A TALLY OF COMPUTED TOMOGRAPHIC SCAN FINDINGS IN THE IMMEDIATE POST-INSTALLATION PERIOD IN A RURAL BASED HOSPITAL IN SUB-SAHARAN AFRICA

ABSTRACT

Background:*The utilization of Computed Tomographic scanners for imaging has gradually evolved in Nigeria since the installation of the first scanner at the University College Hospital, Ibadan in 1989. However, most rural and sub-urban health facilities in Sub-Saharan Africa still lack this all-important modality.*

Aim and objectives: *To retrospectively determine the pattern of distribution of CT requests, indications and findings on imaging amongst a small cohort of patients scanned in the immediate post-installation phase of a 32-slice Canon CT scanner.*

Methods: *We retrospectively reviewed the requests and reports of thirty patients who had undergone CT examinations of different body regions within the first ten days of installation of a 32-slice Aquilion CT scanner at the Radiology department of one of Nigerias' leading infectious disease hospital(IrruaSpecialistTeaching Hospital) in Irrua town. The data were retrieved, coded and entered into Microsoft excel spreadsheet and further analysed using SPSS version 21.*

Results: *Male patients were more than females in an approximate ratio of 2:1. Majority of patients fell within the age range of 18-64 years. Stroke*

was the commonest indication and accounted for 33.3% of patients imaged. Although, the craniofacial region was the most commonly imaged region for suspected neurological diseases accounting for 20(67%) of patients, the brain was observed to be grossly normal in 7(23.3%) patients. Rhinosinusitis was the commonest finding seen.

Conclusions: *Males were the most commonly scanned group, while the craniofacial region was the most imaged region. Neurological disorders and stroke cases together accounted for most CT referrals with stroke being the commonest. Rhinosinusitis and normal brain morphology were the most commonly encountered findings.*

Keywords: Computed Tomography (CT), Stroke, neurological disorders, sinusitis, Irrua.

Introduction

BACKGROUND

Computed Tomographic (CT) scanners are an indispensable tool for radiologic imaging in Africa. This modality has a relatively good soft tissue resolution, and can also be used for imaging bony pathologies. Since the advent of CT scanners in the 1970s, its demand and usage in medical imaging has become so enormous.[1]

CT technology has evolved so rapidly over time from single-slice spiralCT introduced in 1989, to multi-slice spiral CT.[2, 3]The first CT scanner in Nigeria was installed at the University College

Hospital (UCH) Ibadan, in Southwest Nigeria on the 19th of November 1987. Since then, the number of CT scanners have increased, coupled with the increased demand for its usage in investigating patients.[2,4,5] Nevertheless, most rural based health facilities in Nigeria still lack this vital imaging modality which is very basic in Western climes, and still rely on plain radiography and ultrasonography for evaluating complex clinical cases, and in some instances resulting in under diagnosing and missed diagnosis, as well as unwarranted delays in arriving at definitive diagnoses in complicated cases.

The invaluable role of computed tomography in the evaluation of patients with stroke, brain tumours, head injuries, cardiothoracic diseases, otorhinolaryngological diseases, as well as diagnosis and staging of abdominal malignancies have been aptly reported in some previous studies.[5,6,7,8]

Statistical information on the prevalence of common diseases in our environment which may necessitate an immediate referral for a CT scan by a physician is sparse. There also have not been any similar studies detailing the common reasons for CT referrals and commonly imaged body regions in our environment and Hospital in particular.

Although CT scan has the advantage of multi-planar image reconstruction, good image clarity and lack of superimposition of body structures, its production of a high dose of ionizing radiation is a major demerit, thus posing a growing concern over its usage in children.[9]

Computed tomography is the largest contributor to medical radiation exposure among the U.S population.[10, 11]

Radiation exposure is a major concern in children because;

1) Children are considerably more sensitive to radiation than adults.

