

(i)

BRAIN ABSCESS

A STUDY OF BRAIN ABSCESES 1970 - 1979

by .

KAGIRI NDIRANGU, MB.ChB. (NAIROBI)

University of NAIROBI Library

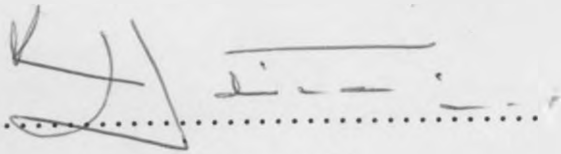


0324864 8

THESIS SUBMITTED AS PART-FULFILMENT FOR THE DEGREE OF
MASTER OF MEDICINE (SURGERY) UNIVERSITY OF NAIROBI 1980

**UNIVERSITY OF NAIROBI
LIBRARY**

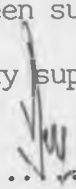
This thesis is my original study and has never been produced in any other study before.

Signed 

KAGIRI NDIRANGU

SUPERVISOR

This thesis has been submitted for examination with my approval as University supervisor.

Signed 

J. J. DAR

There is more than cancer on the brain.

Samuels L.D. 1973.

ACKNOWLEDGEMENTS

I am deeply indebted to the following who made this work possible; Dr. J. Dar, Consultant in charge, Neurosurgical Unit, Department of Surgery for the continued supervision and critical evaluation of this work. Mr. G. M. Sande, Lecturer, Department of Surgery for assisting in the choice of the subject and also in collecting the materials. Professor N. Awori, Department of Surgery for providing useful information during the several discussions over the study. Professor A. Kung'u, Department of Pathology for allowing the use of the laboratory material and facilities. Mrs. R. Kiathe of University Medical Library for helping in the collection of all the relevant references including the computer search from Britain. Mr. J. Kiriga of Kenyatta National Hospital Medical Records for providing all the necessary assistance in tracing the patients record. Mrs. Felicitas F. Karwega of the Dean's Office for typing the manuscript.

(v)

CONTENTS

	<u>Page</u>
SUMMARY	1
INTRODUCTION	2
MATERIALS AND METHODS	5
DISCUSSION	18
CONCLUSION	32
REFERENCES	34

SUMMARY

A series of 41 patients with intracranial abscess over a 10 year period (1970-79) were analysed and discussed. The incidence was 4 cases per year with a male to female ratio of 2:1. The mortality was 29.2 per cent.

The most frequent findings were headache, confusion, nausea and vomiting. Signs of visual disturbance were commonly recorded with pupillary inequality seen in 34:1 per cent. Papilloedema was relatively uncommon but meningeal irritation and pyrexia were quite common.

The value of lumbar puncture in relation to its inherent dangers is rated insignificant. Angiography is considered the most important single diagnostic method. The introduction of CAT-scan is considered long overdue.

The various causes of brain abscess are discussed. Trauma, otogenic and post-operative causes were the most common in that order. Meningitis and sinusitis were not significant causes.

The various treatment protocols are also discussed. Excision of the abscess was more commonly used and was the treatment of choice in all those cases where aspiration failed to effect a cure.

BRAIN ABSCESS

INTRODUCTION

Since the birth of neurosurgery, abscess of the brain has been recognised as a particularly lethal lesion. Even with the advent of antibiotics and the development of new surgical techniques the morbidity and mortality still remains high. Moreover, the natural history of the disease, the timing and type of surgery together with the role of adjuvants to surgery have not been clearly defined by the numerous available clinical studies.

PATHOLOGY OF BRAIN ABSCESS

Abscess of the brain may arise as direct extension of infection involving paranasal sinuses or the middle ear, or following cerebral operations or compound depressed skull fractures. It may also arise by haematogenous spread from sepsis elsewhere in the body. In a significant proportion of cases, the primary source of infection cannot be identified.

Abscesses that develop from head injuries develop immediately beneath the site of injury and those secondary to sinusitis develop in direct continuity with the infected sinus. Thus direct spread abscess commonly, but not always, possess a track communicating with the surface. Abscesses of otitic origin are usually situated in the temporal lobe or in the cerebellum, rarely they may occur in the pons, frontal or the parietal lobes. In the otitic cases, the brain becomes infected as a result of (a) purulent thrombosis of the transverse sinus or (b) osteomyelitis of the tympanic wall or (c) by spread along the adventitial spaces of perforating blood vessels. In the group of cases where the spread is haematogenous from lesions elsewhere in the body, lung is the commonest primary

site of sepsis. Blood-borne abscesses may occur at any situation but are commonly found above the tentorium. The left hemisphere is more commonly involved than the right and in most cases the abscess is superficial and lies in the area supplied by the middle cerebral artery.

