REVIEW OF CLINICAL PRESENTATION AND RADIOLOGICAL DIAGNOSIS IN PATIENTS UNDERGOING BRAIN CT IN KENYATTA NATIONAL HOSPITAL

DISSERTATION

TO BE SUBMITED IN PART FULFILMENT FOR THE DEGREE OF MASTER OF MEDICINE IN DIAGNOSTIC IMAGING AND RADIATION MEDICINE, UNIVERSITY OF NAIROBI < ,

BY
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My sincere gratitude goes to my supervisor Dr Aywak for her tireless effort and patience which have seen the completion of this work.

I would also like to thank Ms Lakati for helping me with the analysis of data, and to my fellow registrars for their encouragement.

Last but not least, I would like to thank my husband Charles for his immense support and encouragement, and to our sons Nathan and Joe who made each day count and brought so much joy during this demanding period of my career.

DECLARATION

I, Dr Leonida Mbuvi declare that the work contained herein has not been presented at any other university for similar or any other degree

Signature. . . . . Date.... /3 1

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This research dissertation has been submitted with my approval as university supervisor

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ABSTRACT

Introduction

Brain CT and MRI are the current techniques of choice in investigation of brain pathology. MRI is available only in some institutions within the capital city while CT is more available in a number of our radiology departments. Plain radiography is useful in initial assessment of skull trauma and has minimal use in brain pathology assessment. CT can be used to pick up hemorrhage and calcification in a lesion. When contrast is administered, (depending on degree of uptake) it can be used to suggest if there is a breach in the blood brain barrier (thus aggressiveness of a lesion) or vascularity of the tumor. The density appearance of a lesion can be used to suggest the cellularity of a tumor. Brain CT remains a convenient, readily available and < \ *i.*

inexpensive way of characterizing various brain pathologies. The patients request form is an important means of communication between the clinician and the radiologist. It acts as a guide to the radiologist in understanding the condition of the patient especially when the radiologist is working in a busy institution and may not be able to interact with the patient to gather more information regarding the history of illness.

Objective

The main purpose of this study was to determine the clinical presentation and the radiological pattern of brain pathology as seen on brain CT scan examinations done in KNH.

Methodology

This

was a retrospective descriptive study of the CT findings of patients who have undergone brain CT studies in th^fadiology department of KNH from January 2008 to June 2008.

Results

A total of 1221 head CT findings were evaluated during the study period. The male to female ratio was 1.1:1. The mean age was 33.4 years. Brain pathology was identified in 85.0% of the CT scans done. Pathologies encountered included trauma 21.4%, neoplasm's 18.0%, inflammatory conditions 16.8%, and brain atrophy 10.2%. Clinical findings in patients with a normal CT scan of the head included - seizures 33.3%, headache 26.8% and meningitis 20.2%. Clinical presentation encountered included injury related to trauma 19.7%, lateralizing signs 11.9%, headache 11.2% and convulsions/seizures 10.0%.

Conclusion

Majority of the patients undergoing a brain CT scan fall in the 21-40 years age group and are of t »
male gender. Trauma related diagnosis and neoplasms are the commonest radiological diagnosis in patients undergoing head CT in KNH, while history related to trauma and lateralizing signs are the leading causes of clinical presentation. Patients with a normal CT scan of the head approximately half of them, will have presented with seizures and about a third will have / <
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Results

A total of 1221 head CT findings were evaluated during the study period. The male to female ratio was 1.1:1. The mean age was 33.4 years. Brain pathology was identified in 85.0% of the CT scans done. Pathologies encountered included trauma 21.4%, neoplasm's 18.0%, inflammatory conditions 16.8%, and brain atrophy 10.2%. Clinical findings in patients with a normal CT scan of the head included - seizures 33.3%, headache 26.8% and meningitis 20.2%. Clinical presentation encountered included injury related to trauma 19.7%, lateralizing signs 11.9%, headache 11.2% and convulsions/seizures 10.0%.

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2.0 LITERATURE REVIEW

CT scanning also known as CAT scanning is a non-invasive, painless medical procedure that helps physicians diagnose and treat medical conditions. CT imaging uses special x-ray equipment to produce multiple images or pictures of the inside of the body and a computer to join them together in cross-sectional views of the area being studied. The images can then be examined on a computer monitor or printed. CT scans of internal organs, bone, soft tissue and blood vessels provide greater clarity than conventional x-ray exams. Using specialized equipment and expertise to create and interpret CT scans of the body, radiologists can more easily diagnose problems such as neoplasms, inflammatory/infective conditions and intracerebral haemorrhages.

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Computed tomography (CT) has revolutionized diagnostic radiology. Since its inception in the

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1970s, its use has increased rapidly. It is estimated that more than 62 million CT scans per year are currently done in the United States, compared to three million in 1980.[1] From its inception in the 1970s, the use of CT has increased rapidly in all developed countries, usage rates vary from country to country. A survey from the mid-1990s,[2] showed the number of CT scanners per million population was 64 in Japan, 26 in the United States of America (USA) and 6 in the United Kingdom (UK), the country where CT was invented.

The increased CT usage in the UK and the USA over the past quarter of a century has been quantified[3]. It is estimated that close to 3 million CT scans per year were performed in the UK in 2005-2006, compared with 0.25 million in 1980[4, 6]. The corresponding figures for the USA are 69 million scans in 2007, compared with 2 million in 1980[5,6] Considering the relative

populations, the data indicate that the number of CT scans per person is five times greater in the USA than in the UK

jhis sharp increase has been driven largely by advances in CT technology that make it extremely user-friendly, for both the patient and the physician.

A significant part of the UK increase in CT scan usage is for pre-surgical diagnosis of acute appendicitis. Dixon and Goldstone [7] report that UK radiology departments are currently experiencing a massive increase in requests for CT of acute abdomen. Of concern is that appendicitis is largely a disease of young people [8], for whom the radiation risks are higher.

