

**"CORRELATION BETWEEN HISTOPATHOLOGY AND
RADIOLOGICAL FINDINGS BY COMPUTED
TOMOGRAPHY (CT) SCAN OF INTRACRANIAL
MASSES IN KENYATTA NATIONAL HOSPITAL
(K.N.H) "**

A FOUR YEAR RETROSPECTIVE STUDY

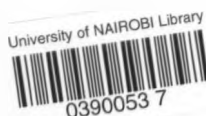
A dissertation submitted in part fulfillment for the degree of:

MASTERS OF MEDICINE IN DIAGNOSTIC RADIOLOGY

UNIVERSITY OF NAIROBI

**BY: DR DANIEL I. KIBAYA
MBCh.B (NAIROBI)**

MAY 1999.



**MEDICAL LIBRARY
UNIVERSITY OF NAIROBI**

DECLARATION

CANDIDATE

This dissertation is my original work and has not been presented for a degree in any other University.

SIGNATURE OF INVESTIGATOR



Dr. D. I. KIBAYA
MB ChB (Nairobi)

DEPARTMENT OF DIAGNOSTIC RADIOLOGY
UNIVERSITY OF NAIROBI

SUPERVISOR:

This dissertation has been submitted for the examinations with my approval as a University Supervisor.

Signature of Supervisor



DR. A. RODRIQUES MB ChB; MMed (Nairobi)
SENIOR LECTURER
DEPARTMENT OF DIAGNOSTIC RADIOLOGY
UNIVERSITY OF NAIROBI

DEDICATION

This work is dedicated to my lovely wife Janet and children Judy, James and Sheila Ndunge whose unmeasurable understanding, support and encouragement was my drive during the difficult period of compiling this work

ACKNOWLEDGEMENT

I would like to express my sincere appreciation to all those who participated in this study.

Special thanks go to my supervisor DR. A. RODRIQUES who gave me unlimited support, encouragement; ideas and positive criticism during the this study.

I sincerely appreciate all the input from my colleagues and all the lecturers in the Department of Diagnostic Radiology during this study.

I am grateful to my parents Mr. James Kibaya and Mrs Ruth M. Kibaya for the effort and sacrifices they undertook to enable me to come this far.

Greatly appreciated is good work done by Esther Kibaya in collecting all the clinical data, Mr Mureithi for collecting histopathological data, Mr E. Muniu statistician at KEMRI for analysing the data and Nyawira Wagura for typing my work.

	TABLE OF CONTENTS	PAGES
1.	SUMMARY	VI
2.	AIM/OBJECTIVES	VII
3.	INTRODUCTION	1-7
4.	LITERATURE REVIEW	7-25
5.	MATERIALS AND METHOD OF STUDY	26
6.	INCLUSION CRITERIA	26-27
7.	EXCLUSION CRITERIA	27
8.	RESULTS, TABLES, FIGURES	28-42
9.	ILLUSTRATIONS	43-48
10.	DISCUSSION	49-55
11.	CONCLUSION	56
12.	RECOMMENDATIONS	57
13.	APPENDICES	58-59
14.	REFERENCES	60-69

SUMMARY

Intracranial masses are a fairly common neurologic problem in our set up. CT scan has a proven ability in the diagnosis of intracranial masses. With CT scan one can precisely know the tumour location and to some extent the tumour type by studying the biological characteristics of these masses. However, histological studies offer the most accepted mode of establishing diagnosis.

Different brain masses exhibit similar (CT) radiological features, a property that may pose some difficulties to the reporting radiologist. To show these difficulties a correlative study between CT scan findings and histological findings of various brain masses was done.

A total of 150 cases with both CT Scan reports and histopathological reports after brain surgery were collected for this study. There were 84 (56%) males and 66 (44%) females giving a M:F ratio of 1.27:1.

The age of patients ranged from 8 days to 72 years.

Most of the patients 123 (82%) had clinical information indicated by the clinician, however 27 (18%) cases no clinical data was available. The commonest clinical presentation with which the patients presented with are associated with increased intracranial pressure and these were headaches 109 (87.2%), visual disturbance 65(52%), seizures 31(24.8%) and locomotor system malfunction 71(56.8%).

The four commonest intra cranial masses were gliomas 54(36%), meningiomas 21 (14%), Medulloblastoma 12 (8.7%) and tuberculoma 12 (8.0%). Patterns of enhancement in various intracranial masses after IV contrast administration are discussed.

The two brain geographical regions where most of these masses were located are parietal and posterior cranial fossa.

CT scan reliability in diagnosing intra cranial masses is discussed on the basis of radiological - histological diagnosis agreement. It is hoped that the results of this study will increase the already existing confidence in the use of CT scan in diagnosis of brain masses by the referring clinicians.

AIM

To determine (CT) radiological and histological diagnosis agreement of intracranial masses.

Specific objectives:

1. Distribution of intracranial tumours by anatomic region and type.
2. To determine the frequency of the commonest histologically confirmed intracranial masses.
3. To study the patterns of enhancement after intravenous (IV) contrast medium administration.
4. To study the age; sex distribution of intracranial masses.
5. To study the clinical presentation of intra cranial masses and the final outcome.

INTRODUCTION

Intracranial lesions that present as masses are of different types such as neoplasms, infective and vascular lesions. Neoplastic lesions form the bulky of these masses. Each of these types is subdivided and discussed as shown below.

I) NEOPLASM

Are either primary or secondary (Metastasis). A number of classifications have been put forward for intracranial masses, but non is without shortcomings. Classification by histology seems to be near acceptable. Baley and Cushing (1) histological classification was in use for a while before it was modified by Russel and Rubinstein(1).

Recently, modification and revision of the original World Health Organization (WHO) classification has been proposed by several authors. (1) The modified 1993 (WHO); and Rubinstein and Russel classification will be used in this study.

a) HISTOLOGICAL CLASSIFICATION OF PRIMARY BRAIN TUMOR:

i) Glial tumors (Gliomas)

- Astrocytoma
- Oligodendroglioma
- Ependymal tumor
- Choroid plexus tumor

ii) Non-Glial tumor

- Neuronal and mixed neuronal glial tumors e.g, Ganglioglioma
- Meningeal and mesenchymal tumor e.g meningioma:

- haemangioblastoma etc.
- Pineal region tumours, e.g Germinoma, teratoma, pinealcytoma, pineblastoma etc.
- Embryonal tumor e.g, Neuroblastoma; primitive ectodermal tumors, etc.
- Cranial nerve tumor e.g, Neuroma; neurofibroma etc.
- Haemopoietic tumor e.g, lymphoma; leukaemic deposits etc.
- Pituitary tumor e.g, microadenoma; macroadenomas etc.
- Cyst and tumor like lesions; e.g Dermoid, Rathke cleft cyst, arachnoid cyst; lipoma, hamatoma.
- Local extension from regional tumor; e.g, craniopharyngioma; chordoma etc.

2. INFECTIVE LESIONS:

- i) Pyogenic
 - Parenchymal infection
 - Cerebritis and abscesses
 - Complications of cerebral abscess
- ii) Tuberculous and fungal infection
 - Central nervous system (CNS) tuberculosis
 - Fungal infection

iii) Parastic infection

- Neurocysticercosis
- Hydatid
- Paragonimiasis;

3. VASULAR LESIONS:

- Aneurysm
- Arterio-venous malformation (AVM)
- Angiomas
- Infarction
- Haemorrhages

Computed tomography plays a major role in detection and localization of intracranial masses. Different intracranial masses may show similar CT radiological findings; a property which makes the differentiation of these masses difficult. Attributes of mass lesion obtainable by computed tomography (CT) which help in narrowing down the diagnosis of these masses are like size, density; calcification; surrounding oedema and mass effect.

The ability to concentrated iodinated contrast medium in masses; a biological behaviour observed in various intracranial masses is studied by CT scan. This biological behaviour which now will be referred to as enhancement is due to interference of the blood brain barrier; or probably due to increased vascularity in the lesion (1)

The value of intravenous (IV) contrast medium in CT scan of the brain is well accepted. David Norman et al emphasized this and showed delayed scans after IV contrast may be a useful diagnostic procedure. (2,5,7).

CT scan is proven diagnostic technique which is highly accurate in a number of neurologic disease states. However false negatives are known to occur. It is recommended that patients who have no radiological existence of a lesion by

convictional CT scan and continue to have clinical manifestation to have high resolution scanning (CT) with a bolus of high dose contrast; continuous infusion and three dimensional reconstruction. (3)

Latwhaw R. E at al showed it is possible to predict brain tumor histology, by observing the change of effective atomic number with contrast enhancement in all grade III and IV gliomas, this depends on the degree of vascularity, necrosis, pleomorphism and cellularity (5).

Probably the most extensive application of the CT scan so far has been in the examination of the head for various disease processes. Intracranial masses is one of the disease entities where the CT scan has played a vital role in its diagnosis and management. CT scan is ideal for examination of head condition because it is non invasive and quick examination.

Reliable CT scan diagnosis is not only of great help to the patient but also to the attending physician. Reliability of diagnosis by CT scan enables early and proper management which reduces costs in the overall management of the intracranial lesion. Bahr A. L et al showed there was a decreased cost per patient and shorter length of stay by more than 8 (eight) days reduction in patients with tumor after CT scan was performed on certain groups of patients. (8) CT scan head has become of the most precise; to predict histopathology of many brain masses. (31)

The clinical efficacy of CT scan largely depends on the understanding of the observed features by the radiologist. CT scan has been shown to improve diagnosis in 41%, reassured physician in 43% and led change of management in 12% of the cases (9).

Histological diagnosis is by far the most accepted mode of diagnosis. It involves obtaining a biopsy during surgery or autopsy and then taking the specimen for histopathological studies. The CT scan findings can therefore be confirmed histologically.

It is important to do correlative studies between CT scan findings and histological findings because different brain masses exhibit similar (CT scan) radiological features. This fact may pose some difficulties to the reporting radiologist. Correlative CT scan diagnosis and histological diagnosis studies have been done in many centres for specific intracranial masses and their results published in the literature. However, no such a study has been done in Kenyatta National Hospital. Such a study will improve a lot the existing knowledge of intracranial masses in terms of their clinical presentation and their biological behaviour.

HISTORICAL BACKGROUND OF CT SCAN

Neuroradiology studies started shortly after the discovery of X-rays by C. Roentgen in 1895.

From 1896 to 1918, conventional radiography ie, the use of simple X-rays remained the only practical mode of imaging the brain.

In 1963 conventional tomography was found. This is technique of excluding unwanted structures above and below the area of interest by creating motion blur.

A new method of forming images from X-rays was developed and introduced into clinical use by the British physicist; Godfrey Hounsfield in 1972 and is referred to as Computed Transmission Tomography (CT); or Computerized Axial Tomography

(CAT). It resulted in 1979 in the nobel prize for medicine being awarded jointly to Dr. Hounsfield and Professor A.M Cormack (10).

In computed tomography a narrow X-ray beam is produced and passed through the patients. Once in the patients, some X-rays photons are absorbed and the remaining X-rays photons that go through the patient are received by a radiation detector. This phenomenon of X-rays being absorbed and others passing through depend on the attenuation characteristic of the body being transversed.

The information from the radiation detector is fed into a computer which reads and translates the information into images. CT numbers are measured in Hounsfield units often abbreviated as HU.

At Kenyatta National Hospital (KNH), the CT scan was acquired in 1992 and has been on use up to the present. A study conducted in K.N.H on cranial CT scan by Mashuke showed brain tumor comprised of 13% infection 9%; vascular lesions 6% lesion associated with raised intracranial pressure 23.5%* (11). This shows that intracranial masses is fairly a common problem in K.N.H.

LITERATURE REVIEW

The role of computerized tomography scan (CT scan) in establishing diagnosis and management of intracranial masses needs not to be over emphasized. For easy identification intracranial masses are subdivided into two; supratentorial and the infratentorial masses. The signs and symptoms of intracranial masses depicted by these masses; by and large depend on the compartment where the mass lies. Intracranial masses is rather a common problem in our set up. D. Mashuke in his study found that of the patients who present for CT scan examination in K.N.H 13% had brain tumours; 9% had infestation and infective lesions and 6% had vascular

related lesions (11).

The clinical presentation of intracranial masses give an idea of the possible location and the nature of the mass (12). Acute lesions may have bizzare presentation even though headache, neurological deficit, seizures, visual disturbances, papilloedema, among other manifestations are common in children. Hydrocephalus, failure to thrive and regression of milestones may also be evident. (12,13). Lesions in the posterior fossa commonly present with nausea, vomiting and imbalance problems (1,10,12,13). CT scan is highly indicated for establishment of diagnosis in conditions presenting with acute onset or neurological deficit without trauma.

Ludwing C.L et al studying histologically proven oligodendroglioma found that the most common presenting symptom was headache followed by seizure, visual loss; papilloedema. (4). In some lesions the clinical presentation is non specific and therefore diagnosis largely depends on the CT radiological findings, e.g., colloid cyst of the third ventricle (10,15,18)

Seizures or epilepsy is a common presenting symptom in patients suspected to have intracranial tumour. Fritsch G. et al analysed CT scan of children with partial epilepsy and found that symptomatic epilepsy due to a cerebral tumour or vascular lesion existed in 10% of the cases. Blom R.J. et al also found that about 50% of the patients with temporal lobe epilepsy had brain tumour (17).

GLIOMA

Tumors of the glial series are by far the commonest of all the intracranial tumors comprising of about 50% of the intracranial tumor. (12,22). 50% of the gliomas are mainly astrocytoma. Gliomas are graded from I to IV, with grade I & II being referred to as benign. Supratentorial gliomas comprise about 40% neoplasms arising

from within the brain. The changes seen after CT scan examination reflect in a general fashion the degree of the malignancy of the tumor; (1,10,12).

Norman E. et al studying histologically proven supratentorial gliomas concluded that CT scan has provided a high degree of accuracy in the diagnosis of supratentorial gliomas, with approximately 90% accuracy pre contrast and approximately 99% post contrast. They also found that CT offers a high degree of sensitivity and specificity. (19,30). In all grade III and IV gliomas the degree of contrast enhancement is related to the degree of vascularity, necrosis, pleomorphism and cellularity (5,22). Grade I & II gliomas on non contrast CT scan presents as a well demarcated lesion with or without surrounding oedema. Usually, there is very minimal enhancement after injection of intravenous contrast medium. (1,10,12)

Centeno R.S et al studying histologically proven supratentorial ependymomas found that majority of the cases (80%) showed small well demarcated calcification, moderate to marked contrast enhancement, however, no correlation was observed between the degree of contrast enhancement and the pathological anaplasia of the tumor (20). Benign astrocytoma may cause very subtle CT abnormalities, thereby making diagnosis very difficult.