Children with cyanotic heart disease have been singled out as the population with the greatest risk of developing a brain abscess. The factors which contribute to this high frequency have been identified as (a) slowed circulation with a high haematocrit producing a sludging of the blood thus causing stagnation. (b) Stagnation leads to infarction which forms a focus for (c) the growth of circulating bacteria. It has been postulated that damaged brain tissue is necessary for the abscess formation to occur and that normal brain tissue resists bacterial growth. Neurotic brain tissue from trauma or infarction seem to increase the likelihood of abscess formation when suitable pathogenic organisms are present. Staphylococcus aureus is the most common organism isolated. Other organisms include anaerobic streptococci, coliforms, pneumococci and diphtheroids.

Intracranial abscesses are usually single but may be multilocular or less commonly multiple. Their development passes through three stages. The first stage is an acute encephalitic without visible pus formation. In the second stage pus makes its appearance but the abscess is not well defined from the surrounding tissue. In the third stage, a definite wall or capsule is formed and the abscess is localized. This localization depends upon various factors among which the patients resistance against the organism is important. In some cases it does not occur and the condition remains in the encephalitic stage.

Microscopically an intracerebral abscess consists of an inner layer of pus cells outside which is a layer of granulation tissue

containing new blood vessels and hyperplastic fibrous tissue. Outside this is a layer of glial reaction mainly cellular in the early stages becoming mainly fibrous in the later stages. The middle layer contains in addition numerous fat-granule cells, plasma cells and polymorphonuclear leucocytes. Inflammatory reaction is present in the overlying meninges.

Given that a clinical setting is not ideal to permit trials of various modes of therapy, the nature and presentation of brain abscess may be either so subtle as not to be suspected or so dramatic as not to allow consideration of randomized treatment protocols. Recent studies on animal models have not proved to be of much help either due to the inherent biological and environmental differences between animals and humans.

At the present time available evidence leads to the conclusion that the incidence of brain abscesses has not decreased appreciably nor has the mortality been considerably influenced by the available methods of diagnosis and treatment. However, it is gratifying to note that with the advent of computerized axial tomography (CAT) scanning, it has become possible to objectively assess the various stages of development of an abscess and to follow the results of different types of treatment and their responses. It has also made it possible to decide on the timing of surgery and the type of surgical intervention.

The above facts hold true for developed countries from where most of the available data comes. The same may apply to the developing countries where neurosurgical units are less sophisticated and wanting in almost every respect - staff, theatre facilities and modern diagnostic equipment. To date there is no available data on brain abscess as a medical problem in Kenya despite the ideal social and environmental establishments which

favour its development.

This study was therefore planned to assess the occurrence of brain abscess in patients seen at Kenyatta National Hospital as an indicator to the problem in the Kenyan community. It was also observed that the surgical findings could not be easily correlated with the final outcome vis-avis abscess in any other organ in the body. It was not possible either to isolate the major factors responsible for this discrepancy without which it was not possible to appraise or condemn. Hence the study.

AIM OF THE STUDY

- (1) To assess the incidence of brain abscess as seen at Kenyatta National Hospital over the period 1970-1979
- (2) To evaluate the diagnostic methods and the efficacy of the various methods of treatment.
- (3) To relate the mortality with the disease variables and the management in general.
- (4) To compare the disease pattern here with those described by other workers and an attempt to identify problems peculiar to our environment and how best to overcome them.