TYPES OF CT SCANNERS

CT scan is a technique of diagnostic roentgenology developed by Godfrey N Hounsfield of EMI limited of England in 1973 [9] CT has undergone technological development from first generation

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to fourth generation spiral scanners with improved efficiency in terms of scan time, radiation dose, and image quality. Reduction of scan times (tube rotation time) has been achieved from five minutes in first generation to less than one second in spiral ct systems [10,n]

First generation scanners

This technology has x-ray tube and detector opposite each other with the subject between them. Two narrow beams of x-ray, each detected by a scintillation detector, simultaneously provide two sections of the subject. The x-ray tube and detector performed translatory and rotary movement. It involves 240 exposures while performing translatory movements, followed by one degree angular tilt. Overall 240X180 exposures were maybe. Scan time for one section took about 5 minutes[10]

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Second generation scanners

In this design the beam of x-ray is fan shaped with an angle of ten degrees, the beam is detected by a series of scintillation detectors, typically about thirty and the source of radiation and detectors scan across the patient in approximately a second. The gantry is then rotated about ten degrees and the operation is repeated. Total scan time is approximately 20 seconds making it 15 times faster than first generation scanners

Third generation scanners

This technology had wider fan systems (30 degrees) with no translatory but continuous rotary movement of the tube and detector. With this technology the scan time was reduced to about 5 seconds per section . < ,

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Fourth generation scanners

This technology has fan shaped beam with annular array detectors that remain stationary. The x-ray tube performs rotational motion inside the detector ring. Scan time for one section was about one second

Volume (spiral, helical) CT technology

Spiral technology involves continuous movement of the patient through a rotating continuous fan beam exposures, allowing compilation of continuous data that has an uninterrupted anatomic detail unlike in conventional CT •

A volume of data set in the form of corkscrew or helix is obtained. As shown by Horocks J. A [12] the slice thickness is not always exact across the whole cross section and often a small gap is left within what is supposedly a volumetric data.

Continuous data acquisition was made possible due to advances in CT technology that introduced slip-ring technology, precise patient table transport, improved software reconstructing algorithms, improved detector efficiency and introduction of higher heat capacity x-ray tubes and sub second x-ray tube rotation time. Kalender et al [11] were the first to introduce these technologies in a working CT scanner

Spiral CT with advanced detector designs (multi-slice technology)

Major advances have occurred in detector technology with the introduction of ceramic detectors which have higher x-ray photon detection efficiency [13]

This has enabled high quality imaging with reduction of radiation burden. By using a beam, which is fanned out in the patients Z direction (patients axis) to include two contiguous detectors, the scan time is halved if the other parameters remain the same (acquiring two slices per tube /«

rotation) currently available systems allow acquisition of up to 64 slices at a time

Hu H, He HD, Foley W D et al[14] have shown

in studies on commercial CT scanners that a two to three times increase in volume acquisition rate as compared to a single slice system is fully compatible with comparable image quality. Multi slice CT today is comparable to MRI in many areas of clinical studies like in detection of aneurysms.[15>

Brain tumours

The American Cancer Society estimates that 16,800 new intracranial tumors were diagnosed in 1999 and primary cancer of the central nervous system was the cause of death in approximately 13,100 people.[16] Metastases to the brain from a systemic primary cancer are even more common; one estimate suggests that more than 100,000 patients per year die with symptomatic intracranial metastases.[17]

For the period from 1950 to 1989, the age- and sex-adjusted incidence of primary tumors of the central nervous system at the Mayo Clinic was 19.1 per 100,000 persons per year (11.8 per 100,000 for symptomatic tumors and 7.3 per 100,000 for asymptomatic tumours. [18] This incidence is almost identical to that found in the Central Brain Tumor Registry of the United States of America, in which the annual rate was 11^.47 per 100,000 persons.[19]

Subarachnoid haemorrhage

Of all cerebrovascular accidents, 3% are due to subarachnoid haemorrhage (SAH), which is responsible for 5% of deaths due to brain infarctions. The mortality rate (including deaths before admission) may exceed 50%. Intracranial aneurysms are the most common cause of non traumatic subarachnoid haemorrhage, occurring in 60-85% of cases[20] Roughly 80 percent of patients with nontraumatic subarachnoid haemorrhage have ruptured saccular aneurysms, which occur in 30,000 patients annually in the United States of America.[12] Among the remaining 20 percent, about half have nonaneurysmal perimesencephalic haemorrhages/[22,23]*

An aneurysm is an abnormal 16cal dilatation in the wall of a blood vessel usually an artery, due to a defect, disease or injury. The three major types of intracranial aneurysms are saccular, fusiform and dissecting. [24] Despite the widespread availability of neuroimaging equipment,

misdiagnosis of subarachnoid haemorrhage remains common,[25,26] and it is an important cause of litigation related to emergency medicine. [27] Subarachnoid haemorrhage is more common in women than in men (2:1) [28]; the peak incidence is in persons 55 to 60 years old. [2g] An estimated 5 to 15 percent of cases of stroke are related to ruptured intracranial aneurysms.[30]

Head trauma

The question of which patients with head trauma should undergo scanning has remained controversial since the introduction of computed tomography (CT) in the early 1970s. Initially, CT was a scarce resource reserved for severely injured patients.

In the early 1990s, several retrospective studies of patients with minor head injury reported 17 to 20 percent with intracranial lesions on CT. The authors concluded that CT was indicated in all patients with minor head injury.[131,32,33}] In subsequent prospective studies of patients with a score of 15 on the Glasgow Coma Scale, the rate of intracranial lesions on CT was much lower at 6 to 9 percent/[34,35,361]

In two studies, selective use of CT on the basis of clinical findings identified 96 percent and 98 percent of patients with abnormalities on CT scanning, [35, 37] and none of the patients with abnormalities who did not have the specified clinical findings required neurosurgery. [34-35] In the west, some physicians are not willing to accept the risk of missing an abnormality. In a survey of emergency physicians, more than half insisted that a clinical decision rule for minor head injury must have a sensitivity of 100 percent.[35] Thus, the use of CT to screen patients with minor head injury for intracranial lesions has become routine, and therefore expensive. According to one estimate, even a 10 percent reduction in the number of CT scans in patients with minor head injury would save moi« than $20 million per year.[36]

Symptoms of Brain pathology

Headache is one of the most frequent ailments of the human race. Headache prevalence is estimated at 11%-48% in children[37,38] and 6%-71% in adults.[39,40] As with migraine, age, sex, and case definition may largely account for this variance.[141] A higher prevalence has been found in Europe and North America[42,43,44] than in Asian and South American countries.[40,45] Prevalence of migraine shows a clear sex difference, affecting about 15%-18% of women and 6% of men.[41,46] Muscle contraction or tension accounts for most of the nonmigraine headaches encountered in population surveys.