2) Children have a longer life expectancy than adults, resulting in a larger window of opportunity for expressing the effects of radiation damage.
3) Children may receive a higher radiation dose than necessary, if CT machine settings are not calibrated for their small body sizes.

As a result, the risk of developing radiation-related cancer can be several times higher for a young child compared to an adult exposed to the same radiation dose over a similar duration of exposure.[10]

Studies documenting the total number of CT scanners in our environment (Southern Nigeria) have not been done previously. However, Adejoh*etal*,[10] did a study in South-Eastern Nigeria which revealed that there were a total of 28 CT scanners distributed amongst 23 radiodiagnostic facilities in South-Eastern Nigeria at that time, and most of the CT scanners were sited in major cities and urban towns. The situation is partly similar in Edo state; a Southern Nigerian state where this study was conducted. There are about six functional CT scanners in Edo State; five of these scanners are distributed amongst a few Radio-diagnostic centres within the state capital (Benin City), with the last one just recently installed in the rural town of Irrua- a town situated over hundreds of kilometres from the city centre. Prior to the installation of the recent CT scanner in Irrua town, patients had to travel several kilometres to assess CT scan services in the capital city when indicated; a herculean task which could further worsen patients conditions especially in cases of head and spinal trauma considering the deplorable state of our roads, prolonged diagnostic time, and also further reduce the patient's prognosis. Our hospital had recorded many instances of preventable deaths from head trauma following motor vehicular accidents, stroke etc.

The acquisition and installation of the new CT scanner was received with a lot of happiness, anxiety and high expectations by physicians, other hospital staff and patients within Irrua and its environs.

This study aims to assess the pattern of distribution of CT scan requests, indications for referrals, and findings on imaging amongst a small cohort of patients scanned in the immediate post installation period of a 32-slice Canon Computed Tomography scanner. Similar research detailing the pattern of distribution of CT referrals, indications and findings in the immediate post-installation period in our environment (Sub-Saharan Africa) are sparse. This research was also conceptualized with the aim that the observations and results obtained would assist in planning and management of the new CT suite.

MATERIALS AND METHOD

This is a retrospective analysis of all Computed Tomographic studies conducted in the department of Radiology of Irrua Specialist Teaching Hospital within the first ten (10) days of installation of a new 32-slice Canon Aquilion Computed tomography scanner.

Irrua Specialist Teaching Hospital is a multi-specialty tertiary centre, and a leading infectious disease hospital located in Irrua- a rural town in Edo State, Nigeria. The hospital receives myriads of referrals from within the Local Government areas of Edo Central and Edo North geopolitical zones. It also receives referrals from neighbouring states of Delta, Kogi and Ondo in Nigeria.

Inclusion criteria were;requests(referrals) for CT examinations within the initial ten days after installation of the CT scanner, CT requests withdocumented information about patients' age, gender, indications for scan/clinical diagnosis, requesting department/ward or clinic, name of

referring physician, history of previous surgery, history of previous investigations and imaging findings.

Exclusion criterion was; incompletely filled radiological request forms.

All CT requests (referrals) received in the department of Radiology of Irrua Specialist Teaching Hospital within the first ten (10) days of installation of the newly acquired CT Scanner, and their respective reportswere retrieved from our departmental records (archives). This study was conducted in March 2023.

All scans were acquired using a newly installed 32-slice Canon Aquilion Helical Computed Tomographic scanner (TSX-037A model, manufactured in Japan) during the testing and training period.

This ten-days immediate post-installation period was chosen for this study as a fairly considerable level of patient turn-out was expected, partly due to the massive sensitization of patients and physicians about the newly installed machine at that time and also because referred patients were scanned at no cost during this period. A total of thirty (30) patients were scanned.

Each patient's demographic details, clinical information/indication for CT and the findings/diagnoses were retrieved from our departmental records.

Data Analysis: The data was recorded in Microsoft excel spreadsheet, and were subsequently analysed using SPSS version 21. Continuous variables were recorded as means and standard deviation, while categorical variables were recorded as percentages. Some variables were also displayed on charts.