A small amount of haemorrhage is sometimes encountered pathologically in glioblastoma multiforme. When the haemorrhages are large they obliterate the evidence of underlying neoplasm and usually appear as a large haematoma indistinguishable from a spontaneous haemotoma (54). The value of non contrast scan in the histological diagnosis of a ring lesion should be emphasised. The presence of a complete or incomplete ring in non contrast CT scan often indicate a glioma, metastasis or an abscess (21).

Histologically differentiated glioblastoma carries a poor prognosis. CT scan features are typical and include marked mass effect, oedema, contrast enhancement which is peripheral and ragged. Other intracranial masses which present with similar features

are solitary necrosis, metastasis, malignant tumors and radionecrosis. H. Pedersen et al compared CT scan findings of benign supratentorial astrocytoma in children with other histological tumors of supratentorium. They found that astrocytomas were often hyperdense, with no calcification and showed greater contrast enhancement than other tumors (23).

Astrocytoma is the commonest intracranial tumor in childhood, which carries long term prognosis. A CT histopathological correlational study on pontine glioma by Tsuchida T. et al showed that all cases had hyperdense lesions with evident mass effect. The hyperdense mass corresponded with tissue necrosis (24).

Narayan S. et al reported a case of glioma presenting as a small calcific lesion with no mass effect. Isolated focal calcification on CT scan require careful follow up because this may be a sign of brain tumor (25).

Supratentorial cystic astrocytoma in childhood is most likely a pilocytic astrocytoma histologically. Once diagnosed, the tumor should be totally excised as this is associated with a very good prognosis. (26). Differentiation of multicentric glioblastoma from diffuse metastasis or multiple abscess can be very difficult, with CT scan alone and can only be made histologically. (27).

Desmoplastic cerebral astrocytoma of infancy are only distinguished from desmoplastic infantile ganglioglioma histopathological otherwise their clinical and imaging features, are the same.

Lilja A. et al found CT scan a very reliable tool for assessing the histopathological features of malignant supratentorial glioma.

TChang S. et al also concurred with these findings after proving that the CT scan was a possible aid in histological grading of supratentorial glioma. (37).

MENINGIOMA

Meningioma comprise of about 16% of all intracranial tumors and comprise the largest group of operable brain tumors. CT scan has replaced the need for plain radiography in the diagnosis of meningioma. The diagnosis of meningioma requires excellent neurological examination to clinically locate and characterize it. (32).

For a given location, much can be anticipated about the histopathological likelihood of any intracranial mass. Increased frequency of meningioma in certain regions corresponds to the distribution of arachnoid granulation. Approximately 90% of meningiomas are supratentorial and about 6-9% are multiple. (1,10,12,32).

Pre contrast CT scan features of meningioma are hyperdense or isodense with or without calcific densities and is correctly diagnosed in non-contrast scan in about 8.5% of the cases. Post contrast CT scan features are dense homogeneous enhancement, hyperostosis or erosive bone changes are readily detectable by CT. Surrounding oedema may be massive and prominent especially in the convexities, parasagittal and antero-frontal lesions.

B. Kendel et al did a comparison study on the consistency on meningioma and CT scan findings. They found that CT scan was probably one of the most accurate imaging methods for detection and the diagnosis of meningioma.(33). The possibility of curative surgery depends mainly on the position of the tumor and its relationship with vital structures. (33).

Most intracranial meningiomas have a characteristic CT features, but significant number show atypical presentation that may lead to difficulties in diagnosis. Russel E.J. et al studied 131 cases of histologically confirmed meningiomas and found that 7% of the cases were misdiagnosed; atypical presentation was the main reason for

misdiagnosis (34).

The commonest histological type of meningioma is sarcomatous type below the age of 15 years(35). S. Kana et al also found that the males were most affected than the females with a ratio of 10:8 as opposed to adults in which the ratio of females:males was 5:3, they also observed that there was a high incidence of cystic formation and without dural attachment (35).

In childhood, meningiomas comprise 0.4 - 4.6% of intracranial neoplasm. In this age group meningiomas are unusual tumors and therefore their characteristics are not well defined, making pre operative and too often antemortem diagnosis unusual. (36).

Many authors have experienced difficulties in differentiating pituitary macroadenoma from suprasellar meningioma because of almost the same contrast enhancing properties. (38). Pituitary macroadenoma enhances homogeneously in 94%. Hyperostosis is commonly encountered feature of meningioma in any location and had been reported in 34% of the cases involving the sellar. (1;38).

Although the imaging characteristics of meningioma are unique, some mimic glioma, Schwannoma, metastasis, angioma, and capillary haemangioma form which they have to be differentiated histologically. (1,38). Savouiano M. et al reported an hyperdense area within a proven meningioma, which was later proved to be a metastatic deposit from breast cancer. (39).

MEDULLOBLASTOMA

The incidence in childhood is 1.3-5% (40). Arises mainly in the region of medullary velum on the front part of vermis. Usually it compresses fourth ventricle thereby

causing hydrocephalus. Medulloblastoma is arguably one of the most primitive tumour in childhood associated with fast growth of the tumor and early metastasis via CSF (Cerebro-Spinal Fluid).

CT scan features of medulloblastoma include hyperdense, isodense lesion sometimes with central necrosis and surrounding oedema. There is homogenous or patchy enhancement after IV contrast. (1,10,12,41) It is difficult to diagnose medulloblastoma with CT scan alone several investigators have expressed the same opinion especially in differentiating this tumor from astrocytoma. (1,10,12,41,42,43).

However, a study done by Tohsihisa K. et al on histologically proven medulloblastomas showed a remarkable correlation between CT scan findings and histological findings (44).

John P.L. et al found medulloblastoma to constitute the largest group of haemorrhagic brain tumors in children (45). Unusual calcification in medulloblastoma was reported by Redy.R et al (46). Primary cerebral neuroblastoma should be considered in the differential diagnosis of calcified cystic supratentorial masses in young patients.

LYMPHOMA

Primary and secondary intracranial lymphoma are rare. There appears to be an increase in the primary lymphoma of the Central Nervous System in immunosuppressed individuals. Primary CNS lymphoma shows predilection for paraventricular region, basal ganglia and corpus callosum. Usual CT scan features are hyperdense lesion with or without little enhancement and the nodules often deep seated. (1,10,12,49,53).

CT scan has been found to be one of the most sensitive methods of detecting

intracranial lymphoma.(50,51). Jack C.R. Jr. et al analyzing the relationship between histologic type and CT scan appearance found that the smaller tumours appeared to be associated with increased histologic grade and a greater percentage of mixed cell types were multiple (47).

Yang P.J. et al found unusual CT findings of large solid homogenous enhancing mass with varying amounts of oedema, which corresponded with Histiocytic lymphoma (48). Some cases of lymphoma may show atypical CT scan features which makes it difficult for lymphoma to be differentiated from metastasis or granulomatous lesions radiologically (50,51). Teraes S. et al reported a case of non-enhancing primary CNS lymphoma (52).

PINEAL REGION TUMORS

Pineal region tumors are of various histological types. These are germinoma, teratoma, pineoloma, and pineoblastoma, and they have different CT scan appearances. (1,10,12).

Correlation between histological and radiological features is difficult because most of these lesions are treated conservatively by ventricular shunting and radiotherapy without necessarily undergoing surgery and biopsy. (1).

CT scan features are rounded isodense lesions enclosing or adjacent to the pineal gland. Usually the third (3rd) ventricle is dilated. There is no surrounding oedema, contrast enhancement is a feature. (1,10,12). Germinoma virtually never calcify but may surround normal calcified pineal gland. (12). There is no consensus on CT in the

useful specificity of CT scan findings for various histological types of pineal region tumors. (12).

Extensive calcification is seen in germinoma and teratomas. Proper diagnosis of germinoma is important because the tumor is highly sensitive to radiotherapy and it potentially curable (55,56,57)

Zimmerman R.A et al found that germinoma was the most frequent tumor in the pineal region. They also found that teratoma can be differentiated from germinal primary pineal tumor on the basis of fat; calcification and variable soft tissue densities within the tumor. (58).

Basal ganglia germinoma and thalamus account for 4-10% of all intracranial germinoma.

PITUITARY TUMORS

Pituitary adenoma is one of the commonest suprasellar masses. It constitutes about 10% of all the brain tumours (63). CT scan as an imaging tool has its role in confirming diagnosis as well as demonstrating the extent of the lesion. The CT scan features are rounded hyperdense mass, showing obvious homogenous enhancement after IV contrast medium. Calcification is rare, and some lesion are hypodense with cystic areas. (1,10,12,63).

Intrasellar pituitary adenoma can show unusual CT scan features. Gardener T.P et al found that some adenomas show homogenous; or heterogenous increased density, while other present as patchy, ring-like density, hypodense or isodense lesions (59). The hypodense areas represent areas of necrosis, haemorrhagic, cystic or abscess

formation within the tumor (59). These CT scan findings are non-specific.

Hilal S.K. et al observed that intrasellar pituitary adenoma are usually hypodense after IV contrast. (61,62) Focal or homogenous enhancement is seen in patients with chromophobe adenomas.

For proper diagnosis of pituitary adenoma, supplementary coronal and sagittal reconstruction images should be obtained. Despite the success of CT diagnosis demonstrated in pituitary tumor, all the diagnostic criteria employed warrant further evaluation (61).

Pre-operative differentiation of histologic etiology of masses involving the sellar turcica and the suprasellar region is important because it determines the use of surgery versus non-surgery depending on the tumor type. (38).

Macro-adenoma show diverse pattern of enhancement with 51% cases enhancing homogeneously, 47% showing heterogenous enhancement (61).

Haji M.R. et al evaluated the correlation between radiological changes in the sellar and location of pituitary macro-adenoma and surgery; and found a significance discrepancy between tomographic and surgical location. (73). The author also cautioned about absolute reliance upon CT for making diagnosis of pituitary macro-adenoma. (73).

CRANIOPHARYNGIOMA

It is the commonest parasellar tumor in childhood. consisting of about 55% of parasellar paediatric tumors, and 5-13% of all intracranial tumor. Most of these tumors are probably developmental in origin.

CT scan features of craniopharyngioma are rounded, midline suprasellar mass of low attenuation centrally and often with a capsule and calcification. The capsule often enhances after IV contrast medium. (1,10,12,64,66). Calcification is commoner in children than in adults.

Craniopharyngioma can be infra sellar (65,72). It is not easy to make a diagnosis of craniopharyngioma by CT alone. Lesions such as Rathkes Cleft Cyst, necrotic pituitary edema, thrombosed aneurysm and cystic glioma should be differentiated from craniopharyngioma.

There is no radiological/histopathological correlation studies in craniopharyngioma available in the literature.

ARACHNOID CYST

Is a fluid filled cavity within the arachnoid membrane, and is common in the anterior cranial fossa. CT scan features are smooth demarcated non-calcified extra axial mass that doesn't enhance after IV contrast. (1,10,12,67).

Since the introduction of CT scan, arachnoid cysts have been reported in an increasing frequency mainly over the cerebral convexities.

Arachnoid cysts of the posterior fossa are uncommon. Jesus V. et al did a study of histologically confirmed posterior arachnoid cysts and found that CT scan was the best for diagnosis and locating the site of the cyst. (74).

There has been increased diagnosis of arachnoid cyst of the middle cranial fossa due to improved knowledge of radiologic and anatomic clinical features of these lesion.

(75). This in part has been due to improved diagnostic ability of CT (75).

No radiological histopathological correlation is available in the literature.

DERMOID/EPIDERMOID

CT scan features are a well rounded uniformly hypodense mass measuring (-20 to -40) HU; capsular calcification is common, usually there is no enhancement after IV contrast (1,10,12).

Epidermoid represent 0.2% to 1% of all primary intracranial tumours. CT scan features are well defined lucent appearing lobulated masses with attenuation similar to CSF. Calcification may be present. Most epidermoid tumors do not enhance after IV contrast (1,10,12).

Some intracranial epidermoids may show atypical presentation, and can mimic many intracranial tumors. Hasagawa H. et al reported a case of proven intracranial epidermoid mimicking a meningioma, ie, calcification homogeneous contrast enhancement. (68).

In many epidermal tumors, the lesion is of CSF density (78). Calcification and tooth elements are a feature of dermoid cyst. (76).

COLLOID CYST

Third ventricular colloid cyst is a well established clinicopathologic entity. Accounts for 0.5 to 1.0% of all intracranial tumor, and represent 15% to 20% of intraventricular masses (1,10,12).

CT features of colloid cyst are homogeneously hyperdense on non-contrast scan, usually there is no enhancement after IV contrast (1,10,12). Similar CT appearances were also reported by several other investigators after studying histologically proven colloid cyst (69,70).

Maender PP et al established a remarkable correlation of CT findings with histological findings in colloid cysts of the third ventricle. (71)

The differential diagnosis of colloid cyst are aneurysm of basilar artery tip, meningioma, ependymoma, glioma, and craniopharyngioma. (70). Colloid cyst of 3rd ventricle occurring in the posterior margin of foramen of Monro causes obstructive hydrocephalus. (10).

LIPOMA

Rare intracranial masses. Calcification is common. Account for 5% of all corpus callosum tumor. They are found in 0.06% to 0.30% of all CT scan examination and 0.08% to 0.21% of autopsies (1).

CT features are low density mass with tissue attenuation of -50 to -100 HU. Often a curvilinear or nodular calcification is seen. There is no enhancement following contrast studies.

ACOUSTIC NEUROMA

It is commonest tumor found around the cerebello-pontine angle. It enlarges posteriorly and medially. There are associated changes of the internal auditory meatus.

CT scan accuracy in non-treated neuroma is 94% (77). The lesion enhances

homogeneously after IV contrast media (78). CT contrast enhanced scan detects lesion in 92%. Any non-specific CT scan appearance in the cerebellopontine angle should raise suspicion of acoustic neuroma.

Differential diagnosis of acoustic neuroma should include lymphoma, metastasis, meningioma and haemangioma (1).

In acoustic neuroma, the usual CT features are displacement of the ventricles; hydrocephalus, surrounding oedema and uniform enhancement of an oval mass around the internal auditory meatus. A case of cystic lesion around the cerebellopontine angle region turned to be acoustic neuroma after histological studies. (80).

METASTASIS

Metastasis can be seen anywhere within the brain parenchyma. The distribution of brain metastasis tend to be in the grey/white matter interface. CT scan features are hypodense or hyperdense lesion which show obvious enhancement after IV contrast.

Generally, there is no clear correlation between CT appearance and histological diagnosis (10). Haemorrhagic metastasis are characteristic of malignant melanoma while calcified lesions although rare are from colonic or osseous tumor. (1,10,12). Often there is surrounding oedema.

Unusual CT presentation of metastasis is a cystic lesion which further complicates diagnosis. A case of proven cystic metastatic neuroblastoma was reported by Pizer B.L et al (79). The histology of primary tumor has limited influence upon CT scan

appearance of cerebral secondary deposit. (10).

Calcification is rare in untreated metastatic tumor. Double dosed delayed CT scan significantly improve sensitivity and specificity of cerebral metastatic tumor detection. (1).