By comparison, the frequency of pathology presenting with headache is low. The yearly incidence of brain tumors in the US is 46 per lOOjOOO, and for subarachnoid hemorrhage (SAH), 9 per 100,000. Arteriovenous malformations (AVMs) are about one-tenth as frequent as saccular aneurysms. Only a small percentage of these patients present with isolated headache.[42]

Headache occurs in about half of all patients with brain tumors. The headache is typically diffuse and can accurately indicate the hemisphere in which the tumor is located.[47] The headache tends to be more noticeable on awakening in the morning and, even without treatment, dissipates within a few hours. The headache can occasionally be unilateral and throbbing and can mimic migraine or even cluster headaches.[48]

Approximately 18% of all patients referred for a cranial computed tomography complain of headache only. Demaerel P, Boelaert I, Wilms G, et al reviewed 363 consecutive patients in order to assess the value of this examination in the diagnostic approach. Results showed a large number of normal examinations (88.4%), in spite of these results they advocate the routine use of

a cranial computed tomography in every patient with chronic headache. From the study it was suggested that the cost of the examination can significantly be reduced by performing an unenhanced scan only. An additional contrast-enhanced scan should be obtained if a suspicious lesion is seen. Brain magnetic resonance imaging is not indicated except in the preoperative workup of a lesion visualized on computed tomography.[49]

Seizures occur at presentation in 15 to 95 percent of patients with brain tumors, depending on the type of tumor. Typically, the seizures are focal but may become generalized and cause loss of consciousness.[47] It is standard practice to obtain head CT scans in patients with new-onset seizures, even though more than half of such tests are negative in this patient group.[50]

In a prospective study involving 301 adults with suspected meningitis, it was confirmed that clinical features can be used to identify patients who are unlikely to have abnormal findings on cranial CT (41 percent of the patients in this study).[51] Of 235 patients who underwent cranial CT, in only 5 patients (2 percent) was bacterial meningitis confirmed. From this study it was concluded that cranial imaging should precede lumbar puncture in patients who have new-onset seizures, an immunocompromised state, signs that are suspicious for space-occupying lesions, or moderate-to-severe impairment of consciousness.[5152-53]

Another study where Computed Tomography of the Head was done before Lumbar Puncture in Adults with Suspected Meningitis, 76 percent of CT of the head were normal. Of the 56 patients with abnormal results, only 11 had abnormalities associated with a mass effect and only 4 (2 percent of the 235 patients who underwent CT) had abnormalities that caused the clinician to avoid lumbar puncture.[54]

Baker ND, Kharazi H, Laurent L, et al, reported similar results in a study that included a more heterogeneous cohort of adults.[55]

3.0 JUSTIFICATION

In our set up, CT scans of the head are commonly carried out in the routine activities of a radiology department and in emergency settings. They form the bulk of CT work done in our department.

A similar study was done twelve years ago by Dr Mashuke for his dissertation. In his study only 200 patients were evaluated and a third generation CT scanner was used. Currently KNH has acquired a 16 slice CT scanner. A study to review pattern of brain pathology in CT scan examinations using a larger sample size is timely. Comparison of pathological outcome then and now will be made, to check if there has been any change in the radiological diagnoses being made.

The findings of this study will broaden the understanding of pattern of brain pathologies in our local population.

Knowledge of the pattern of brain pathology as seen on CT scans and the various clinical presentations will lead to improved pick up of cases from the general population and better decision making regarding those who really require the examination as far as symptomatology is concerned. Depending on the clinical symptoms of the patient a focused and appropriate imaging modality will be requested by the clinician. This in turn will ensure efficient and cost effective diagnosis and management of patients with these pathologies.

The knowledge generated through this study will complement the one applicable now from the western studies and allow clinicians to adapt it to our local setup/population.

4.0 OBJECTIVES

4.1 Broad Objectives

The main objective of the study was to determine clinical presentation^ JI the radiological pattern of brain pathology as seen on CT scan examinations done in l

4.2 Specific Objectives

1. To determine the commonest radiological brain pathology in undergoing he^ CT scan examinations
2. To determine the clinical presentation of patients undergoing (wscan of the head
3 To determine the age and sex distribution of these patients
4 To determine the clinical presentation of patients with a CT sc^. reported as normal

4.3 Research Questions

1. What is the commonest brain pathology seen on CT head at K^rjJ
2. Which is the commonest presenting symptoms of patients refe^d f°r CT scan of th^ head
3. What is the demographic pattern of,patients undergoing CT s c ^ of the head

5.0 STUDY METHODOLOGY

5.1 Study area

The study was carried out in the radiology department at K^nyatta National Hospj^,

5.2 Study population

The study population consisted of the adequately filled patient request lorms and patients who had undergone a brain CT scan examination finding*

5.3 Study design

A retrospective descriptive study from January to June 20O8. Available request f0 CT examination findings were studied. Patient's bio cfeta w^s obtained from the r Vs ^^ t forms.

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5.3.1 Inclusion criteria

All head CT findings of patients who had undergone brain CT scan during the study period and had adequately filled request forms.

5.3.2 Exclusion criteria

Patients with examinations that had other body areas that needed to be scanned other than the head.

5.4 Sample size determination

The sample size involved all the appropriately reported brain CT findings in the radiology department of KNH. Thi^was based on the assumption that a minimum of 10 brain CT scans are

done on a daily basis, thus 200 brain scans on a monthly basis. In a span of 6 months, a minimum of 1200 brain CT scans are done, which was used as the minimum sample size

5.5 Data collection tools

Required information elicited from the patients request forms and CT findings were collected and recorded using a structured data sheet. The collected data was then processed and results presented in the form of frequency distribution tables and descriptive statistics.

5.6 Data Management

Data was collected, cleaned and entered for analysis using windows XP and software for social science research (SPSS) version 12. Results were then presented in form of frequency distribution tables and descriptive statistics. The level of significance was set at 0.05.

6.0 ETHICAL CONSIDERATION

Before commencing on the study, a request was submitted together with a copy of the Proposal to the ethical and research committee of KNH for approval which was granted on 31st July 2008. Patients name were not to be recorded during the study in order to maintain confidentiality. Information acquired from this study was used exclusively for research and improvement of the knowledge of clinicians. It was handled and treated with utmost confidentiality.

The results of the study were delivered to the KNH ethical committee to assist in forming a data base for future studies.

7.0 RESULTS

During the study period a total of 1221 head CT findings of patients were evaluated.

Characteristics of the sample population

There were 653 (53.5%) males and 568 (46.5%) females with a male to female ratio of 1:1.1. The sample population had a mean age of 33.4 with a minimum of <1 year and a maximum of 84 years. There was no statistically significant difference (p=0.58) in the mean age of males (32.7 years) and females (31.9 years). The age and sex distribution of the sample population was as shown in table 1 below. Overall, the 21-40 years age group comprised the commonest age group (32.4%) referred for brain CT examinations. The 21-40years age group was the commonest group (37.2%) for males referred for brain CT scan examination while the 0-20 age group was the commonest for females (29.8%).