RESULTS

The CT scan requests and the respective reports from 30 patients scanned withinthe first 10 days of installation of a newly acquired Aquilion CT scanner were retrieved from the departmental

archives and analysed statistically. Nineteen (63.3%) of the patients were males, while 11(36.7%) were females.

The overall mean age of the patients was 58.4 ± 4 years. The mean age of the males was 59.4 ± 17.0 years, while that of the females was 56.7 ± 13.1 years. The elderly (above 65 years) were fewer, accounting for about 11(36.7%), while the middle age group were more in number 19(63.3%). These are depicted in table 1 below. No case was recorded from the paediatric age group during the first 10 days after installation of the CT scanner.

Table 1: Age and sex distribution of patients

Age group (years)	Female	Male	Total, n (%)
18 – 64	8	11	19 (63.3)
≥ 65	3	8	11 (36.7)
Total	11	19	30 (100.0)

The craniofacial region was the most commonly scanned region of the body, accounting for about 67% of the total number of request for CT received during the immediate post-installation period of 10 days. The lumbosacral spine was the least scanned region (3%). The distribution of the body regions scanned is represented in a pie chart in fig.1 below.

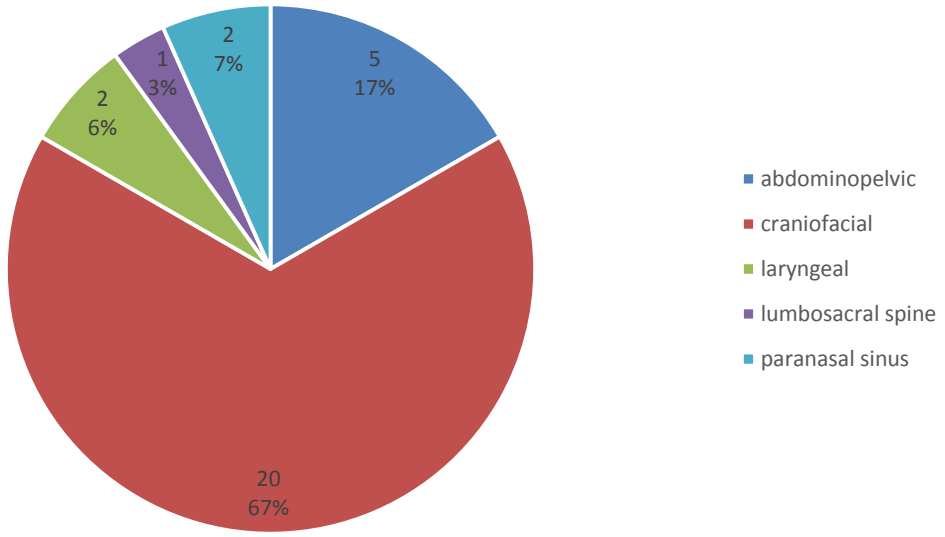

Figure 1: Pie chart showing distribution of CT requests based on the Regions of the body involved.

Table 2 and 3 below show the classification of disease entities referred for CT scan and the various clinical indications for the requests.

Suspected neurological diseases formed the bulk of indications for CT referral by clinicians, accounting for about 44.8% of the total number of cases referred. Of these numbers, suspected stroke cases accounted for 33.3% of cases, while a combination of suspected cases of stroke, head injuries and other neurological disorders accounted for over two-thirds of the total number of cases (63.3%).

Suspected tumours formed the 2nd commonest condition that was referred for imaging, accounting for about 27.6% of all referrals.

Inflammatory diseases (3.5%) had the least number of referrals.

Table 2: Classification of disease entities referred for CT

Class	Frequency	Percent
Neurologic disease	13	44.8
Tumour	8	27.6
Normal	3	10.0
Trauma	2	6.9
Otorhinolaryngology disease	2	6.9
Genitourinary disease	1	3.5
Inflammatory	1	3.5

Neurologic disease was the most frequently encountered disease entity referred for CT.