ABSCESS

Intracranial abscesses can be pyogenic, fungal or tuberculous with former being the commonest. Brain abscesses can be unifocal or multiple. The commonest site is at the grey/white matter interface. Predisposing factors include valvular heart disease, sinusitis, mastoiditis, otitis media and penetrating injury or compound fractures of the skull. (1,10,12). In the recent past, there has been an upward surge in the number of cases with brain abscesses (1,10) probably this is due to increased number of Acquired Immunodeficiency Syndrome (AIDS) cases.

CT scan presentation is a lucent area surrounded by a faint dense rim with another lucent zone outside, the rim. After IV contrast media the faint rim show deep dense ring enhancement. (1,10,12,81,85).

Whelan M.N. observed atypical CT features in a confirmed abscess, these features are a dense nodule which show contrast enhancement after IV contrast. This phenomenon is observed in septic patients and there is associated haemorrhagic infection (81).

CT scan has simplified the diagnosis of abscesses and surgical decision is purely based on CT scan information. (82,83,84) The outcome of brain abscess depend on early diagnosis and its early management. The ability to early diagnosis has been

shown to result to dramatic decrease in patient morbidity and mortality (84).

Fungal abscess mainly occur in immuno-compromised individuals. The abscesses are normally multiple. 30.5% to 50% of the cases have debilitating diseases e.g, lymphoma, corticosteroid therapy, or on cytotoxics (87).

The usual fungal abscess CT features are non specific and are mainly an hypodense area with faint dense rim which enhances homogeneously after IV contrast (1,10,12,86).

Whelan M.A et al observed that the CT appearance of intracranial fungal infection was dependant on the type of fungus as well as the infecting form i.e the yeast or the hypae form (88).

TUBERCULOSIS: (TB)

Tuberculosis is a major health problem in developing countries as well as developed countries. Intracranial tuberculosis is potentially lethal if not recognized, therefore prompt diagnosis and treatment are imperative.

Intracranial tuberculosis frequently follow a known episode of tuberculous meningitis (1,10,12,88). The lesions are often multiple in 50-60% cases; and the sequelae are meningitis, abscess formation or tuberculoma (98)

CT scan features of tuberculosis are various(89,90). The lesions are usually hypodense, isodense and hyperdense with surrounding oedema. Often there is contrast enhancement (1,10,12,88,90)

Bhangara S. et al found CT scan to be an excellent guide of monitoring efficiency of medical treatment in intracranial T.B. (89). CT scan is of great value in the diagnosis

and management of intracranial tuberculosis (88).

There are two distinct pattern of enhancement in tuberculosis as shown by Whelan M.A. et al. A small ring enhancement surrounding a central punctate lucent area and a nodular enhancing lesion. These features were typical for tuberculosis (tuberculoma) and correlated well with histopathological findings (91).

PARASITIC INFESTATION

Hydatid disease presents as an intracranial cystic mass. It can be found anywhere within the brain parenchyma.

CT features are a rounded homogenous water density lesion without a significant enhancement after IV contrast. (1,10,12,92,93). Rudwen M.A et al also reported on some cases of cerebral hydatid disease, whose CT features were large well defined spherical; non-enhancing unilocular cyst (92).

Cystercercosis infestation is seen in CT as multiple small hypodense well defined lesion in active phase of the disease; but often becomes calcified in chronic stage (94).

HAEMANGIOBLASTOMA

It is a vascular neoplasm of unknown origin which is surgically curable. It is associated with phacomatosis. Account for 1 -2.5% of all primary CNS neoplasm and approximately 7% primary posterior fossa tumors in adults (1,10,12,95). Most tumors are found in the posterior fossa.

The classical CT features of haemangioblastoma is a large high density cystic

appearing cerebellar mass on non-contrast scans. Usually a mural nodule that enhances strongly is identified adjacent to the pial surface.

INFARCTION

Results form a sequence of processes which take place due to brain ischaemia. CT scan has a vital role to play in diagnosis and management of patients suspected to have brain infarction. Apart from diagnosing infarction CT scan also excludes other structural lesion such as haemorrhages that can mimic infarction.

CT findings in acute infarct are non-specific because of evolution. chronic infarct in CT appear as a focal well delineated low attenuation area, often with prominence of sulci and enlargement of the ipsilateral ventricle. There is non-specific enhancement after IV contrast.

INTRACRANIAL HAEMORRHAGE

Intracranial haemorrhage is a common cause of acute neurological deterioration and a frequent indication for emergency neuro imaging. These haemorrhages frequently complicate presentation and appearance of many CNS lesions (1).

CT features of intracranial haemorrhage is comparatively straightforward. The typical appearance is homogeneous hyperdense lesion measuring 57-70 HU often with surrounding oedema. Occasionally, there can be atypical CT features in patients with acute intracranial haemorrhage. In acute haemorrhage the haematoma will be isodense in certain disease processes like severe anaemia, coagulation disorders and haemorrhagic disorders.

Sub acute haemorrhage (about 1-6 weeks) is isodense with adjacent brain parenchyma in CT and often show peripheral enhancement. Chronic haemorrhages; are hypodense with rim enhancement provided there is no re-bleeding.

ANEURYSM

Cerebral aneurysms are commonly found in the circle of Willis, and middle cerebral artery bifurcation in 90% of the cases.

Although CT scan and magnetic resonance imaging have a role to play in the diagnosis of intracranial aneurysm, the definitive diagnosis and pre-operative delineation of intracranial aneurysm remains the domain of catheter angiography (1). CT scan features of aneurysm vary quite a lot and depend on whether the lesion is patent or thrombosed. A patent aneurysm on a CT scan appear as a well delineated isodense or hyperdense lesion in suprasellar; arachnoid space or sylvian fissure region. This lesion often enhances uniformly after IV contrast.

Several authors have reported cases where CT played a vital role in demonstrating intracranial giant aneurysm (95,96,97)

MATERIAL AND METHODS OF STUDY

The study is going to be a retrospective one conducted in Kenyatta National Hospital for a period of four years; from January 1995 to December 1998. The CT scans were performed using a Philips tomoscan CX/Q machine which is a 3rd generation CT scanner.

The sample size is estimated to be between 160 to 200. Usually, the number of intracranial neurosurgical operations performed in K.N.H. per year range between 40 to 50 for brain masses.

The patient's data, clinical history and clinical examination was be obtained from the patients files in the central medical records. This information was indicated in Appendix A (attached). Each case to be studied was assigned a code number which will stand for the patient's identity other than the actual name of the patient.

The radiological findings (CT scan) and the histopathological findings of each case studied was obtained in the radiology department and pathology department respectively and are indicated in Appendix B (Attached).

Additional patients clinical data was also obtained from the radiological CT request form. A sample of this form is Appendix C (attached)

INCLUSION CRITERIA

- i) Only patients done cranial CT scan in K.N.H

- ii) Only patients done brain surgery or biopsy and histopathological studies performed.

EXCLUSION CRITERIA

Patients with radiological diagnosis and no histopathological reports or vice versa.

LIMITATIONS

- i) Loss of patients clinical records will interfere with completion of required data.
- ii) Unavailability of histological report or radiological report.

- ii) Only patients done brain surgery or biopsy and histopathological studies performed.

EXCLUSION CRITERIA

Patients with radiological diagnosis and no histopathological reports or vice versa.

LIMITATIONS

- i) Loss of patients clinical records will interfere with completion of required data.
- ii) Unavailability of histological report or radiological report.

RESULTS

A total of 150 cases of intracranial masses with CT scan diagnosis and histopathological diagnosis (after surgery/biopsy) were reviewed. There were 84 (56%) males and 66 (44%) females giving a male:female ratio 1.3:1.

Only 144 cases had ages indicated while in 6 cases the ages couldn't be established thus leaving 144 valid cases. The ages of the patients ranged from 8 days to 72 years. The mean age was 24.409 years with a standard error of 1.499. The distribution of ages for various histologically confirmed brain tumours is shown in table 1.

Sex distribution of intracranial masses is shown in figure 1 and 2; tables II & III.

Distribution of signs and symptoms that the patients presented with are given in table IV.

The commonest symptom was headache 83 (67.5%) followed by impairment of locomotor function 71(57.7%) and visual disturbance 60(48.8%).

There were 27 (18%) cases with no clinical data available.

Only 142 (94.7%) cases had intravenous contrast given and 8 (5.3%) cases none.

Patterns of enhancement after intravenous contrast injection in histologically proven tumours is shown in table VI & VII.

Brain geographical location of various histologically proven brain tumours is shown

in table VIII.

Radiological diagnosis and histological diagnosis correlation of various brain tumours is given in table V.

Radiological/histological level of agreement is shown in figure 1.

TABLE I: AGE IN HISTOLOGICALLY PROVEN INTRACRANIAL TUMOUR

HISTOLOGICAL DIAGNOSIS INTRA CRANIAL MASS	AGE GROUP IN YRS													TOTAL
	0-5Y	5-9Y	10-14Y	15-19Y	20-24Y	25-29Y	30-34Y	35-39Y	40-44Y	45-49Y	50-54Y	55-59Y	60+	
GLIOMAS	2 [3.8%]	8 [15.1%]	6 [11.3%]	6 [11.3%]	6 [11.3%]	3 [5.7%]	4 [7.5%]	2 [3.8%]	1 [1.9%]	4 [7.5%]	3 [5.7%]	5 [9.4%]	3 [5.7%]	53 [36.8%]
MENINGIOMA	1 [5.6%]	-	2 [11.1%]	-	1 [5.6%]	4 [22.2%]	-	2 [11.1%]	4 [22.2%]	-	2 [11.1%]	-	2 [11.1%]	18 [12.5%]
NEUROBLASTOMA	1 [100%]	-	-	-	-	-	-	-	-	-	-	-	-	1 [0.7%]
PITUITARY TUMORS	-	-	-	-	-	1 [50.0%]	1 [50.0%]	-	-	-	-	-	-	2 [1.4%]
CRANIOPHARYNGIOMA	-	1 [33.3%]	1 [33.3%]	1 [33.3%]	-	-	-	-	-	-	-	-	-	4 [2.8%]
ABSCESSSES	-	-	1 [25.0%]	-	1 [25.0%]	-	1 [25.0%]	-	-	-	-	-	1 [25.0%]	4 [2.8%]
TUBERCULOMAS	-	1 [9.1%]	3 [27.3%]	2 [18.2%]	3 [27.3%]	-	2 [18.2%]	-	-	-	-	-	-	11 [7.6%]
VESCULAR LESIONS	-	-	-	3 [60.0%]	-	-	1 [20.0%]	1 [20.0%]	-	1 [20.0%]	-	-	-	6 [4.2%]
ENCEPHALOCOELE	4 [100%]	-	-	-	-	-	-	-	-	-	-	-	-	4 [2.8%]
MEDULLOBLASTOMA	6 [46.2%]	4 [30.8%]	1 [7.7%]	1 [7.7%]	-	-	-	-	-	-	1 [7.7%]	-	-	13 [9.0%]
TUMORS (NON SPECIFIC)	-	-	-	1 [50.0%]	1 [50.0%]	-	-	-	-	-	-	-	-	2 [1.4%]
METASTASIS	-	-	-	-	-	-	-	-	-	-	-	1 [50.0%]	1 [50.0%]	2 [1.4%]
MUCOCOELE	-	-	-	-	-	-	-	-	-	1 [100%]	-	-	-	1 [0.7%]
GLIOSIS	1 [7.1%]	-	2 [14.3%]	5 [35.7%]	2 [14.3%]	-	2 [14.3%]	-	-	1 [7.1%]	1 [7.1%]	-	-	14 [9.7%]
NORMAL BRAIN TISSUE	-	2 [22.2%]	1 [11.1%]	-	1 [11.1%]	-	4 [44.4%]	1 [11.1%]	-	-	-	-	-	9 [6.3%]
CRYPTOCOCCUS NEOFORMAS	-	-	-	-	-	-	-	1 [100%]	-	-	-	-	-	1 [0.7%]
TOTAL	15 [10.4%]	16 [11.1%]	17 [11.8%]	19 [13.2%]	15 [10.4%]	8 [5.6%]	15 [10.4%]	7 [4.9%]	5 [3.5%]	7 [4.9%]	7 [4.9%]	6 [4.2%]	7 [4.9%]	144

TABLE II: SEX DISTRIBUTION IN RADIOLOGICAL MASSES OF INTRACRANIAL MASSES.

INTRACRANIAL MASSES	MALES	FEMALES	TOTAL
GLIOMAS	36 [56.3%]	28 [43.8%]	64 [42.0%]
GANGLIOGLIOMA	1 [100%]	-	1 [0.7%]
MENINGIOMA	10 [50.0%]	10 [50.0%]	20 [13.3%]
PINEAL REGION TUMORS	1 [50.0%]	1 [50.0%]	2 [1.3%]
LYMPHOMAS	1 [100%]	-	1 [0.7%]
PITUITARY TUMORS	4 [57.1%]	3 [42.9%]	7 [4.7%]
ARACHNOID CYST	1 [100%]	-	1 [0.7%]
CRANIOPHARYNGIOMA	2 [40.0%]	3 [60.0%]	5 [3.3%]
ABCESSES	4 [50.0%]	4 [50.0%]	8 [5.3%]
TUBERCULOMA	4 [80.0%]	1 [20.0%]	5 [3.3%]
VASCULAR LESION	2 [100%]	-	2 [1.3%]
ENCEPHALOCOELE	4 [80.0%]	1 [20.0%]	5 [3.3%]
MEDULLOBLASTOMA	5 [71.4%]	2 [28.6%]	7 [4.7%]
TUMORS (NON SPECIFIC)	7 [35.0%]	13 [65.0%]	20 [13.3%]
METASTASIS	1 [100%]	-	1 [0.7%]
MUCOCOELE	1 [100%]	-	1 [0.7%]
TOTAL	84 [56.0%]	66 [44.0%]	150

TABLE III: SEX DISTRIBUTION HISTOLOGICAL DIAGNOSIS OF INTRACRANIAL MASSES.