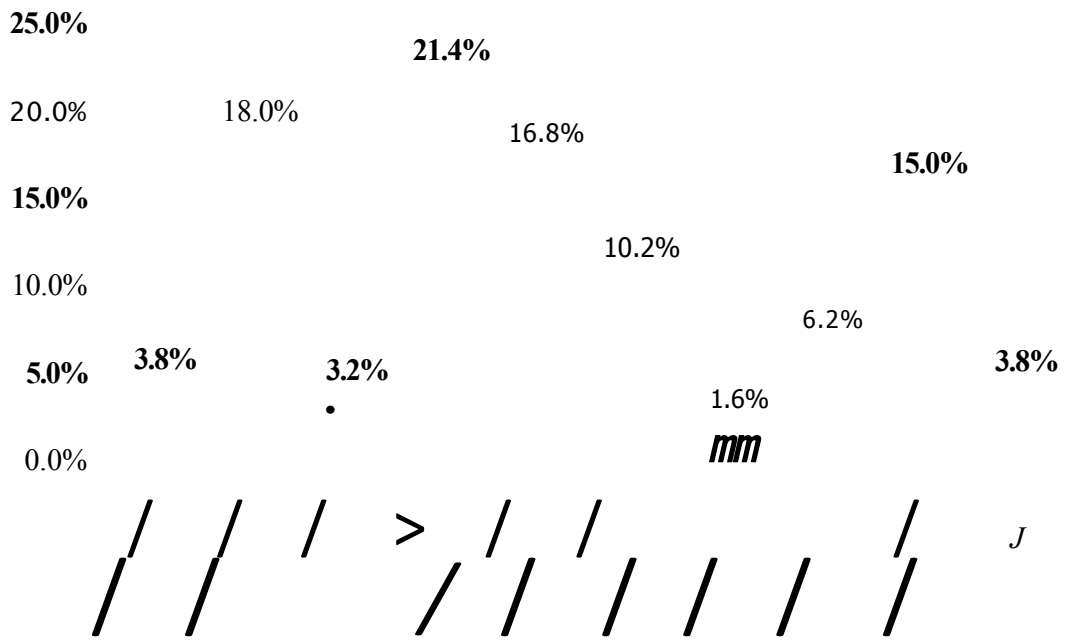
Table 1: Age and sex distribution of the patients under study (n=1221)

	Male		**Female**		**Overall**	
Age group	**n**	(%)	**n**	(%)	**n**	(%)
0-20	154	(23.5)	169	(29.8)	323	(26.5)
21-40	243	(37.2)	153	(26.9)	396	(32.4)
41-60	159	(24.4)	122	(21.5)	281	(23.0)
61-80	67	(10.3)	96	(16.9)	163	(13.4)
81-100	30	(4.6)	28	(4.9)	58	(4.7)
Total	**653**	**(100.0)**	**568**	**(100.0)**	**1221**	**(100.0)**

Distribution of brain pathology findings

Pathology was found in 85.0% of the head CT scans done. The commonest CT radiologic^ diagnosis was trauma related injury which comprised 261 (21.4%) of the pathology. The le^ common diagnosis was white matter abnormalities 20 (1.6%). There were 183 (15.0%) CT sca^ where the radiological diagnosis was concluded as normal. The distribution of the various (V radiological diagnoses is as shown in figure 1 below.

Figure 1: distribution of brain radiological diagnosis (n=1221)



The CT radiological diagnoses and sex distribution is as shown in table 2. Trauma was the commonest 177 (27.1%) radiological diagnosis in male patients while inflammatory conditions were the commonest 108 (19.0%) in the females. White matter abnormalities was the least frequently made diagnosis, 7 (1.0%) for male patients and 13 (2.4%) for female patients.

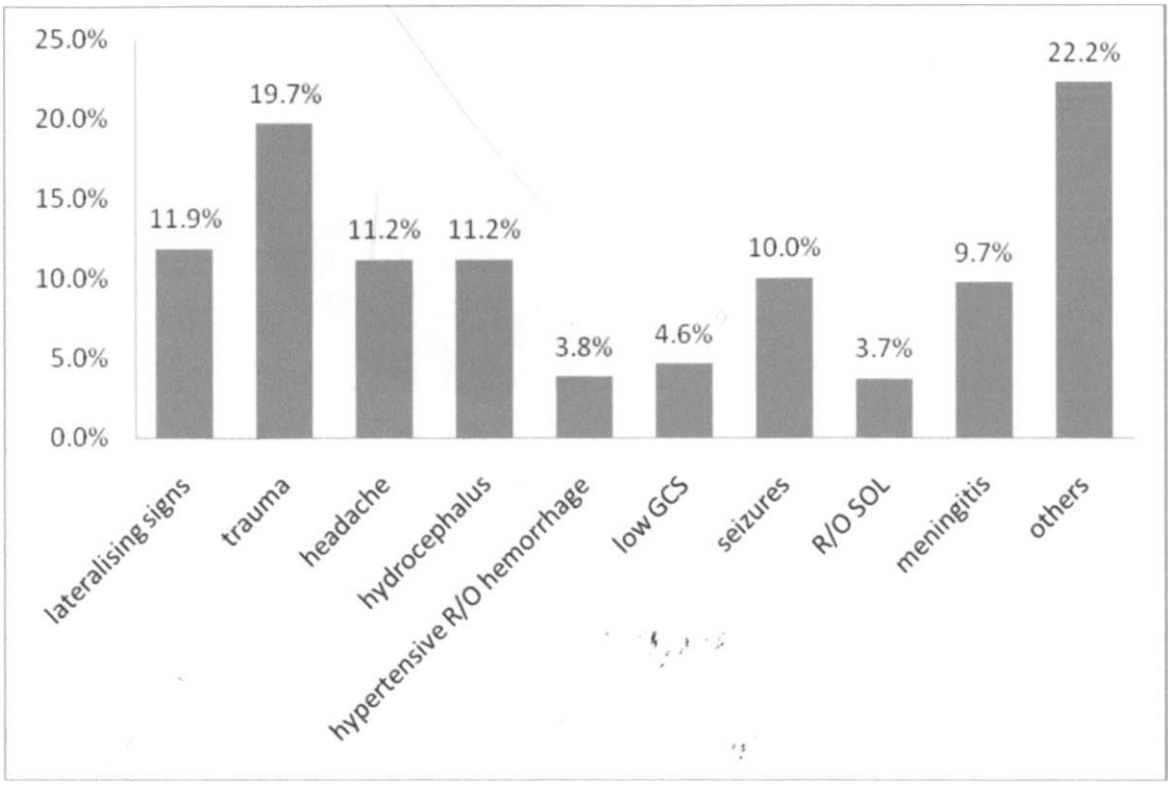
Table 2: distribution of brain CT diagnosis versus sex in the study (n=1221)

CT Diagnosis	Male n (%)	Female n (%)
Hydrocephalus	24 (3.7)	22 (3.9)
Neoplasm	113 (17.3)	107 (18.8)
Sub arachnoid haemorrhage (SAH)	14 (2.1)	25 (4.4)
Trauma	177 (27.1)	84 (14.8)
Inflammatory conditions	97 (14.9)	108 (19.0)
Brain atrophy	67 (10.3)	57 (10.0)
White matter abnormalities	7 (1.0)	13 (2.4)
Infarcts	35 (5.4)	41 (7.2)
Normal	96 (14.7)	87 (15.3)
others	23 (3.5)	24 (4.2)
total	**653 (100.0)**	**568 (100.0)**

Distribution of clinical presentation

Trauma related injury 239 (19.7%) and lateralising signs 147 (11.9%) were the commonest clinical presentation encountered in the brain CT scans done. The least common clinical presentation was hydrocephalu$/enlarging head 39 (3.2%) and to rule out a space occupying lesion 44(3.7%). The other clinical presentation encountered is as shown in figure 2 below.