Table 3: Indications for CT

Indication	Frequency	Percent
Stroke	10	33.3
Neurological disease	6	20.0
Abdominal disease	6	20.0
Head injury	2	6.7
Laryngeal mass	2	6.7
Hypertensive encephalopathy	1	3.3
Bilateral nasal polyp	1	3.3
Chronic sinusitis	1	3.3

Recurrent low back pain	1	3.3

Although, suspected sinusitis and other otorhinolaryngological conditions had the least number of referrals, rhinosinusitis was the commonest finding seen incidentally on CT scan in about 30.0% of cases (9 patients).

Nearly a quarter of the patients scanned showed normal brain findings. However, another 20% (6) had imaging features of stroke.

Brain atrophy and abdominal masses were identified on imaging in 4 (13.3%) patients each.

Two patients had maxillary sinus polyps and another two had varying degrees of fractures of the long bones. Other combined miscellaneous findings were seen amongst the remaining 4 patients (29.7%). These values are well depicted in Table4 below.

Table 4: Findings on Computed Tomography

Finding	Frequency	Percent
Sinusitis	9	30.0
Normal brain	7	23.3
CVA	6	20.0
Abdominal mass	4	13.3
Brain atrophy	4	13.3
Maxillary polyp	2	6.7

Fracture	2	6.7
Arterial wall calcification	1	3.3
Bilateral basal ganglia calcification	1	3.3
Hypo/hyperparathyroidism	1	3.3
Intracranial dermoid	1	3.3
Laryngeal mass	1	3.3
Lumbar spondylosis	1	3.3
Normal CT urography	1	3.3
Scalp hematoma	1	3.3
Traumatic brain injury	1	3.3

Positive findings corroborating clinically suspected abnormalities were identified in 16 patients (53.3%).

DISCUSSION

A total of thirty (30) retrospective CT scan requests and their respective reports were retrieved and the data were analysed for this research. This number was fairly impressive, considering the rural location of our hospital, the level of patients' enlightenment and the long period of absence of a CT scanner in our hospital in the recent past.We presume this fairly impressive turnout of patients could probably be due in part to the enthusiasm with which the clinicians, patients and radiologists received this modality and their eagerness to apply this modality in solving diagnostic problems.

In our study, the numbers of male patients (19) were almost twice the number of females (11), with a male-to-female ratio of approximately 2:1. This observation is similar to that from a similar study done in North Central Nigeria by Daniel *etal*[12] even though the latter conducted their research over a twelve (12) months period, using a larger number of patients (350).

A possible reason that can be adduced is that males are more prone to trauma and ailments like stroke which may necessitate imaging with computed tomography. Our study further corroborates the findings of more males presenting for CT examination as had been observed in a few other studies previously done in Nigeria, especially with the use of cranial computed tomography.[5,13,14]

The mean age of patients referred for CT examination in the immediate post-installation period of the CT was 58.4 ± 4 years. No paediatric patient was referred for CT. This could be a result of the increased level of awareness about the principles of radiation protection, and also awareness about the deleterious effects of radiation exposure to vulnerable age-groups like children, hence exercising restraints in requesting CT examination for paediatric patients. The clinician may rather prefer to explore the use of other non-ionizing imaging modalities like ultrasonography during the diagnostic evaluation of their patients in the first instance.

In our study, the craniofacial region was the most commonly scanned region of the body in about 20 patients (67%). Stroke and neurological disorders combined, accounted for most referrals for CT scans (44.8%), with stroke being the commonest indication in 10 (33.3%) patients. This finding is however surprising to us, considering the poor state of our roads and the increasing spate of reckless driving amongst bike riders and motorists, often linked with the increasing occurrence of road traffic accidents. Our findings in this regard, are however contrary to the findings by Daniel *etal*,[12] in North Central Nigeria. They noted traumatic brain injury from road

traffic accidents as the commonest clinical indication for cranial CT. Some other authors have also corroborated this finding by Daniel etal.[12, 15,16] We cannot completely forecast from our study if head injury cases would eventually become the commonest indication if this study was done over a longer period with more patients, as against this immediate phase after the installation of our new CT scanner.