INTRACRANIAL MASSES	MALES	FEMALES	TOTAL
GLIOMAS	29 [53.7%]	25 [46.3%]	54 [36.0%]
MENINGIOMA	10 [47.6%]	11 [52.4%]	21 [14.0%]
NEUROBLASTOMA	-	1 [100%]	-
PITUITARY TUMOURS	3 [100%]	-	3 [2.0%]
CRANIOPHARYNGIOMA	1 [33.3%]	2 [66.7%]	3 [2.0%]
ABSCESSSES	2 [50.0%]	2 [50.0%]	4 [2.7%]
TUBERCULOMAS	7 [58.3%]	5 [41.7%]	12 [8.0%]
VASCULAR LESION	4 [66.7%]	2 [33.3%]	6 [4.0%]
ENCEPHALOCOELE	3 [75.0%]	1 [25.0%]	4 [2.7%]
MEDULLOBLASTOMA	8 [65.1%]	5 [38.5%]	13 [8.7%]
TUMORS (NON SPECIFIC)	1 [50.0%]	1 [50.0%]	2 [1.3%]
METASTASIS	1 [50.0%]	1 [50.0%]	2 [1.3%]
MUCOCOELE	1 [100%]	-	1 [0.7%]
GLIOSIS	9 [64.3%]	5 [35.7%]	14 [9.3%]
NORMAL BRAIN TISSUE	5 [55.6%]	4 [44.4%]	9 [6.0%]
CRYPTOCOCCUS NEOFORMAS	-	1 [100%]	1 [0.7%]
TOTAL	84 [56.0%]	66 [44.0%]	150

TABLE IV: DISTRIBUTION OF SIGNS & SYMPTOMS OF HISTOLOGICALLY CONFIRMED TUMORS

INTRACRANIAL MASS	DIZZINESS	VISUAL DISTURBANCE	SPEECH DISTURBANCE	LOCOMOTOR MALFUNCTION	SEIZURES	HEADACHE	VOMITING	CHANGE OF LEVEL OF CONCIIOUSNESS	HYDROCEPHALUS
GLIOMAS	2 [4.2%]	30 [62.5%]	5 [10.4%]	27 [56.3%]	13 [27.1%]	66 [75.0%]	15 [31.3%]	5 [10.4%]	8 [16.7%]
MENINGIOMA	1 [7.1%]	4 [28.6%]	1 [7.1%]	5 [35.7%]	5 [35.7%]	11 [78.6%]	4 [28.6%]	1 [7.1%]	2 [14.3%]
NEUROBLASTOMA	-	-	-	1 [100%]	-	-	-	-	-
PITUITARY TUMORS	-	-	-	-	-	-	-	-	-
CRANIOPHARYNGIOMA	-	2 [100%]	-	1 [50%]	-	-	-	-	1 [50%]
ABSCESSSES	-	2 [66.7%]	-	3 [100%]	1 [33.3%]	-	-	-	-
TUBERCULOMA	2 [20%]	5 [50%]	1 [10%]	5 [50%]	4 [40%]	9 [90%]	5 [50%]	1 [10%]	1 [10%]
VASCULAR LESIONS	-	5 [100%]	-	1 [20%]	1 [20%]	4 [80%]	2 [40%]	1 [20%]	1 [20%]
MEDULOBLASTOMA	1 [10%]	5 [50%]	1 [10%]	8 [80%]	1 [10%]	6 [60%]	3 [30%]	-	5 [50%]
TUMORS (NON SPECIFIC)	-	1 [50%]	-	2 [100%]	2 [100%]	1 [50%]	-	-	1 [50%]
METASTASIS	-	-	-	1 [100%]	-	-	-	-	-
MUCOCOELE	-	-	-	-	-	1 [100%]	-	-	-
GLIOSIS	1 [10%]	7 [70%]	3 [30%]	8 [80%]	1 [10%]	6 [60%]	3 [30%]	-	1 [10%]
NORMAL BRAIN TISSUE	1 [11.1%]	3 [33.3%]	1 [11.1%]	8 [88.9%]	3 [33.3%]	5 [55.6%]	1 [11.1%]	-	1 [11.1%]
CRYPTOCOCCUS NEOFORMAS	-	-	-	1 [100%]	-	-	-	-	-
ENCEPHALOCOELE	-	-	-	-	-	-	-	-	2 [50%]
TOTAL	8 [6.5%]	65 [52%]	12 [9.8%]	71 [56.8%]	31 [24.8%]	109 [87.2%]	33 [26.49%]	8 [6.5%]	23 [18.7%]

CONT. TABLE IV: DISTRIBUTION OF SIGNS & SYMPTOMS OF HISTOLOGICALLY CONFIRMED TUMORS

INTRACRANIAL MASS	HYDROCEPHALUS	MENTAL DETERIORATION	HEARING DISTURBANCES	SMELLING	IMBALANCE
GLIOMAS	8 [16.7%]	8 [16.7%]	2 [4.2%]	-	-
MENINGIOMA	2 [14.3%]	3 [21.4%]	3 [21.4%]	-	-
NEUROBLASTOMA	-	-	-	-	-
PITUITARY TUMORS	-	-	-	-	-
CRANIOPHARYNGIOMA	1 [50%]	-	-	-	-
ABSCESSSES	-	1 [33.3%]	-	-	-
TUBERCULOMA	1 [10%]	-	-	-	-
VASCULAR LESIONS	1 [20%]	-	-	-	-
MEDULOBLASTOMA	5 [50%]	-	-	-	2 [20%]
TUMORS (NON SPECIFIC)	1 [50%]	1 [50%]	1 [50%]	-	-
METASTASIS	-	1 [100%]	-	-	-
MUCOCOELE	-	-	-	1 [100%]	-
GLIOSIS	1 [10%]	4 [40%]	-	-	1 [10%]
NORMAL BRAIN TISSUE	1 [11.1%]	3 [33.3%]	2 [22.2%]	-	1 [11.1%]
CRYPTOCOCCUS NEOFORMAS	-	-	-	-	-
ENCEPHALOCOELE	2 [50%]	-	-	3 [75%]	-
TOTAL	23 [18.7%]	21 [17.1%]	8 [6.5%]	4 [3.2%]	4 [3.2%]

CONT. TABLE IV: DISTRIBUTION OF SIGNS & SYMPTOMS OF HISTOLOGICALLY CONFIRMED TUMORS

INTRACRANIAL MASS	HYDROCEPHALUS	MENTAL DETERIORATION	HEARING DISTURBANCES	SMELLING	IMBALANCE
GLIOMAS	8 [16.7%]	8 [16.7%]	2 [4.2%]	-	-
MENINGIOMA	2 [14.3%]	3 [21.4%]	3 [21.4%]	-	-
NEUROBLASTOMA	-	-	-	-	-
PITUITARY TUMORS	-	-	-	-	-
CRANIOPHARYNGIOMA	1 [50%]	-	-	-	-
ABSCESSSES	-	1 [33.3%]	-	-	-
TUBERCULOMA	1 [10%]	-	-	-	-
VASCULAR LESIONS	1 [20%]	-	-	-	-
MEDULOBLASTOMA	5 [50%]	-	-	-	2 [20%]
TUMORS (NON SPECIFIC)	1 [50%]	1 [50%]	1 [50%]	-	-
METASTASIS	-	1 [100%]	-	-	-
MUCOCOELE	-	-	-	1 [100%]	-
GLIOSIS	1 [10%]	4 [40%]	-	-	1 [10%]
NORMAL BRAIN TISSUE	1 [11.1%]	3 [33.3%]	2 [22.2%]	-	1 [11.1%]
CRYPTOCOCCUS NEOFORMAS	-	-	-	-	-
ENCEPHALOCOELE	2 [50%]	-	-	3 [75%]	-
TOTAL	23 [18.7%]	21 [17.1%]	8 [6.5%]	4 [3.2%]	4 [3.2%]

TABLE V: CT RADIOLOGICAL & HISTOLOGICAL DIAGNOSIS AGREEMENT FORVARIOUS INTRACRANIAL MASSES

INTRACRANIAL MASSES	RADIOLOGICAL DIAGNOSIS	HISTOLOGICAL DIAGNOSIS	RADIOLOGICAL DX IN AGREEMENT WITH HISTOLOGICAL DX
GLIOMAS	64[42.7%]	54[36%]	38[59.4%]
GANGLIOGLIOMAS	1[0.7%]	-	-
MENINGIOMAS	20[13.3%]	21[14.0%]	13[65%]
PINEAL REGION TUMORS	2[1.3%]	-	-
NEUROBLASTOMAS	-	1[0.7%]	-
LYMPHOMAS	1[0.7%]	-	-
PITUITARY TUMORS	7[4.7%]	3[2.0%]	2[42.9%]
ARACHNOID CYST	1[0.7%]	-	-
CRANIOPHARYNGIOMA	5[3.3%]	3[2.0%]	2[40%]
ABSCESSSES	8[5.3%]	4[2.7%]	3[37.5%]
TUBERCULOMA	5[3.3%]	12[8.0%]	4[80.0%]
VASCULAR LESION	2[3.3%]	6[4.0%]	1[50.0%]
ENCEPHALOCOELE	5[3.3%]	4[2.7%]	4[80.0%]
MEDULLOBLASTOMA	7[4.7%]	13[8.7%]	5[71.4%]
TUMORS (NON SPECIFIC)	20[13.3%]	2[1.3%]	-
METASTASIS	1[0.7%]	2[1.3%]	1[100%]
MUCOCOELE	-	1{0.7%}	1[100%]
GLIOSIS	-	14[9.3%]	-
NORMAL BRAIN TISSUE	-	9[6.0%]	-
CRYPOCOCCUS	-	1[0.7%]	-

TABLE VI: DISTRIBUTION OF PATTERNS OF ENHANCEMENT OF INTRACRANIAL MASSES BY RADIOLOGICAL DIAGNOSIS.					
RADIOLOGICAL DAIGNOSIS	PATTERNS OF ENHANCEMENT				
	HOMO GENOUS	HETERO GENOUS	RING	NONE	TOTAL
INTRACRANIAL MASSES					
GLIOMAS	7 [11.5%]	37 [60.7%]	3 [4.9%]	14 [23.0%]	61 [43.0%]
GANGLIOMAS	-	1 [100%]	-	-	1 [0.7%]
MENINGIOMA	14 [73.7%]	5 [26.3%]	-	-	19 [13.4%]
PINEAL REGION TUMORS	-	1 [50.0%]	-	1 [50.0%]	2 [1.4%]
LYMPHOMAS	-	1 [50.0%]	-	-	1 [0.7%]
PITUITARY TUMORS	2 [28.6%]	5 [71.4%]	-	-	7 [4.9%]
ARACHNOID CYST	1 [100%]	-	-	-	1 [0.7%]
CRANIOPHARYNGIOMA	-	3 [60.0%]	1 [20.0%]	1 [20.0%]	5 [3.5%]
ABSCESSES	-	1 [12.5%]	7 [87.5%]	-	8 [5.6%]
TUBERCULOMAS	1 [20.0%]	2 [40.0%]	-	2 [40.0%]	5 [3.5%]
VASCULAR LESION	2 [100%]				2 [1.4%]
ENCEPHALOCOELE	-	-	-	3 [100%]	3 [2.1%]
MEDULLOBLASTOMA	1 [14.3%]	5 [71.4%]	-	1 [14.3%]	7 [4.9%]
TUMORS (NON SPECIFIC)	2 [11.1%]	10 [55.6%]	1 [5.6%]	5 [27.8%]	18 [12.7%]
METASTASIS	1 [100%]		-		1 [0.7%]
MUCOCOELE	-	-		1 [100%]	1 [0.7%]
TOTAL	31 [21.8%]	71 [50.0%]	12 [8.5%]	28 [19.7%]	142

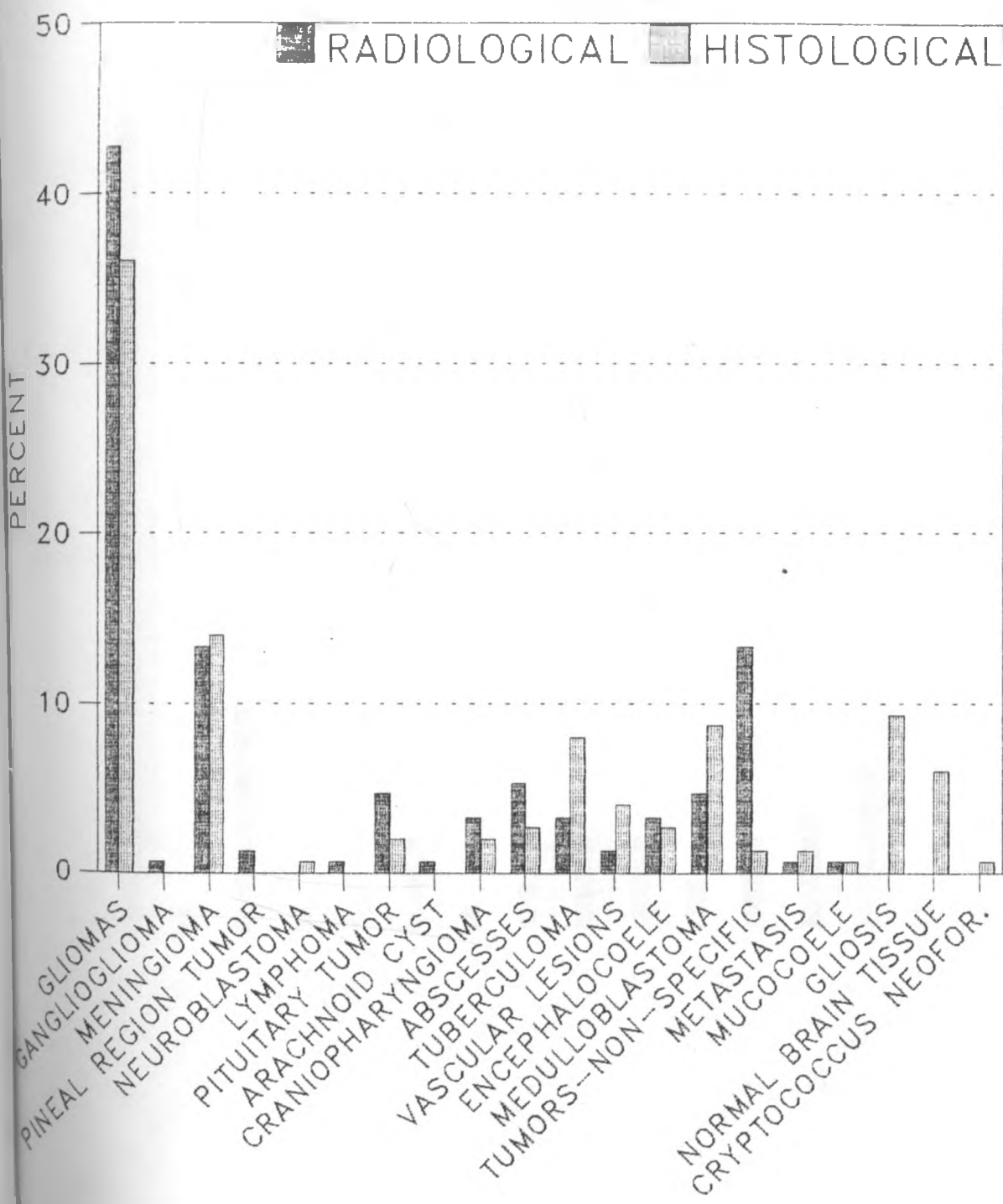
TABLE VII: DISTRIBUTION OF PATTERNS OF ENHACEMENT IN HISTOLOGICALLY CONFIRMED INTRACRANIAL MASSES.