Figure 2: distribution of clinical presentation in the study. (n=1221)



Distribution of clinical findings in CT scans with a normal radiological diagnosis.

CT scans where patients had clinical signs and symptoms and were found to be normal after the examination were 183 (15.0%). Majority of them had seizures/convulsions 61 (33.3%) as the clinical presentation. Headaches were encountered in 49 (26.8%) request forms. The distribution is as shown in figure 3.

Figure 3: Distribution of clinical presentation in patients with a normal CT scan (n=183)

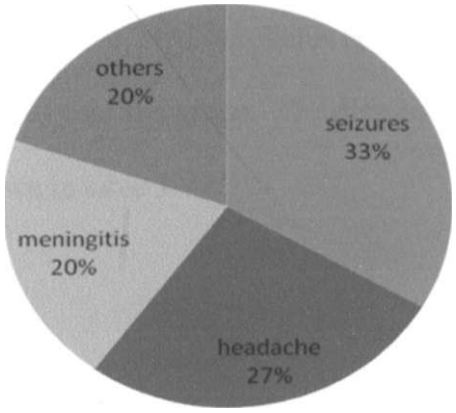


Table 3: distribution of brain pathology in the various age groups (n=1221)

Age group	Hydrocephalus	Neoplasm	SAH	Trauma	Infections	Atrophy	WM disease	Infarcts	Normal	Other
0-20	46 (100)	27 (12.3)	(0.0)	52 (19.9)	93 (45.4)	31 (25.0)	3 (15.0)	16 (21.0)	44 (24.0)	11 (23.C
21-40		64 (29.1)	11 (28.2)	136 (52.1)	84 (41.0)	22 (17.7)	4 (20.0)	18 (23.7)	41 (22.4)	16 (28.1
1 41-60		83 (37.7)	19 (48.7)	35 (13.4)	18 (8.7)	19 (15.3)	11 (55.0)	32 (42.1)	53 (29.0)	11 (23.4
1 61-80		35 (15.9)	8 (20.5)	26 (10.0)	7 (3.4)	47 (38.0)	1 (5.0)	6 (7.9)	36 (19.7)	
81-100		11 (5.0)	1 (2.6)	*n* (4.6)	3 (1.5)	5 (4.0)	1 (5.0)	4 (5.3)	9 (4.9)	12 (25.5)
	46		**39**	**261**	**205**	**124**	**20**	**76**	**183**	**47**

The 21-40 year age group was the commonest for trauma patients (52.11%). Most neoplasm's (37.7%) were encountered in the 41-60 years age group and so were sub arachnoid haemorrhages (48.7%) and infarcts (42.1%). Hydrocephalus being a condition mainly of the young was encountered in the 0-20 year age group. The distribution of the other pathologies in the different age groups is as shown in table 3.

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8.0 DISCUSSION

The overall objective of this study was to determine the clinical presentation and the radiological pattern of brain pathology as seen on brain CT scan examinations. The study showed demonstrable pathology in 85.0% of the cases done.

The commonest age group examined was the 21-40 years which comprised 32.4% of the sample population. In Dr Mashukes study the commonest age group was 0-20 years.

Trauma related head injury was the commonest 21.4% radiological diagnosis encountered in the study. The injuries ranged from fractures, intracerebral hemorrhages, epidural

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hematomas, subdural hematomas, contusions etc. These were caused by various injuries including road traffic accidents, assault and fall from heights. In our set up, road traffic accidents are a leading cause of morbidity and mortality and thus can explain the high number of trauma related injury radiologically. In addition, the large number of trauma related cases can be explained by the political related violence experienced at the beginning of the year. Trauma was also reported in a majority of the male sex 52.1% and in the 21-40 years age group. Dr Mashukes study revealed trauma related diagnoses to be the fourth commonest radiological diagnosis (26 cases). His study also revealed the male gender (19 cases) to be more affected compared to the females (7 cases).

Cranial trauma is a major problem in accident and emergency departments and in one series provided 10% of patients seen. [56] Kenyatta being a referral hospital receives a large number of accident victims as referrals and this could explain the difference with

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other studies. Approximately 2 million head injuries occur each year in the United States, producing a brain injury rate of 175 to 200 per 100,000 population and causing as many as 56,000 deaths per year.[61]

Neoplasms were the second commonest radiological diagnoses encountered at 18.0% of the sample population in the study. They mainly included gliomas, meningiomas, metastatic lesions, medulloblastomas and craniopharyngiomas. However these had not been pathologically correlated and a study to correlate these findings can be carried out. The tumours were common 37.7% in the 41-60 years age group. A lower incidence of brain neoplasms was encountered after 60 years compared to those below 40 years, in our set up, this can be explained by the declining life expectancy. According to Dr Mashukes study tumors were the fifth commonest radiological diagnosis[11] (24 cases). From his study tumors were common in the male patients (14 cases).

Cerebral tumors are predominantly tumors of adult life with a peak incidence of 13 cases per 100 000 population at age 55-65. They are relatively uncommon in infants and children at 2 cases per 100 000. [56] In the USA, approximately 2000 children and adolescents younger than 20 years of age are diagnosed with malignant brain tumors each year.[62]

According to McKinney P A, Lassman A B et al, in a study of brain tumors: incidence, survival and aetiology showed that primary brain tumors occur in 10 people per 100,000 population. Primary brain* tumors can affect anyone but are commonly seen in children

under 15 years of age and in middle-aged adults. Secondary brain tumors are commonly seen in adults.[63]

A study by Lennard A, Leigh K et al on brain abscesses concluded that in developed countries, bacterial abscesses are rare in healthy adults. In children, cerebral abscesses are rare, even in patients with congenital heart disease and immune defects.[64] Mamelak AN, Mampalam TJ et al also concluded that Brain abscess is rare in the general population; however, immunocompromised patients have increasing incidence of brain abscess, often with fungal or protozoan organisms.In the United States, 1500-2500 cases are reported per year.[65]

