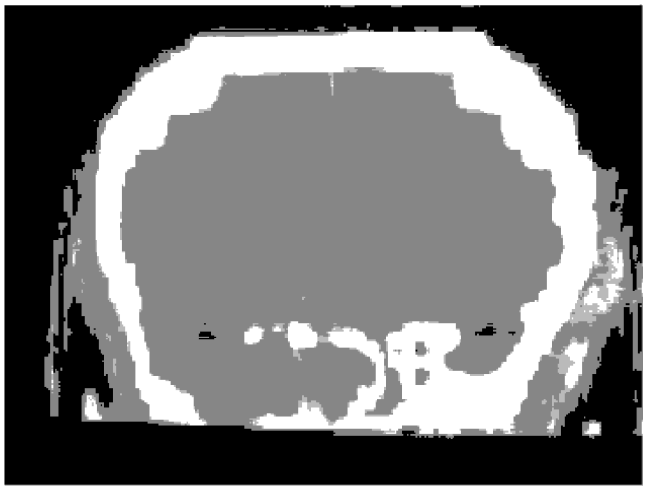

FIGURE 2

LEGEND TO FIGURES

FIGURE 1: Direct axial section of the brain, in a patient with acute subdural collection following head injury, obtained using non-helical CT.

FIGURE 2 : Coronal reconstructed section of the brain, showing a pituitary tumour, extending from the region of the sella to the suprasellar region, obtained using non-helical CT (with attendant loss of image quality).

Lesions in brain and congenital anomalies of the brain usually traverses more than one anatomical region of the brain. An intra cranial lesion may extend from the lateral to the posterior aspect. This explain why in this study extra cuts beyond axial to coronal and sagittal/coronal sections were utilized in order to have three dimensional anatomical imagination of such lesions (Fig. 2).

The finding from most of the extra cuts in those below 30yrs in this study (Table II) may not be unconnected with the fact that, most cases of congenital anomalies of the brain and brain tumours are diagnosed at this age range, thus contributing to the diagnostic yield.

The advent of spiral CT has revolutionalised the technology of multiplanarity of cuts in CT with much ease, in addition to the significant reduction in the image acquisition time. Despite this developments, imaging centres in developing countries still have to rely on the use of non-spiral CT's. Since for sure, as for any other new technology it will take time before full conversion to helical CT is effected in such centers.

In conclusion, we recommend that CT radiographers incorporate findings from this study in the overall pre-scan planning protocol for proper optimization of scanning time.

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