RADIOLOGICAL DIAGNOSIS INTRACRANIAL MASSES	HOMO GENEIOUS	HETERO GENOUS	RING	NONE	TOTAL
	GLIOMAS	6 [11.8%]	37 [72.5%]	3 [5.9%]	5 [9.8%]
MENINGIOMAS	13 [65.0%]	4 [20.0%]	2 [10.0%]	1 [5.0%]	20 [14.1%]
NEUROBLASTOMA	1 [100%]	-	-	-	1 [0.7%]
PITUITARY TUMORS	1 [33.3%]	2 [66.7%]	-	-	3 [2.1%]
CRANIOPHARYNGIOMA	-	2 [66.7%]	-	1 [33.3%]	3 [2.1%]
ABSCESSSES	-	2 [50.0%]	2 [50.0%]	-	4 [2.8%]
TUBERCULOMAS	1 [8.3%]	2 [37.4%]	-	5 [41.7%]	12 [8.5%]
VASCULAR LESION	1 [16.7%]	-	-	3 [45.9%]	6 [4.2%]
ENCEPHALOCOELE	-	6 [54.5%]	-	3 [100%]	3 [2.1%]
MEDULLOBLASTOMA	3 [27.3%]	2 [100%]	-	2 [18.2%]	11 [7.7%]
TUMORS (NON SPECIFIC)	-	-	-	-	2 [1.4%]
METASTASIS	1 [50.0%]	-	1 [50.0%]	-	2 [1.4%]
MUCOCOELE	-	4 [30.8%]	-	1 [100%]	1 [0.7%]
GLIOSIS	4 [30.8%]	3 [33.3%]	2 [15.4%]	3 [23.1%]	13 [9.2%]
NORMAL BRAIN TISSUE	-	1 [100%]	2 [22.2%]	4 [44.4%]	9 [6.3%]
CRYPTOCOCCUS NEOFORMANS	-	-	-	-	1 [0.7%]
TOTAL	31 [21.8%]	71 [50.0%]	12 [8.5%]	28 [19.7%]	142

VIII: DISTRIBUTION OF HISTOLOGICAL DIAGNOSIS OF INTRACRANIAL MASSES BY GEOGRAPHICAL REGION.

HISTOLOGICAL DIAGNOSIS INTRACRANIAL MASS	CEREBEL- LLAR	TEMPO- RAL	PARIETA- L	FRONTA- L	OCCIPI- TAL	TEMPO- RO PARIET- AL	PARRIE- TAL OCCIPI- TAL	FRONT O PARIET- AL	PINEAL	INTRV- EN- TRICU- LAR	FRONT O TEMPO- RAL	SELLAR	TOTAL
GLIOMAS	7 [13.0%]	-	19 [35.2%]	4 [7.4%]	1 [1.9%]	3 [5.6%]	4 [7.4%]	8 [14.8%]	-	2 [3.7%]	1 [1.9%]	5 [9.3%]	54 [36.0%]
MENINGEOMAS	2 [9.5%]	-	5 [23.8%]	4 [19.0%]	2 [9.5%]	1 [4.8%]	1 [4.8%]	1 [4.8%]	-	1 [4.8%]	-	4 [19.0%]	21 [14.0%]
NEUROBLASTOMA	1 [100%]	-	-	-	-	-	-	-	-	-	-	-	1 [0.7%]
PITUITARY TUMORS	-	-	-	-	-	-	-	-	-	-	-	3 [100%]	3 [2.0%]
CRANIOPHARYNGIOMA	-	-	1 [33.3%]	-	-	-	-	-	-	-	-	2 [66.7%]	3 [2.0%]
ABSCESSSES	-	-	3 [75.0%]	-	-	-	-	-	-	-	-	1 [25.0%]	4 [2.7%]
TUBERCULOMAS	3 [25.0%]	-	7 [58.3%]	-	-	1 [8.3%]	-	-	-	-	-	1 [8.3%]	12 [8.0%]
VASCULAR LESIONS	-	1 [20.0%]	1 [20.0%]	-	-	-	2 [40.0%]	-	-	-	-	2 [40.0%]	6 [4.0%]
ENCEPHALOCOELE	-	-	-	3 [75.0%]	1 [25.0%]	-	-	-	-	-	-	-	4 [2.7%]
MEDULLOBLASTOMA	12 [92.3%]	-	-	-	1 [7.7%]	-	-	-	-	-	-	-	13 [8.7%]
TUMORS (NON SPECIFIC)	-	-	-	-	-	1 [50.0%]	-	-	1 [50.0%]	-	-	-	2 [1.3%]
METASTASIS	-	-	2 [100%]	-	-	-	-	-	-	-	-	-	2 [1.3%]
MUCOCOELE	-	-	-	1 [100%]	-	-	-	-	-	-	-	-	1 [0.7%]
GLIOSIS	2 [14.3%]	-	7 [50.0%]	-	-	2 [14.3%]	1 [7.1%]	-	-	-	-	2 [14.3%]	14 [9.3%]
NORMAL BRAIN TISSUE	2 [22.2%]	-	5 [55.6%]	-	-	-	1 [11.1%]	-	1 [11.1%]	-	-	-	9 [6.0%]
CRYPTOCOCCUS NEOFORMAS	-	-	1 [100%]	-	-	-	-	-	-	-	-	-	1 [0.7%]
TOTAL	29 [19.3%]	1 [0.7%]	51 [34.0%]	12 [8.0%]	5 [3.3%]	8 [5.3%]	9 [6.0%]	9 [6.0%]	2 [1.3%]	3 [2.0%]	1 [0.7%]	20 [13.3%]	150