From the study the third commonest radiological diagnoses were inflammatory conditions 16.8% which included cerebritis, meningoencephalitis, toxoplasmosis and abscesses and were encountered in majority of patients less than 40 years 86.4%. The high incidence in this age group could be because of the high degree of immunosupression due to HIV/AIDS in our population. A study to correlate the immune status of those with radiological intracranial infections can be done. Infections are known to occur in majority of those whose immunity is compromised. Although cerebral abscesses may occur in any age group, they are most common in the first four decades of life and males are more commonly affected than females. [56] From the study inflammatory/infections were more common in females 19.0 % compared to males. Infestations and infections were the commonest radiological diagnoses encountered in Dr

Mashukes study at 94 cases. These were common in the male gender (84 cases). The difference between the two studies could be explained by the fact his study was conducted at the time when immunosuppression was high and the cost of retroviral drugs was high compared to the current time. Currently with the inexpensive and ease of availability of retroviral drugs the immunity of most people is improved and they are unlikely to suffer from opportunistic infestations and other infections

A study by Desprechins B, Stadnik T et al showed that the early findings of CT examinations are not specific for cerebral abscess. The oedema pattern and moderate mass effect cannot be differentiated from tumour or stroke in some patients. From their findings diffusion weighted imaging is superior to CT scans in separating necrotic tumours and cerebral abscesses.

They thus suggested that the preferred initial examination of the patient in whom brain abscess is suspected is MRI with and without gadolinium enhancement. [66] This is not practical in out setup because of the lack of MRI scanners except in some parts of the city and because of the high financial implication. Majority of the patients seeking health services in KNH are of low social economic status.

The true incidence of intracranial aneurysms is unknown but is estimated at 1-6% of the population. [67]In one series of patients undergoing coronary angiography, incidental intracranial aneurysms were found in 5.6% of cases, and another series found aneurysms

in 1% of patients undergoing 4-vessel cerebral angiography for indications other than subarachnoid hemorrhage.[68]

Majority of cerebral aneurysms present clinically as sub arachnoid hemorrhage after they have ruptured. In this study subarachnoid haemorrhages formed 3.2% of the radiological diagnoses. Osborn [57] stated that aneurysms typically become symptomatic in people aged 40-60 years. Ruberti [58] also showed that intracranial aneurysms typically become symptomatic at the age group 40-60 years. This is comparable to the results in the study where most sub arachnoid hemorrhages 48.7% were encountered in patients of age group 41-60 years. SAH was also more common in female patients compared to the male gender. Subarachnoid haemorrhage is more common in women than in men (2:1) the peak incidence is in persons 55 to 60 years old according to Greenberg M S.[29] Brisman JL, Song JK et al from their study concluded that aneurysms typically become symptomatic in people aged 40-60 years, with the peak incidence of SAH occurring in people aged 55-60 years. [69] They also found intracranial aneurysms are uncommon in children and account for less than 2% of all cases. Aneurysms in the paediatric age group are often more posttraumatic or mycotic than degenerative and have a slight male predilection. Aneurysms found in children are also larger than those found in adults, averaging 17 mm in diameter.[69]

CT of the brain is the initial examination done on patients with aneurysms. Catheter angiography is mainly done on patients who will require intervention.

In the study majority 46.4% of the patients with a brain CT scan reported as normal were less than 40 years. Even though there is minimal risk associated with exposure to ionizing radiation, people in the reproductive age group should not be exposed to radiation unless it is necessary. Majority of these patients were found to have seizures/convulsions 33.33%. According to a study by Diane M, Streiner D et al where it is standard practice to carry out CT scans in patients with new onset seizures, more than half of the scans were found to be negative for pathology radiologically.[50]

From this study headaches formed 26.8% of the presenting symptoms in those with a normal scan. Several studies have confirmed a lo\(/ yield in imaging procedures done on patients with isolated headache unaccompanied by other neurologic findings. [5960] Hasbun R, Abrahams J et al did a study on patients suspected to have features suggestive of meningitis with no neurological deficits that showed a high likely hood of having no pathology on CT examinations. From their study only 2 percent had bacterial meningitis confirmed. [5,] In this study there were 20.2 per cent patients with a CT scan with no pathology despite having features suggestive of possible meningitis.

Trauma formed a small portion of the others in patients with a normal CT scan. A study conducted by Essam AE, Sherif M et al where 600 patients with minor head trauma were evaluated in the accident and emergency department, only 130 patients were referred for cranial CT scan. Of these 24 (18,5%) had evidence of intracranial injuries, 19 of whom were admitted for observation and only 2 patients (1.5%) required a craniotomy. Brain

CT was normal in 100 patients (77%). [70] From this study it can be concluded that patients with minor head trauma should be thoroughly vetted to ensure that CT scan is really necessary and thus avoid unnecessary exposure to radiation.

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9.0 CONCLUSION

Based on the findings of this study and on the objectives that were set, the following conclusions were made:

Majority of the patients undergoing a brain CT scan fall in the 21-40 years age group and are of male gender.

Trauma related diagnosis and neoplasms are the commonest radiological diagnosis in patients undergoing head CT in KNH, while history related to trauma and lateralizing signs are the leading causes of clinical presentation.

Patients with a normal CT scan of the head approximately half of them will have presented with seizures and about a third will have presented with headaches.

10.0 RECOMMENDATIONS

As shown from the study, patients less than 40 years presenting with seizures and headaches without other associated findings like neurological deficits are likely to have a normal CT scan of the head. This raises issues of exposure to radiation to those in the reproductive age.

The clinician should thus be encouraged to refer patients with other associated syptomatology on top of the headaches and seizures for CT scanning in order to avoid unnecessary exposure to radiation considering that majority of these patients are within the reproductive age group. This will lead to an improved diagnostic yield. Other imaging modalities like MRI which do not involve exposure to radiation can also be used as an alternative to CT examination. MRI is known to be a superior examination to CT in evaluating other causes of seizures like missiotemporal sclerosis.

11.0 REFERENCES

1).David J. Brenner, Ph.D., and Eric J. Hall, Growth of CT scan use may lead to significant public health problem *The New England Journal of Medicine* 2007; 457:1077-1084

2) UNSCEAR. Sources and effects of ionizing radiation: United Nations Scientific Committee on the Effects of Atomic Radiation: *UNSCEAR 2000 report to the General Assembly*. New York, NY: United Nations; 2000.

3) Brenner DJ, Hall EJ. Computed tomography—an increasing source of radiation exposure. *New England Journal of Medicine* 2007; 357:2277-2284.

4) UK Department of Health. Department of Health Hospital Activity Statistics: *Imaging and Radiodiagnostics Data files*

5) International Marketing Ventures. 2006 *CT Market Summary Report.* Rockville, MD; 2006.

6) Brenner DJ, Doll R, Goodhead DT, Hall EJ, Land CE, Little JB, et al. Cancer risks attributable to low doses of ionizing radiation: assessing what we really know. *Proc Natl Academic Science USA* 2003; **100**:13761-13766.