From our study, we observed that nearly a quarter of the patients (23.3%) referred for cranial CT had normal brain findings. This further corroborates the findings of normal brain amongst the majority of patients recruited in previous similar but separate research done by Daniel *etal,*[12] and Ugwuanyi*etal.*[13] who observed findings of normal brain in 34% and 39% of cases respectively.

From our study, rhinosinusitis was the most common finding seen in 30.0% of the patients. They were either seen in isolation or co-existing with other pathologies. This is similar to the observation by Ehigiamusoe*etal*[5] who noted sinusitis as the commonest finding amongst 25 (12.8%) patients out of a total of 177 patients whose CT reports were retrospectively studied while evaluating CT scan utilization in the diagnosis of otorhinolaryngological diseases amongst patients in Benin city.

In our study, CT findings of stroke (either hemorrhagic or ischemic) were seen in about 20% of cases, making it the third most common finding. This may be attributable to sedentary life style pattern, smoking, and increased drinking of alcohol amongst young people etc, which have been implicated in the aetiology of hyperlipidemia and systemic hypertension; the commonest causes of stroke (ischemic and hemorrhagic).

We also observed that CT scanning corroborated the clinical indications for the CT scan request of various body regions in 16 patients referred by clinicians, further confirming the high reliability of CT in confirming or excluding suspected diagnoses.

The small sample size, short duration of the research, and it being a single-centre study, are possible limitations of our study. It is therefore appropriate to exercise caution when generalizing our findings. However, our findings are simply reflective of the immediate response of the clinicians and their patients to this newly installed all-important imaging modality, and by extension, the acceptability of this vital investigative tool by the patients and clinicians in this rural based tertiary health facility.

Coincidentally, this study was conducted during the raining season which is also the early farming season in Sub-Saharan Africa. During such seasons, most of the villagers are primarily pre-occupied with farming, as this is a major occupation in the community where this hospital is sited. Depending on the severity of ailments, some patients may prefer to defer clinic visits to a non-farming season in the later part of the year. This may have impacted negatively on the total number of ill patients who visited the various clinics in our hospital during this period, and also on the numbers who were ultimately referred for CT investigations by the attending physicians.

CONCLUSION

Computed tomographic scanners are an indispensable tool for radiologic imaging. Their relative non-availability in most hospitals portends great danger for patients and the future of health care delivery in Sub-Saharan Africa.

Our study revealed that the craniofacial region was the most frequently imaged region. Also, neurological disorders and stroke cases together accounted for most CT referrals (44.8%), with stroke being the commonest indication (33.3%).

Following CT imaging, sinusitis, normal brain findings and features of stroke (ischemic and hemorrhagic), accounted for the three most common findings we saw on the CT images of our

patients in the ten-days immediate post-installation period, constituting about 30%, 23.3%, and 20% of the total population of patients respectively.

Overall, CT positively corroborated suspected clinical diagnosis in 53.3% of cases. It also diagnosed other disease conditions which were not primarily suspected by clinicians. Some of these diagnoses would have been missed if not for the high diagnostic yield of this important imaging modality.

Consent

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

RECOMMENDATIONS

All tertiary health care facilities should be equipped with CT scanners as the minimum cross sectional imaging modality. In this regard, Public-Private partnership (PPP) in the procurement and installation of Computed Tomography scanners, as well as in the training of staff in diagnostic imaging units should be encouraged.

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DECLARATIONS

All authors of this research paper have directly participated in the planning, execution or analysis of this study.

The authors have also read and approved the final version submitted.

The contents of this manuscript have not been copyrighted or published previously.

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LIST OF ABBREVIATIONS

CT: Computed Tomography.

Int: International

SPSS: Statistical package for the Social Sciences.