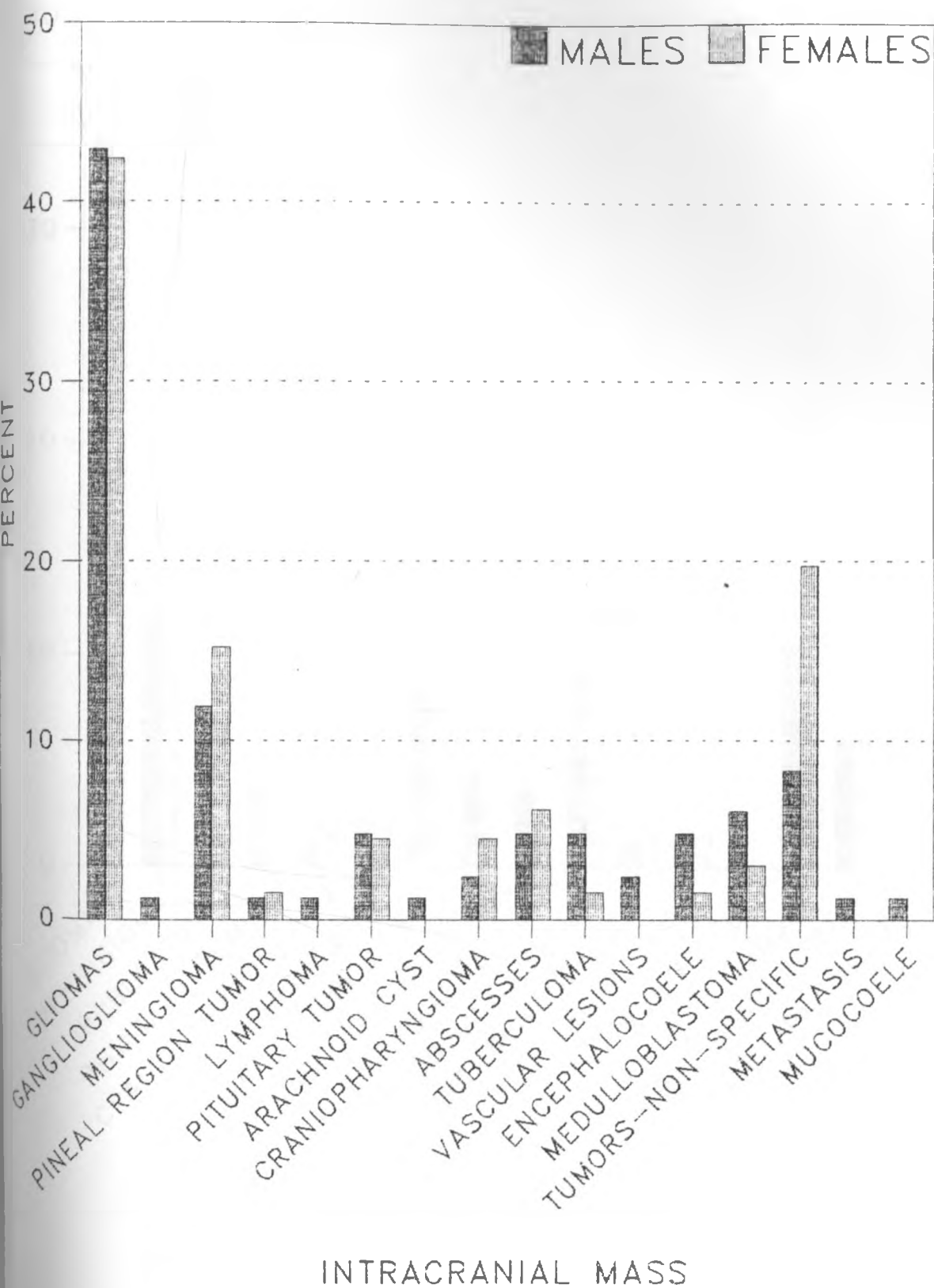
FIG 1: DISTRIBUTION OF RADIOLOGICAL & HISTOLOGICAL DIAGNOSIS



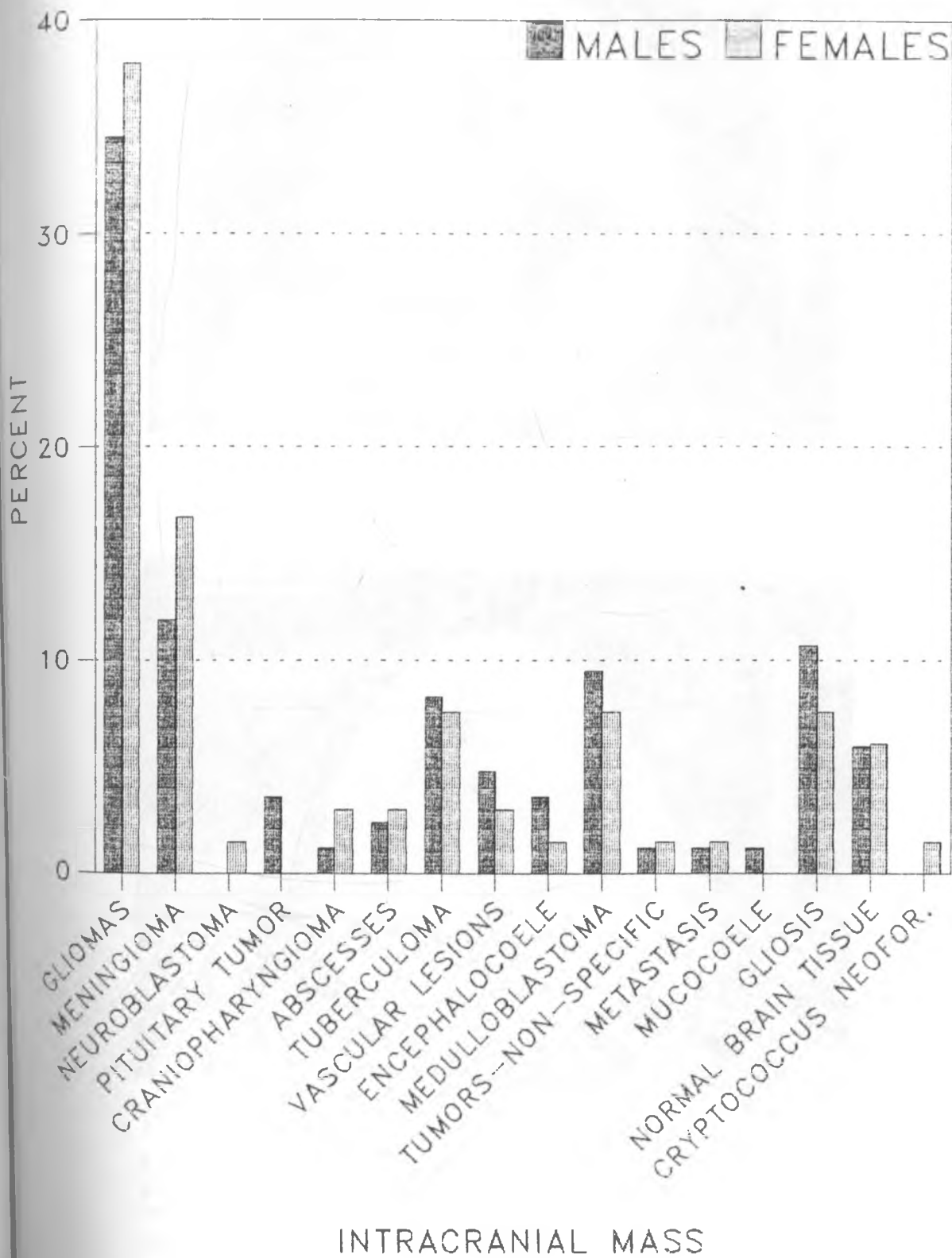
INTRACRANIAL MASS

NEOFOR. = NEOFORMANS

2: DISTRIBUTION OF RADIOLOGICAL DIAGNOSIS BY SEX



3: DISTRIBUTION OF HISTOLOGICAL DIAGNOSIS BY SEX



INTRACRANIAL MASS

NEOFOR. = NEOFORMANS

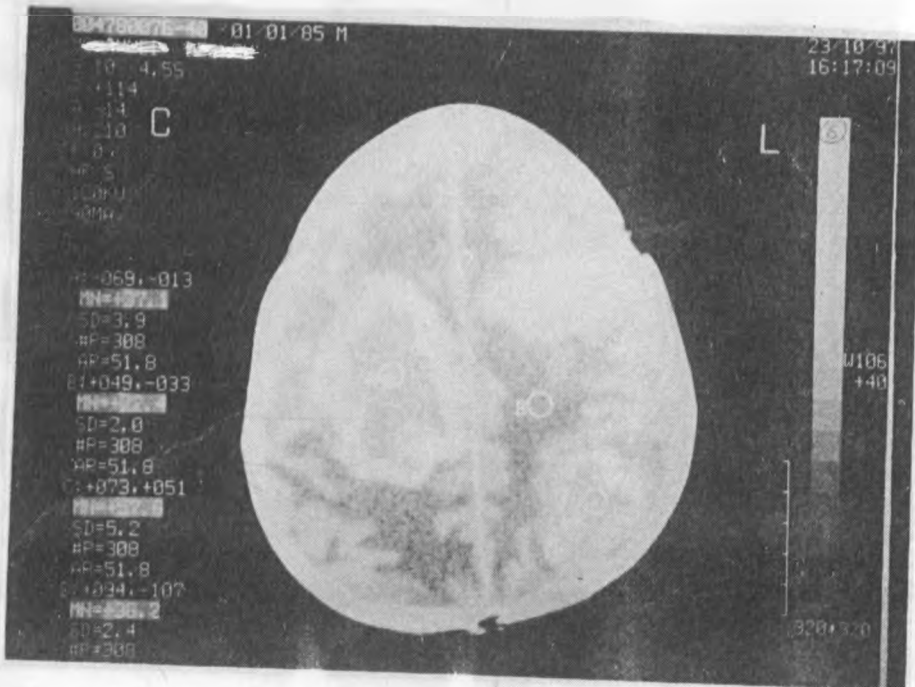
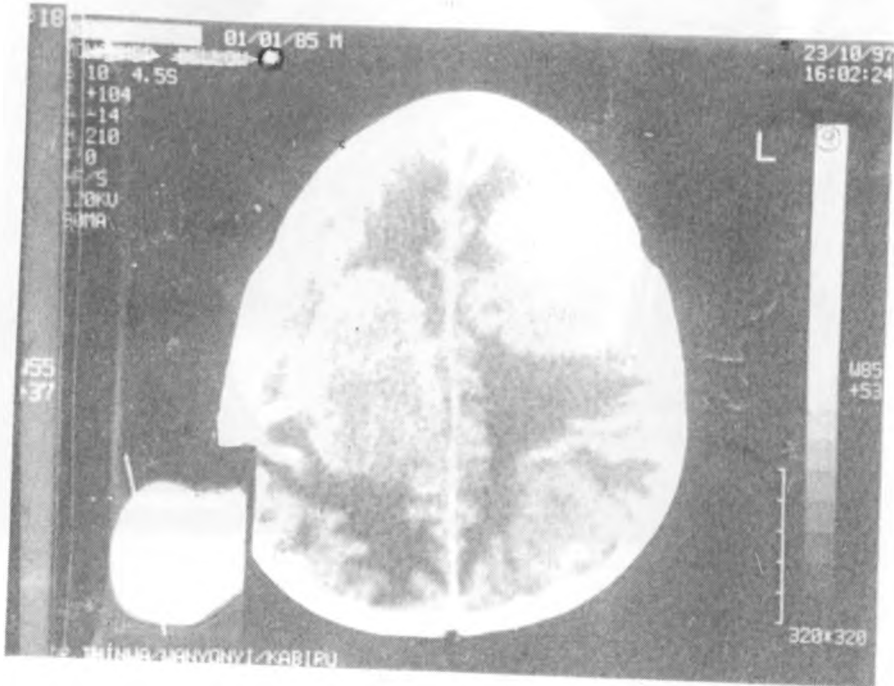
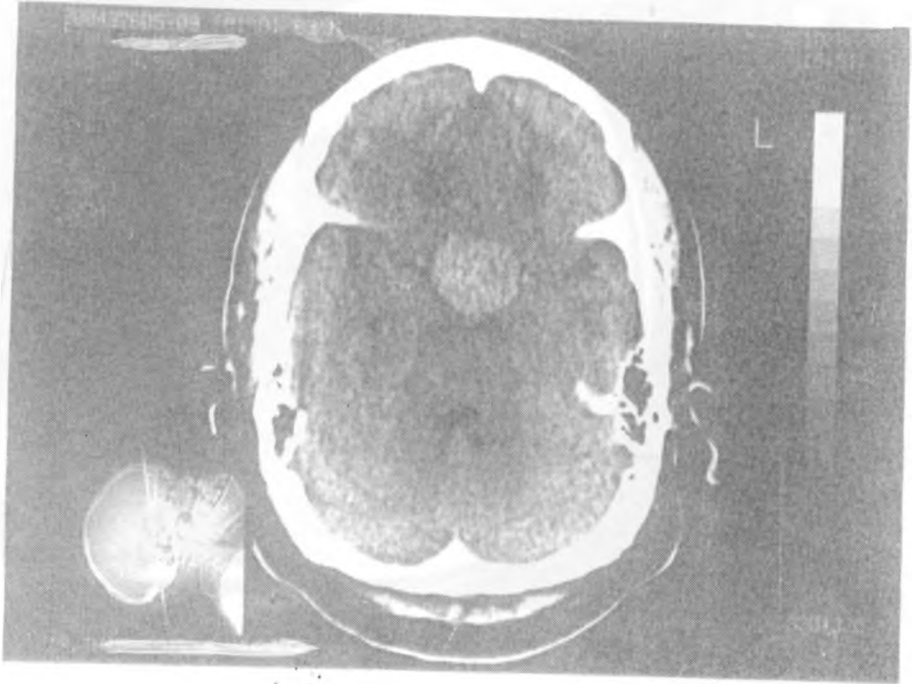


ILLUSTRATION 1(A) and (B)

A 12yr old male who presented with visual disturbance, neck stiffness and weakness of lower limb. CT scan showed multiple ring enhancing lesions with surrounding oedema in parietal region reported to be abscesses. Histology report turned out to be normal brain tissue.

A



B

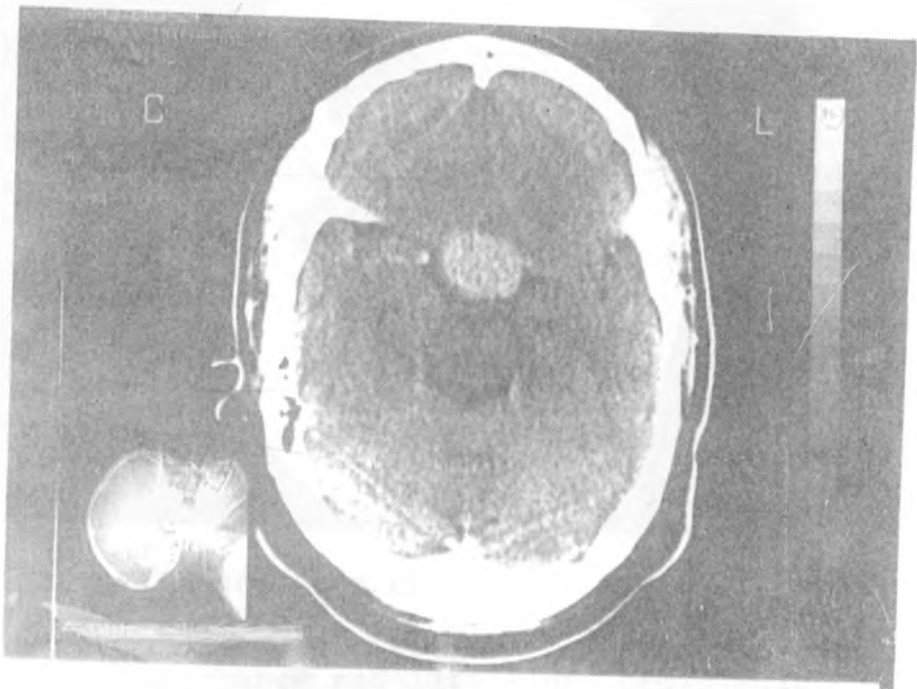
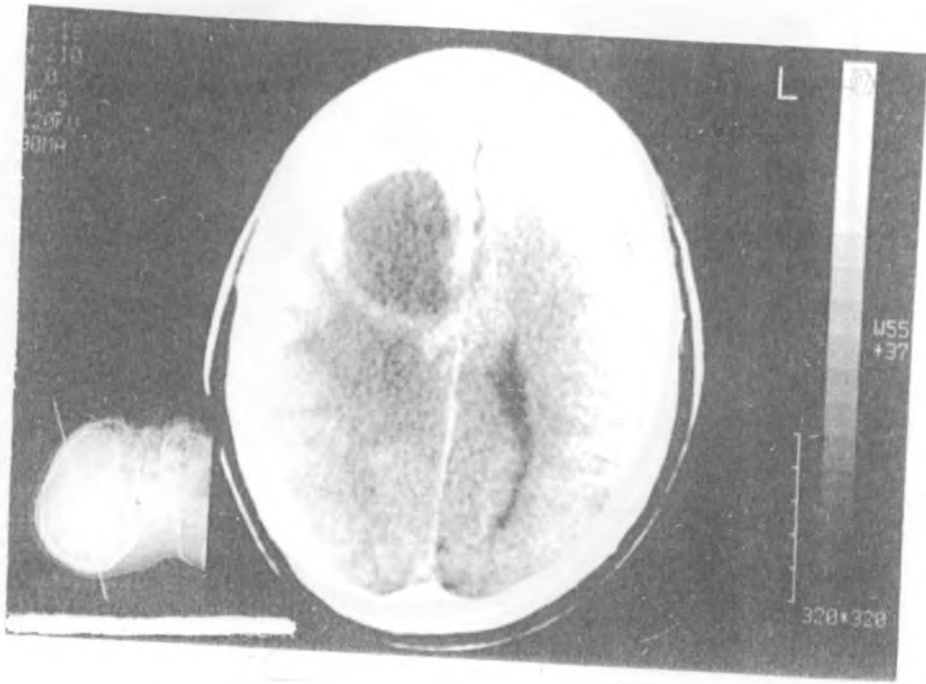


ILLUSTRATION 3(A) and (B)

A male patient said to have a space occupying lesion. CT scan showed a high attenuating pituitary mass with slight enhancement reported to be pituitary tumour. After histology this turned out to be a pituitary adenoma.

A



B



ILLUSTRATION 4(A) and (B)

A 56yr old male who presented with convulsions; speech disturbance and left sided hemiplegia. CT scan showed an hypodense ring enhancing lesion in the right fronto-parietal region reported to be an abscess. This lesion turned out to be a glioblastoma multiforma after histology.

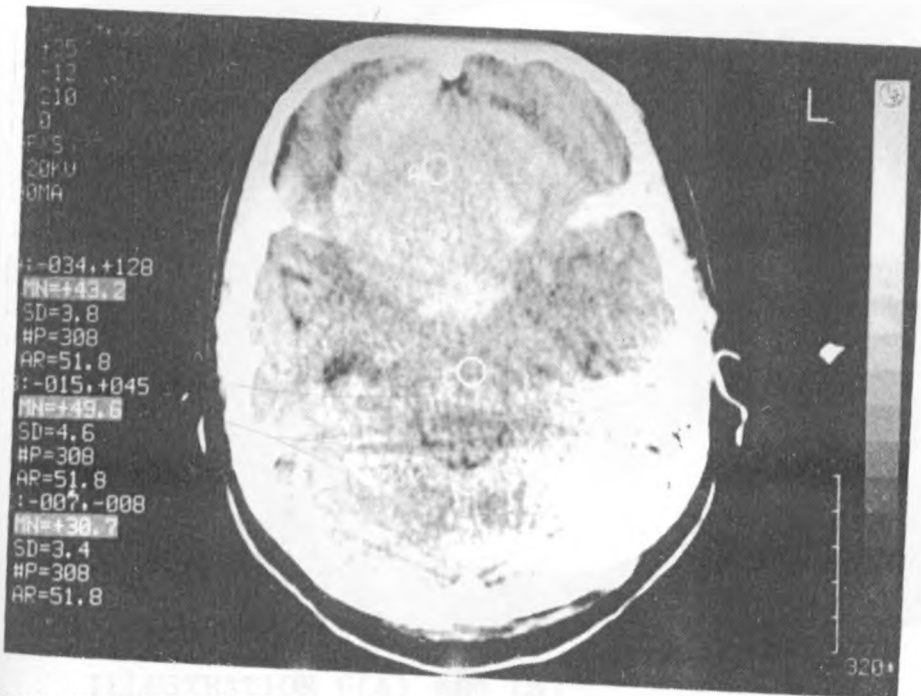
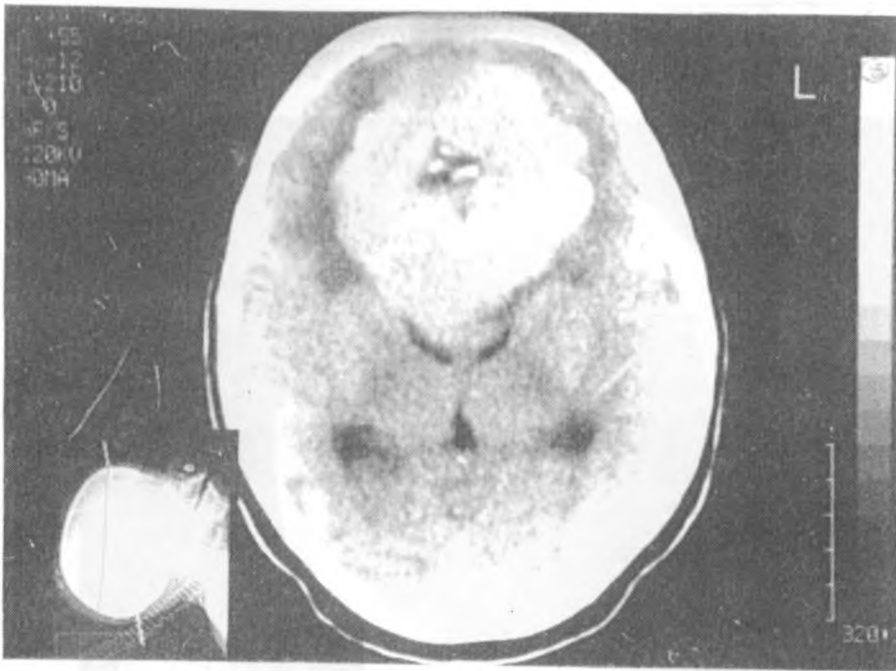
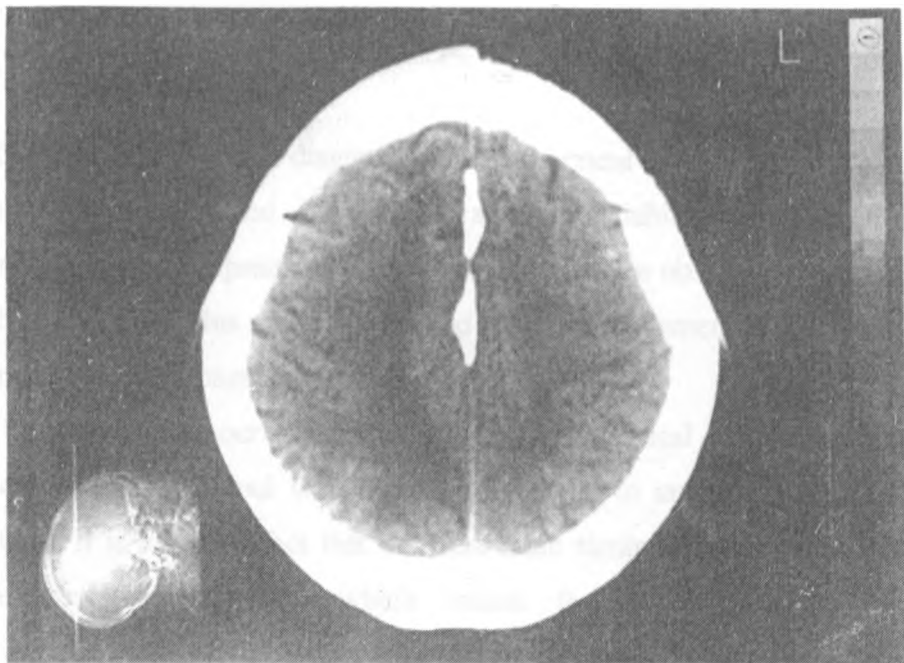


ILLUSTRATION 5(A) and (B)

A 36yr old female with convulsions in pregnancy. Non enhanced CT scan showed a high attenuating mass in the frontal region reported to be a meningioma. After histology the lesion was reported to be a meningioma.