< >

7) Dixon AK, Goldstone KE. Abdominal CT and the Euratom Directive. *European Radiology* 2002; **12**:1567-1570.

‹ ‹

8) Al-Omran M, Mamdani M, McLeod RS. Epidemiologic features of acute appendicitis in Ontario, Canada. *Canadian Journal of Surgery* 2003; 46:263-268.

9) Hounsfield G.N. Computerised transverse axial scanning (tomography) description of a system *British journal of radiology* 1973; 46: 1021 -1022

10). Seminars in roentology, volume XII No 1 January 1977

1 l).Kalender W.A Seissler W et al Spiral volumetric CT with single breath hold technique, continuous table transport and continuous scanner rotation. *Radiology* 1990; 176: 181-183

12) Horocks J A, Speller R. D Helical computed tomography: Where is the cut *British journal of Radiology* 1994; 67: 107-111

13) Peter Danson, William R Lees Multislice technology in computed Tomography *Clinical Radiology* 2001; 56: 302-309

14) Hu H, He HD, Foley WD, Fox SH, Four multi-detector row helical CT: image quality and volume coverage speed. *Radiology2000-,* **215:** 55-62

15) Leslie E Quint, Isaac R , Francis et al Evaluation of thoracic aortic disease with the use of helical CT and multi planar reconstruction: comparison with surgical findings *Radiology'.* 1996; **201**:37-41

16) Landis SH, Murray T, Bolden S, Wingo PA. Cancer statistics, 1999. CA Cancer Clinical *journal* 1999; **49**:8-10

17) Posner JB. Neurologic complications of cancer. Philadelphia: F.A. Davis, 1995

18) Radhakrishnan K, Mokri B, Parisi JE, O'Fallon WM, Sunku J, Kurland LT. The trends in incidence of primary brain tumors in the population of Rochester, Minnesota. *Neurology* 1995; **37**:67-73

19) Surawicz TS, McCarthy BJ, Kupelian V, Jukich PJ, Bruner JM, Davis FG Descriptive epidemiology of primary brain and CNS tumors: results from the Central Brain Tumor Registry of the United States, 1990-1994. *Neurooncology* 1999; 1:14-25

20) Kavous F, Hossein G, Majid S, Angiographic findings in 130 patients eith aneurismal subarachnoid hemorrhage. *Archives of Iranian medicine Vol 8*, 2005:184-187

21) Mayberg MR, Batjer HH, Dacey R, et al. Guidelines for the management of aneurysmal subarachnoid hemorrhage: a statement for healthcare professionals from a special writing group of the Stroke Council, American Heart Association. *Stroke* 1994; **25**:2315-2328

22) Vermeulen M. Subarachnoid haemorrhage: diagnosis and treatment. *Journal of Neurology* 1996; **243**:496-501

23) Vermeulen M, van Gijn J. The diagnosis of subarachnoid haemorrhage. *Journal of Neurology Neurosurgery Psychiatry* 1990; **53**:365-372

24) Osborn AG Intracranial aneurysms *Diagnostic Neuroradiology* 1994:248-263

25) Neil-Dwyer G, Lang D. Brain attack' ~ aneurysmal subarachnoid haemorrhage: death due to delayed diagnosis. J R Coll Physicians Lond 1997; *31:49-52*

26) Mayer PL, Awad IA, Todor R, et al. Misdiagnosis of symptomatic cerebral aneurysm: prevalence and correlation with outcome at four institutions. *Stroke* 1996; **27**:1558-1563

27) Karcz A, Holbrook J, Burke MC, et al. Massachusetts emergency medicine closed malpractice claims: 1988-1990. *Emergency Medicine* 1993;22:553-559

28) Stapf C, Mohr JP. Aneurysms and subarachnoid hemorrhage — epidemiology. In: Le Roux PD, Winn HR, Newell DW, eds. Management of cerebral aneurysms. Philadelphia: Saunders, 2004:183-7.

29) Greenberg MS. SAH and aneurysms. In: Greenberg MS, ed. Handbook of neurosurgery. 5th ed. New York: Thieme Medical, 2000:754-803.

30) Bederson JB, Awad I A, Wiebers DO, et al. Recommendations for the management of patients with unruptured intracranial aneurysms: a statement for healthcare professionals from the Stroke Council of the American Heart Association. Stroke 2000**;31**:2742-2750

31) Stein SC,Ross SE. The value of computed tomographic scans in patients with low risk head injuries. *Neurosurgery* 1990**;26**:638-640

32) Stein SC, Ross SE. Mild head injury: a plea for routine early CT scanning. *Journal of Trauma* 1992**;33:11**-13

33) Harad FT, Kerstein MD. Inadequacy of bedside clinical indicators in identifying significant intracranial injury in trauma patients. *Journal of Trauma* 1992**;32**:359-361

34) Miller EC, Derlet RW, Kinser D. Minor head trauma: is computed tomography always necessary? *Ann Emergency Medicine* 1996**;27**:290-294

35) Miller EC, Holmes JF, Derlet RW. Utilizing clinical factors to reduce head CT scan ordering for minor head trauma patients. *Journal of Emergency Medicine* 1997**;15**:453-457

36) Jeret JS, Mandell M, Anziska B, et al. Clinical predictors of abnormality disclosed by computed tomography after mild head trauma. *Neurosurgery* 1993; **32:9-15**

36) Nagy KK, Joseph KT, Krosner SM, et al. The utility of head computed tomography after minimal head injury. *Journal of Trauma* 1999; **46**:268-270

37) Abu-Arefeh I, Russell G Prevalence of headache and migraine in schoolchildren *British Medical Journal* **1**994**;309:**765-769

38) Brattberg G The incidence of back pain and headache among Swedish school children. *Quality Life Resarch* 1994;3 Suppl 1:S27-31

39) Gobel H, Petersen-Braun M, Soyka D. The epidemiology of headache in Germany: a nationwide survey of a representative sample on the basis of the headache classification of the International Headache Society. *Cephalalgia* 1994**;14**:97-106

40) Wong TW, Wong KS, Yu TS, et al. Prevalence of migraine and other headaches in Hong Kong. *Neuroepidemiology* 1995**;14**:82-91

41) Lipton RB, Stewart WF. The epidemiology of migraine. *European Neurology* 1994**;34** Suppl 2:6-11

42) Kryst S, Scherl E. A population-based survey of the social and personal impact of headache. *Headache* 1994**;34**:34^50

43) Merikangas ICR, Whitaker AE, Isler H, et al. The Zurich Study: XXIII. Epidemiology of headache syndromes in the Zurich cohort study of young adults. *European Archives Psychiatry Clinical Neuroscience* 1994**;244:**145-152