A



B

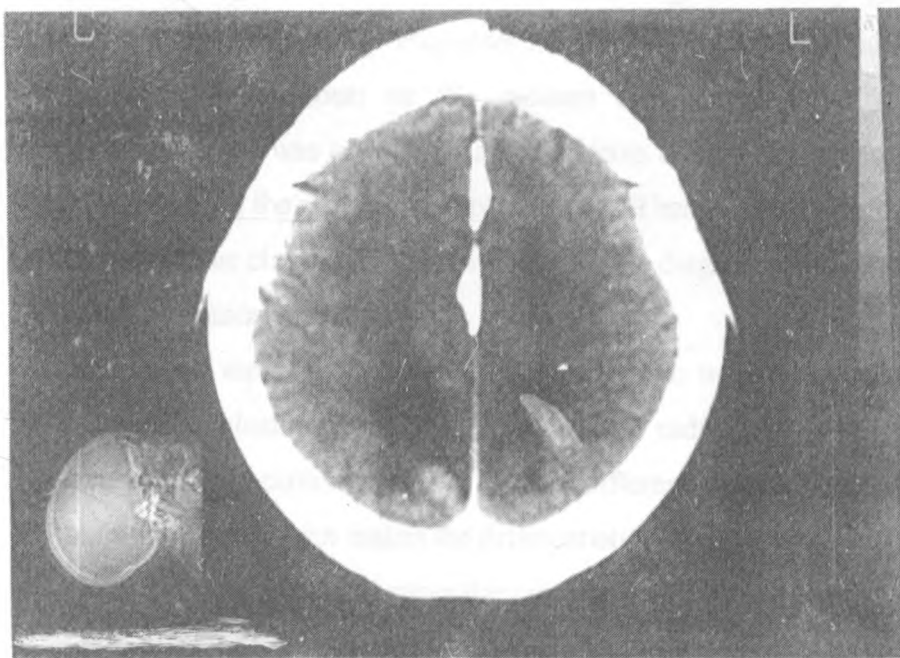


ILLUSTRATION 6(A) and (B)

A 66yr old female said to have a space occupying lesion. CT scan showed an isodense right cerebral lesion with strong enhancement and surrounding oedema reported to be a glioma or metastasis. After histology the lesion was reported to be a metastatic ductal carcinoma.

DISCUSSION

The role of CT scan in diagnosis and management of intracranial masses needs not to be emphasized. Clinical efficacy and reliability of CT scan in brain imaging largely depends on the understanding of the observed characteristics by the radiologist. This enables early and proper management which reduces costs in the overall management of intracranial lesions.

The observed tumour characteristics plus good clinical information makes CT scan a diagnostic tool which can be relied on in many neurological disease states. It is a known fact that different brain tumours exhibit similar CT scan features (characteristics) which makes their radiological differentiation difficult. It is therefore important to obtain accurate clinical information so as to come up with a reliable CT scan diagnosis without which one will end up with a long list of differential diagnosis.

In this study a good number of physicians had given a fairly good clinical information. However, 27 (18%) cases no clinical data was available from the radiological request form or the patients medical records. SOL (Space Occupying Lesion) was given by many clinicians to stand for clinical summary often requested in the radiological request form. There seems to be over-reliance of CT scan by the clinician as it's only the CT scan diagnosis that appears instead of the actual clinical presentation.

While it is not easy for clinician to diagnose brain tumour with specification after clinical evaluation it is also not easy for a radiologist to diagnose some brain tumours with certainty. This is because different brain tumour show similar CT scan properties which makes the differentiation of these tumours by CT scan alone difficult. In 20 (13.3%) cases the radiological diagnosis was non specific a fact which was more attributed to lack of proper clinical information.

Histological diagnosis is by far the most accepted mode of diagnosis even though 2 (1.3%) cases of the histological diagnosis were non specific. Radiological/histological diagnosis correlation is a good measure of CT scan efficacy.

difficult. In 20 (13.3%) cases the radiological diagnosis was non specific a fact which was more attributed to lack of proper clinical information.

Histological diagnosis is by far the most accepted mode of diagnosis even though 2 (1.3%) cases of the histological diagnosis were non specific. Radiological/histological diagnosis correlation is a good measure of CT scan efficacy.

GLIOMA

Glioma was the most prevalent tumour consisting 54 (36%) of the histologically proven tumours. Only 38 (59.4%) cases were in agreement with the radiological diagnosis. The bulky of the brain parenchyma is made up of glial cells hence the high incidence of glioma. Varied patterns of enhancement were seen after IV contrast injection. Most of the glioma showed heterogenous pattern of enhancement 37 (72.5%), homogenous 6 (11.8%), ring 3 (5.9%) and 5 (9.8%) no enhancement at all. This variance in the observed characteristics of this tumour may be attributed to relatively low agreement percentage between the radiological and histological diagnosis. Gliomas were found in all the ages and this agrees with studies done elsewhere. Usually no sex preponderance is seen in this tumour although in this study 29 (53.7%) were males and 25 (46.3%) were females. These figures may be stastically equal.

Gliomas are usually found in any part of the brain. In this study majority of gliomas were found in the parietal frontal region. The clinical presentation of gliomas is associated with signs and symptoms of increased intracranial pressure. Most of the gliomas presented with headache 36 (75.0%) visual disturbance 30 (62.5%) seizures 13 (27.1%) and locomotor function impairment 27 (56.3%).

MENINGIOMA

Second commonest intracranial tumour comprising of 21 (14%) cases. Only 13 (65%) cases (confirmed) were in agreement with the CT scan radiological diagnosis. This frequency compares very well with 16% of all intra cranial tumours being meningiomas (1). Most meningiomas exhibit unique characteristic CT findings of hyperdense lesion with homogenous enhancement although a significant number may show atypical CT scan characteristics which often lead to difficulties in diagnosis. 13 (65%) of meningiomas showed homogenous pattern of enhancement after IV contrast administration, 4 (20%) heterogenous pattern 2 (10%), ring pattern and 1 (5%) no enhancement at all. This tumour was found almost in all the brain geographical regions. These two factors atypical tumour characteristics and widespread locations may be attributed to the difficulties encountered in diagnosing this tumour radiologically. Meningiomas are normally found in areas with arachnoid granulations or along the meninges. Even with a good clinical information it may not be easy to differentiate suprasellar meningioma radiologically from pituitary adenoma; vascular lesion and glioma (38).

Males are usually more affected in meningiomas than females, giving a ratio of 5:4 (M:F). In this study 10 (47.6%) males and 11 (52.4%) females had meningioma giving a ratio of M:F = 10:11 a ratio which is statistically equal. All the age groups were affected. The commonest signs and symptoms were associated with increased intra cranial pressure.

TUBERCULOMA

Tuberculosis (TB) is a common problem in developing countries as well as developed countries.

Tuberculoma (brain granulomatous lesion as a result of TB) is one of the commonest extra-pulmonary sites and frequently follows a known episode of tuberculous meningitis. The sequelae is abscess formation or tuberculoma.

In this study there was underdiagnosis of intracranial TB by CT scan. Only 5 (3.3%) cases were picked radiologically but histological studies 12 (8.0%) cases were observed. Radiological/histological agreement was 4 (80%)

After IV contrast administration there were varying patterns of enhancement observed. Heterogenous pattern of enhancement was seen in 6 (50%), homogenous 1 (8.3%) and 5 (41.7%) no enhancement at all.

The commonest patterns of enhancement in tuberculoma after IV contrast injection are heterogenous and ring enhancement (91).

These unusual patterns of enhancement may have led to missing of diagnosis in tuberculoma.

Most tuberculomas were found in the parietal region 7(58.3%) and the posterior cranial fossa 3 (25%). Normally tuberculomas and TB abscess are found commonly in the grey/white matter interface of the cerebral cortex in adults while in children they are found in cerebella hemisphere. No age prevalence was observed but the highest number of cases was in the 2nd and 3rd decades. The clinical presentation of tuberculoma was non-specific.

MEDULLOBLASTOMA

Medulloblastoma is probably one of the commonest neoplasm originating from the cerebellum in childhood and carries an incidence of 1.3 - 5% (40).

It is extremely difficult to diagnose medulloblastoma with CT scan alone. Several investigators have encountered difficulties especially in differentiating this tumour from astrocytoma (cerebella) (1:10;12;41;42;43)

Radiological features of medulloblastoma range from hyperdense, hypodense cystic and haemorrhagic lesion. The patterns of enhancement after IV contrast were 3(27.3%) homogenous 6(54.3%) heterogenous, 2(18.2%) no enhancement and no ring enhancement pattern was observed.

The incidence of medulloblastoma was found to be 13 (8.7%) with radiological/histological agreement of 5(71.4%). The male:female ratio was 8:5 and mainly affecting children of less than 10 years (77%). Usually this tumour show slight male predominance at the ratio of 1.5 - 3:1 and 50% of the cases are seen in the first decade. The clinical presentations vary a lot and are mainly associated with increased intracranial pressure.

GLIOSIS

Proliferation of normal glial cells. The aetiology of gliosis is not well understood although cell injury with repair seem evident.

This is an histological diagnosis. CT scan appearance of reported cases of gliosis 14 (9.3%) vary a lot and are non-specific and can mimic any brain tumour. After IV contrast administration 4(30.8%) showed homogenous pattern; 4(30.8%) heterogenous pattern 2(15.4%) ring pattern of enhancement 3(23.1%) cases showed no enhancement at all.

OTHERS

Pituitary tumours 7 (4.7%) seems to have been overdiagnosed by CT. A wide variety of tumours can be found in and around the sellar. Such tumours are meningiomas, glioma, vascular lesions and craniopharyngioma. The presence of these many different tumours with similar characteristics (radiological) in a small area may lower the CT scan efficacy in diagnosing these tumours. The radiological/histological diagnosis agreement for pituitary tumours no wonder is 3(42.9%).

Abscesses were also overdiagnosed radiologically 8(5.3%) after histological studies only 4(2.7%) cases were proved to be abscesses.

Radiological histological agreement was 3(37.5%). A number of tumours with ring pattern of enhancement (peculiar to abscesses) were observed. One cannot therefore differentiate cystic glioma, tuberculoma, and metastasis from an abscess radiologically. With increased numbers of AIDS (Acquired Immunodeficiency syndrome) cases in the recent past possibly one would have expected a higher number of abscesses. This fact could have led to overdiagnosis of brain abscesses by CT scan.

Vascular related lesion were underdiagnosed radiologically 2 (1.3%) as compared to histological diagnosis 6 (4.0%). In case of haemorrhagic lesions one.

needs to understand the various stages of an evolving haematoma. A haematoma can be hyperdense, hypodense or isodense depending on its age.

CT scan characteristics depend on the age of the haematoma. Without a good clinical information the radiologist may face some difficulties in differentiating an infarct from an abscess or a glioma.

Craniopharyngioma may not be differentiated easily radiologically from necrotic pituitary adenoma, thrombosed aneurysm or a cystic glioma hence the low CT scan reliability in the diagnosis.

Radiological - histological agreement was 2(40%).

Congenital lesions like encephalocoele did not show much problem in diagnosis by CT scan. The radiological/histological agreement was 4(80%)

9(6.0%) cases were reported as normal brain tissue after histological studies.

After IV contrast injection some of these showed heterogenous 3(33.3%); 2(22.2%) ring pattern of enhancement and 4(44.4%) no enhancement at all. The overall results of these 9(6.0%) cases may be due to sampling error.

Metastatic lesions 2(1.3%) cases were picked by histology and were mainly from ductal carcinoma of the breast. Radiologically the only 1(0.7%) case was picked. One of these cases showed homogenous pattern of enhancement while the other showed ring pattern of enhancement; just like abscesses these lesions exhibit different characteristics. Radiological/histological agreement was 1(100%). Cryptococcus, neoformons infection (fungal) was picked up by histological studies and its patterns of enhancement were heterogenous.

CONCLUSION

1. The four commonest intracranial masses in KNH are gliomas (36%) meningioma (14%) medulloblastoma (8.7%) and tuberculoma (8.0%).
2. Many intracranial masses show heterogenous pattern of enhancement after IV contrast administration.
3. Heterogenous pattern of enhancement is mainly shown by:
 - Gliomas 37 (72.5%)
 - Tuberculoma 6 (50%)
 - Craniopharyngioma 2 (66.7%)
 - Medulloblastoma 6 (54.5%)While homogenous pattern of enhancement is a feature of meningioma 13 (65%).
4. Signs and symptoms associated with increased intracranial pressure are the usual presenting features of many intra cranial masses.
5. Many intra cranial lesions are found in the parietal region 51 (34%) and the cerebellum/brain stem region 29 (19.3%)
6. Age predominance was observed in encephalocoele where all the cases 4 (100%) was in less than 5 years age group and in medulloblastoma 10 (77%) cases were in less than 9 years age group.
7. No significant sex preponderance was observed in the various intra cranial masses.
8. The radiological/histological diagnosis agreement on average was above 50% in most of the intra cranial masses; implying CT scan is a reliable diagnostic tool for brain masses.

RECOMMENDATIONS

1. To obtain a reliable CT scan diagnosis for brain masses a good clinical history is mandatory.
2. Where the patient is not at risk IV contrast medium should always be administered. This enables further evaluation of biological behaviour (patterns of enhancement) of tumours and hence narrowing diagnosis.
3. Patterns of enhancement (after IV contrast) for individual tumours like glioma should be correlated with histological grade of this tumour.
4. For the radiologist to make a reliable CT scan diagnosis he/she is expected to appreciate the natural course and the characteristics of the disease in question very well, therefore further exposure in neuroradiology is encouraged i.e sub specialization in CT.

APPENDIX A

DATA SHEET

CASE NUMBER

1) I.P number SEX MALE FEMALE

1) WARD/CLINIC.....

2) Provisional diagnosis.....

.....
.....

3) Clinical features;

Symptoms:.....

.....
.....
.....
.....

Signs:.....

.....
.....
.....

APPENDIX B

CASE NUMBER:

1. I.P number SEX Male Female AGE

2. Ward/Clinic.....

3. Radiological (CT scan) diagnosis
a)..... (most likely)
b).....
c)..... (least likely)

4. IV contrast given YES NO

4. Patterns of enhancement

Homogeneous	<input type="checkbox"/>
Heterogeneous	<input type="checkbox"/>
Ring	<input type="checkbox"/>
None	<input type="checkbox"/>
Not applicable	<input type="checkbox"/>

5. Histopathological diagnosis

.....
.....
.....
.....