44) O'Brien B, Goeree R, Streiner D. Prevalence of migraine headache in Canada: a population-based survey. *International Journal of Epidemiology* 1994**;23**:1020-1026

45) Cruz ME, Cruz I, Preux PM, et al. Headache and cysticercosis in Ecuador, South America. *Headache* 1995**;35**:93-97

46) Russell MB, Rasmussen BK, Thorvaldsen P, et al. Prevalence and sex-ratio of the subtypes of migraine. *International Journal of Epidemiology* 1995**;24**:612-618

47) Forsyth PA, Posner JB. Headaches in patients with brain tumors: a study of 111 patients. *Neurology* 1993**;43**:1678-1683

48) DeAngelis LM, Payne R. Lymphomatous meningitis presenting as atypical cluster headache. *Pain Neurology* 1987;30:211-216

49) Demaerel P, Boelaert I, Wilms G, et al. The role of cranial computed tomography in the diagnostic work-up of headache. *Headache* 1996; **36**:347-348

50) Diane M. Birnbaumer, MD, FACEP New-Onset Seizures: Head CT Scans Required *Published in* Journal Watch Emergency Medicine*'February 27, 2002*

51) Hasbun R, Abrahams J, Jekel J, Quagliarello VJ. Computed tomography of the head before lumbar puncture in adults with suspected meningitis. *New England Journal of Medicine* 2001**;345**:1727-1733

52) van Crevel H, Hijdra A, de Gans J. Lumbar puncture and the risk of herniation: when should we first perform CT? *Journal of Neurology* 2002**;249**:129-137.

53) van de Beek D, de Gans J. Prognostic factors in adults with bacterial meningitis. *New England Journal of Medicine* 2005;352:514-514.

54) Hasbun R, Abrahams J, Jekel J, Quagliarello VJ. Computed tomography of the head before lumbar puncture in adults with suspected meningitis. *New England Journal of Medicine* 2001 • **345**:1727-1733.

55) Baker ND, Kharazi H, Laurent L, et al. The efficacy of routine head computed tomography , (CT scan) prior to lumbar puncture in the emergency department. Journal of Emergency Medicine 1994; **12**:597-601.

56) David Sutton, Radiolfrgy and Imaging text book; volume 2: Intracranial neoplasms, seventh edition. London Churchill Livingstone: 2003

57) Osborn AG. Intracranial aneurysms. Diagnostic neuroradiology 1994;:248-263

58) Ruberti R F Aneurysms intracranial- East Africa African Journal of neurological sciences Vol 17 No. 1,1998

59) Jordan JE, Ramirez GF, Bradley WG, et al. Economic and outcomes assessment of magnetic resonance imaging in the evaluation of headache. *J Natl Med Assoc* 2000**;92**:573-578

60) Tsushima Y, Endo K. MR imaging in the evaluation of chronic or recurrent headache. *Radiology* 2005**;235**:575-579

61) Kraus JF, McArthur DL. Epidemiologic aspects of brain injury. *Neurology Clinical* 1996; **14** :435 -450

62) Gurney, James G; Smith, Malcolm A; Bunin, Greta RJ'CNS and Miscellaneous Intracranial and Instraspinal Neoplasms" (PDF). *SEER Pediatric Monograph.* National Cancer Institute, pp. 51-52 (incidence); pp. 56-57 (trends); p. 57 (survival)

63) McKinney P A,Lassman AB,DeAngelis LM,et al. Brain tumours: incidence, survival, and aetiology. *Journal Neurology Neurosurgery Psychiatry.* June 2004;75 Suppl 2:iil2-7.

64) Lennard A Nadalo, Leigh K Hunter, Song JK,et al Brain, Abscess New England Journal of Medicine . Aug 31 2006; **355**(9):928-39

t >

65) Mamelak AN, Mampalam TJ, Obana WG, et al. Improved management of multiple brain abscesses: a combined surgical and medical approach. *Neurosurgery.* 1995; **36(l)**:76-85

11

66) Desprechins B, Stadnik T, Koerts G. Use of diffusion-weighted MR imaging in differential diagnosis between intracerebral necrotic tumors and cerebral abscesses. American Journal of Neuroradiolgy. Aug 1999; 20

67) Wiebers DO, Whisnant JP, Huston J 3rd, et al. Unruptured intracranial aneurysms: natural history, clinical outcome, and risks of surgical and endo vascular treatment. Lancet. July 12 2003; 362(9378): 103-10.

68) Schievink WI. Intracranial aneurysms. New England Journal of Medicine. January 2 1997-336(1):28-40.

69) Brisman JL, Song JK, Newell DW. Cerebral aneurysms. New England Journal of Medicine. August 31 2006; **355**(9):928-39.

70) Essam A. Elgamal, Sherif M. El-Watidy, Zain A. Jamjoom, Ali Abdel-Raouf, Hamdy Hassan, Hassan Alwaraqi and Sabry Al-Malah Evaluation of the Canadian CT Head Rule for Minor Head Trauma in a Tertiary Referral Institution . American Journal of Roentgenogy 2006 March; 186(3):611-2.

ANNEX A: DATA COLLECTION FORM

1 Patient serial No

2 Age yrs

3 Sex M F

4 CLINICAL SUMMARY (tick only one accordi$_{ng}$i$_{y}$)

1. LATERALISING SIGNS, WEAKNESS,
2. TRAUMA- RTA, FALL, ASSAULT
3. ENLARGING HEAD/HYDROCEPHALUS
4. HEADACHE
5. HYPERTENSIVE R/O HEMORRHAGE
6. UNCONCIOSNESS/LOW GCS (glascow coma scale)
7. SEIZURES/CONVULSIONS
8. R/O SOL(space occupying lesion) / ' "
9. MENINGITIS
10. OTHERS

5 RADIOLOGICAL DIAGNOSIS (tick one accordingly)

1. HYDROCEPHALUS
2. NEOPLASMS
3. SAH
4. TRAUMA {bleed,contusion,fractures}
5. INFLAMMATORY (meningitis,cerebritis,encephalitis,abscesses)
6. BRAIN ATROPHY
7. WHITE MATTER ABNORMALITIES
8. INFARCTS
9. NORMAL
10. OTHERS

ANNEX B: BUDGET

ITEM	AMOUNT
PREPARATION OF THE PROPOSAL	
REFERENCE MATERIALS	12,000
STATIONERY	5,000
SECRETARIAL SERVICES	6,000
BINDING	4,000
ETHICAL CERTIFICATION FEES	1,500
MATERIALS	20,000
DATA ANALYSIS	10,000
REPORT WRITING	
WRITING	6,000
SUBMISSION FEES	5,000
CORRECTION & BINDING	10,000
SUM TOTAL	**79,500**
CONTINGENCIES(10% OF TOTAL)	* • 7,950
GRAND TOTAL	**87,450**

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