X - RAY REQUEST / REPORT FORM

TYPE OF INVESTIGATION REQUESTED				NAME	
WALKING	CHAIR	TROLLEY	PORTABLE	SEX	AGE
APPOINTMENT			TIME	HOSPITAL No.	
L.M.P. IF PERIODS MISSED				X-RAY No.	
Is EXAM STILL NECESSARY (Yes / No.)				REPORT TO BE SENT TO	
BRIEF CLINICAL SUMMARY				PREVIOUS X-RAY No.	
				OFFICIAL USE ONLY	
REQUESTING DOCTOR (<i>Print Name</i>)		SIGNATURE		No. of Films	Charges
RADIOGRAPHER NAME				Comments	
				DATE.....	

RADIOLOGIST NAME

SIGNATURE

DATE

REFERENCES

- 1) Diagnostic Neuroradiology- Osborn Ch.12 Pg; 402
Publisher: George Stamathis; 1994
- 2) David Norman Steven E.A wing S.D. et al
Quantative aspect of contrast enhancement in cranial CT
Radiology 129: 683:1978
- 3) Carter O snead et al
Child's brain 9: 1-9 (1982)
- 4) Latchaw R.E; Payne J.T et al
Predicting tumour histology: change of effective atomic number with contrast enhanced CT scan
AJR 135: 757. 1980
- 5) Butler AR: Horii S.C. et al
CT in astrocytoma, statistical anlaysis of the parameter of malignant and positive constrast enhanced CT scan
Radiology: 129:433. 1978
- 6) Hian F.P et al
Contrast enhancement of brain tumour in CT
Diagonistic Imaging 52: 113 - 116; 1983
- 7) Hayman L.A; Evans R.A; Hinck V.C et al .
Delayed high iodine dose conrst CT cranial neoplasm.
Radiology 136: 677:1980
- 8) Bahr A.I. Fred J. Hodges et al
Efficacy of CT of head in changing patients care and health cost. Retrospective study.
AJR 131: 45-49: 1978
- 9) Jack Wittenberg, Harvey V et al
Clinical efficacy of CT body.
AJR 4-14; 1978
- 10) Sutton D. et al.
A Text book of radiology and imaging. Vol:II Ch.62 Pg 1598
Publisher: Churchill Livingstone 1987

- 11) Mashuke D.A
Review of cranial computed tomography in patients referred to K.N.H.
Mmed dissertation. 1997
- 12) Grainger A
Text book of radiology Vol; 3 Ch. Pg 1700
Publisher: Churchill Livingstone 1986
- 13) Isabelle L; Charles B.W. et al
Child's Brain 7:73-84 1980
- 14) Ludwing C.L; Smith MT. Godfrey AD et al
Clinicopathological study of 323 patients with oligodendrogliom.
Annals Neurology 19: 15, 1986
- 15) Maeder PP, Holtas S.L. et al
Colloid cyst of the 3rd ventricle. Correlation of MRI/CT finding with history and clinical analysis.
AJR. 1980: 135.153
- 16) Fritsch G; Ebner F, et al
Compr, Tomography in partial epilepsies in childhood.
European Neurology 28: 306; 1988
- 17) Blom R.J., Vinuela F; FOX AJ: et al
Computed tomography in temporal lobe epilepsy
J. computer assisted tomography 8:(3) Pg.401-405 1984
- 18) Ramaiah Ganti C. et al
CT Colloid Cyst 3rd ventricle.
Radiology 138:385:1981
- 19) Norman E. et al
Seminors of Roentology Pg.27
- 20) Centeno R.S., Lee A.A; Winten J. Barbe D et al.
Supratentorial ependymomas. Neuro imaging and clinicopathological correlation
J. Neurosurgery 64: 209-215 1986
- 21) Braun I.F et al
The value of un-enhanced scan in differentiating lesion producing ring enhancement
AJNR 3: 643-647 1982

- 22) Hannu J.A., Inna E.G et al
Radiology:191 41-51; 1994
- 23) H. pedersen et al
Supratentorial astrocytoma of infancy childhood.
Neuroradiology 21: 87-91 1981
- 24) Tsuchida T; Shimbo Y, Fukunda M. et al.
CT and Histopathological studies of pontine glioma.
Child's nervous system 1 (4) 223-9: 1985
- 25) Narayan S. Marianne L. et al
Brain tumour presenting a small calcified lesion on CT
Child's Brain 7: 95-100 1980
- 26) Lucio Palma et al.
Cystic cerebral astrocytoma in infancy/childhood
Child's brain 10:79-91 1983
- 27) Rao K.C: Levine H: Itani: A et al
CT findings in multicentril glioblastoma; diagnostic pathologic correlation
J. Comput Tomography 4 (3): 187-182 1980
- 28) Alexander S; John; S
case report" Desmoplastic cerebral astrocytoma of infacy: Report/review of imaging characteristics
AJR 166;1459-1461; 1966
- 29) Lilja A., Berstom K; Spanmore B; et al
Reliability of CT in assessing histopathological features of malignant supratentorial glioma
J.Comput. Assisted Tomography 5: 625-636 1981
- 30) Silverman C: Marks J.E et al
Prognostic significance of contrast enhancement in low grade astrocytoma of the adult cerebrum
Radiology 139: 211-213 1981
- 31) Salazer O.M et al
Role of CT in diagnosis and management of brain tumours
Radiology 143; 301 1982
- 32) Arther E. Rosenbaum:
Meningioma
Seminors in Radiology Vol: XIX (1): 8-26: 1984

- 33) Kendell B; Pullicino P. et al
Comparison of consistency of meningioma and CT appearances
Neuroradiology 18: 173 - 176 1979
- 34) Russel E.J George AE; Kricheff II et al:
Atypical CT features of intracranial meningioma
Radiology 135:637:1980
- 35) S. Kano; S. Wakai et al:
Meningioma in children. Eighth scientific meeting of international society of paediatric neuro-surgery
Child's brain 7: Pg.49-50 1981
- 36) David A. et al:
Intracranial meningioma of infancy: childhood: adolescence
Child's brain 7: 43-56: 1980
- 37) Tchang S; Terbrugge K. G et al:
CT as a possible aid to histological grading of supratentorial glioma
Radiology 127:842 1978
- 38) Joseph L. Donovan et al:
Distinction of masses involving the sellar and suprasellar space – specific imaging features
AJR 167:597-603:1996
- 39) Savoiano M; Londrini S; et al:
Hypodense area within a meningioma: metastasis from breast cancer
Neuro-radiology 20(2): 107-110:1980
- 40) Anthony J. Raymonds; Tadanori T; et al:
Medulloblastoma,
Child's brain 10: 193-207: 1983
- 41) Tsuchinda T. et al:
CT findings of medulloblastoma,
Child's brain 11: 60-68:1984
- 42) Zimmerman R.A et al:
Spectrum of medulloblastomas demonstrated by CT
Radiology 126: 137-141: 1978

- 43) Naidich T.P et al:
Primary tumour and other masses on the cerebellum and fourth ventricle:differential diagnosis by CT
Neuro-radiology 14: 153-174: 1977
- 44) Yohsihisa K et al:
CT findings in medulloblastoma:correlation of histologic types
Child's brain 7: 164:1990
- 45) John P. Laurent: Derek A.B. et al:
Haemorrhagic brain tumor in paediatric patients
Child's brain 8: 263-270: 1981
- 46) Reddy D.R; Sundaram C. et al:
Calcified medulloblastoma in childhood.
Clinical imaging 18:275:1984
- 47) Jack C.R. Jr: O'Neil BP; Banks P.M et al:
Central nervous lymphoma: histologic types and CT appearances
Radiology 167;211-215: 1988
- 48) Yang P.J et al:
Primary and secondary histiocytic lymphoma: CT features
Radiology 154:683;1984
- 49) Stallmever MJB; Brown JH. et al:
Primary cerebral lymphoma
AJR 165,626:1995
- 50) Tadmor R., Davis K.R. et al:
CT in primary malignant lymphoma of brain
Radiology 129:271:1978
- 51) Radvany J; Levine H L; et al:
CT in diagnosis of primary lymphoma of CNS
Radiology 129; 272;1978
- 52) Terae S. Ogata A et al:
Non-enhancing primary CNS lymphoma
Neuro-radiology 38: 34:1996
- 53) Barsky M.F et al:
CT features of primary brain lymphoma
Journal of Canadian Association of Radiologists 40:80:1989

- 54) Kaline P. et al:
Haemorrhagic Sub-ependymal giant cell astrocytoma
Paediatric Radiology 25:66:1995
- 55) Chang T. et al:
CT of pineal tumour and intracranial germ cells
AJNR 10:1039:1989
- 56) Altaman N: Fitz CU et al:
Radiological characteristics of primitive neuroectodermal tumour in children
AJNR 6: 15-18; 1985
- 57) Smirniotopoulos T.G et al:
Germinomas
Radiographics 12: 577-596 1992
- 58) Zimmerman R.A, Bilanink L.T. et al:
CT of pineal, peripineal and histologically related tumour
Child's brain 7:53;1980
- 59) Gadener T.P Nandich et al:
CT features of intrasellar pituitary adenoma
Neuro-radiology 20;241;1981
- 60) Hilal S.K. et al:
CT of normal anatomy of intrasellar structures
17th annual meeting of American Society of Neuro-Radiology, Toronto;
1979
- 61) Silvester A. et al:
CT appearance of the normal pituitary and pituitary microadenoma
Radiology 133;385-391, 1979
- 62) Wolvert S.M et al:
Value of CT in evaluating patients with prolactinoma
Radiology 131: 117-119: 1979
- 63) Sadoka K. et al:
CT scan of pituitary adenoma
Neuro-Radiology 20:249;1981
- 64) Zimmerman R.A et al:

- Imaging of intrasellar, suprasellar tumour
Seminors of Roentogenology 25:174;1990
- 65) Hillman T.H et al:
Infrasellar craniopharyngioma CT/MRI studies
JCAT 12: 702;1988
- 66) Fitz CR; Wortzman G. et al:
CT in craniopharyngioma
Radiology 127:687;1978
- 67) Leo J.S., Pinto R.S. et al:
CT of arachnoid Cyst
Radiology 130; 675;1979
- 68) Hasagawa H; Bitoh S; et al:
Intracranial epidermoid mimicking meningioma (ab)
Radiology 142;275;1982
- 69) Akkeraju V; et al:
CT appearance of colloid cyst (ab)
Radiology 145;870; 1982
- 70) Ganti SR et al:
CT diagnosis of collid cyst 3rd ventricle
Radiology 138;385; 1981
- 71) Maeder PP. Holtas SL. Et al:
Colloid cyst of 3rd ventricle correlation of MRI and CT with histology and
chemical analysis
AJNR 11; 575; 1990 of AJR 155;135; 1990
- 72) Kameda H. Abiko S. et al:
Infrasellar craniopharyngioma
Neuro-radiology 31, 180: 1989
- 73) Haji MR. Kishore P.R.S, Becken D.P at al:
Pituitary micro-adenoma; Radiological surgical correlative
study.
Radiology 139;95-99: 1981
- 74) Jesus, Vaguero; Rafael C; Jose M.C. et al:
Arachnoid cyst of posterior fossa.
Surgical neurology 16; 117-121 1981

- 75) Gallessi E; Piazza G. et al:
Arachnoid cyst of middle cranial fossa, a clinical and radiological study of 25 cases treated surgically
Radiology 139;783: 1979
- 76) Zimmerman RA; Bilanink L.T. et al:
Cranial CT of epidermal and congenital fatty tumour of mal development origin
Radiology 132:783: 1979
- 77) A.Moller; A.Haen et al:
Differential diagnosis of pontine angle meningioma and acoustic neuroma with CT
Neuro-radiology 17;21-23, 1978
- 78) Gregory D.M; Gerge U.F et al:
Symptom findings methods of diagnostic in patients with acoustic neuroma
Radiology 132; 788; 1979
- 80) Krassanakis K. et al:
Acoustic neuroma, unusual CT findings
Neuro-radiology 21; 51-53, 1981
- 81) Whelan M.A; Hilal S.K. et al:
CT as a guide in the diagnosis and follow up of brain abscesses.
Radiology; 135, 663-671; 1980
- 82) J.F Hisch, et al:
Brain abscess in childhood.
Child's brain; 10; 251-265; 1984
- 83) Danzinger A; Price H; Schechter et al:
Analysis of 113 intracranial infection.
Neuro-Radiology 19; 31-34 1980
- 84) Nielsen H; Glydensted G. et al:
CT on the diagnosis of cerebral abscess.
Neuro-Radiology 12:207-217: 1977
- 85) Edwin A. Steven et al:
Retrospective study of 25 brain abscesses diagnosed by CT scan
AJR 130; 111-114: 1978

- 86) Cornell S.H et al:
Varied CT appearances, intracranial cryptococcosis.
Radiology 143; 703; 1981
- 87) Whelan M.A; Stern Z, et al:
CT brain mycosis. Correlation with histopathology.
Radiology 141; 703; 1981
- 88) Loizon L.A Anderson; M. et al:
Intracranial tuberculoma correlation of computerized tomography with
Clinical pathological findings
Q.J. med (England) 51;104; 1982
- 89) Bhangara S. Tandon P.N et al:
Tuberculoma CT study.
BJR 53; 935-945; 1980
- 90) Price H; Danzier A. et al:
CT in cranial tuberculosis.
AJR 130; 799-771: 1978
- 91) Van Dyk. A. et al:
CT of intracranial tuberculoma with specific reference to the target sign
Neuro-Radiology 30; 496; 1988
- 92) Rudwan M.A; Khaffiji; S. et al:
CT of cerebral Hydatid diseases.
Neuro-Radiology 30; 496; 1988
- 93) Abrassioun K; Rachmat H; et al:
CT Hydatid cyst brain (ab).
Radiology 139; 533; 1981
- 94) Marvis B. et al:
CT in parenchymatous cerebral systicercosis (ab).
Radiology 139;533; 1981
- 95) Ganti S.R Steriber A. et al:
CT demonstration of giant eneunsym of vertebro-basilar system (ab)
Radiology 143; 589; 1982
- 96) Zimmerman R.A. Bilanink L.T intracerebral.
Aneunysm by CT (ab)
Radiology; 128; 849; 1978

MEDICAL LIBRARY
UNIVERSITY OF NAIROBI

- 97) Schubiger O; Valavanis A et al:
CT in cerebral aneurysm with special emphasis on giant intracranial
aneurysm (ab)
Radiology 135; 803; 1982
- 98) Evans F.C; Patrick AT; David Sobel; et al:
Radiologic characteristics of primary cerebral neuroblastoma.
Radiology 139; 101-104; 1981