MATERIALS AND METHODS

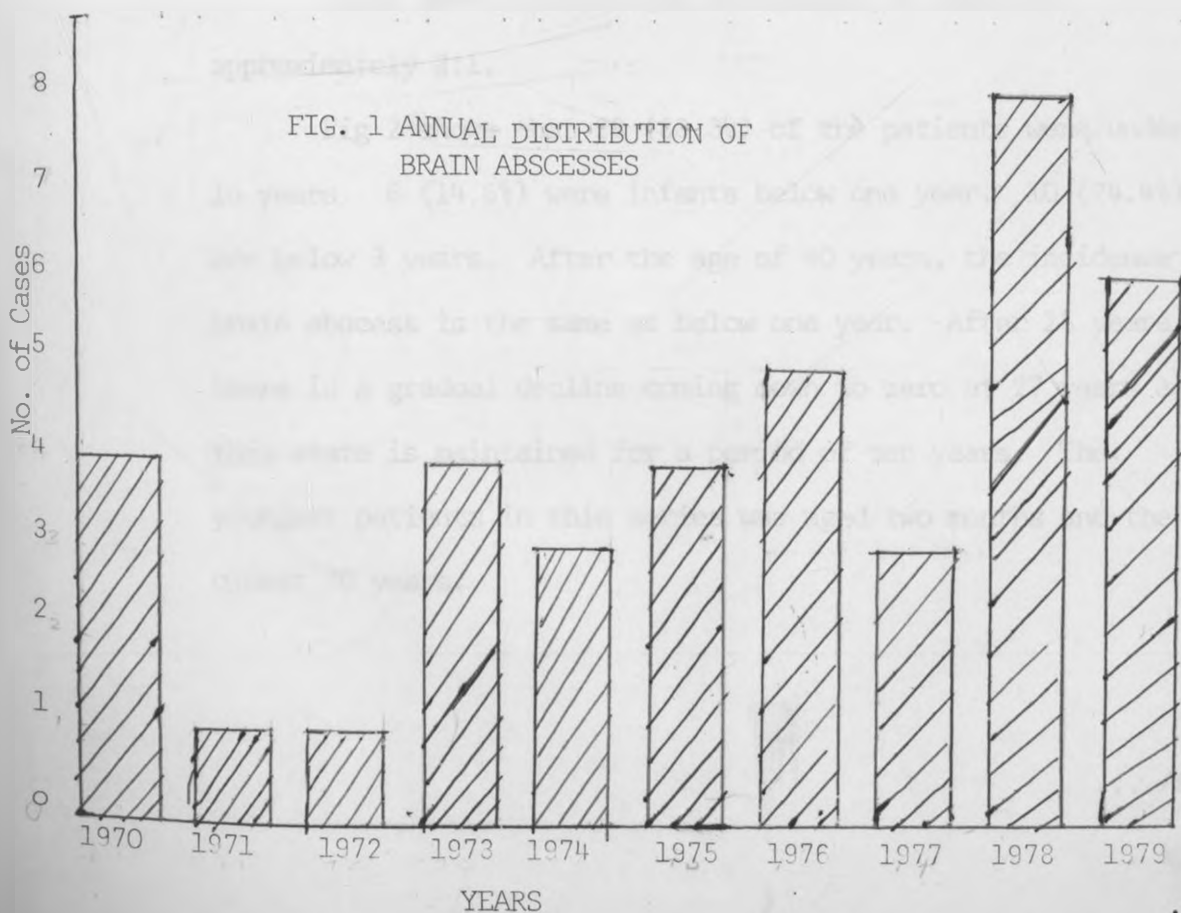
This is a ten year study (1970 - 79) of brain abscesses diagnosed and treated at Kenyatta National Hospital. This is Kenya's only referral hospital and the teaching hospital for the country's only medical school. Retrospective files of the cases studied were traced from the theatres operation record book.

A total of sixty seven files were studied. Of these forty one had adequate information suitable for analysis. Of the forty one six were studied prospectively while thirty four were retrospective. The six prospective cases were admitted between January and December 1979 and were followed up until, i)they left the hospital either through discharge after recovery ii) or were transferred to another hospital or iii) died. There were only three post mortem diagnosis and although they died before operation, all but one had correct clinical diagnosis. The subdural, epidural and post-mortem cases are excluded from this study.

OBSERVATIONS

INCIDENCE

The total number of patients was 41. An average of 4.1 cases a year were seen.



1978 and 1979 recorded the highest figures in that order while 1971 and 1972 recorded the lowest. The years 1970, 73 to 77 have a steady incidence. The distribution of the aetiological causes for the 1978 and 1979 are such that they do not explain the apparent increase for 1978. There were 3 cases of chronic suppurative otitis media; 2 of post-operative origin; 2 of unknown causes and one of depressed skull fracture. For 1979, three abscesses were caused by forked jembe injury (compound depressed fracture skull); one was a postoperative complication and two were due to chronic suppurative otitis media.

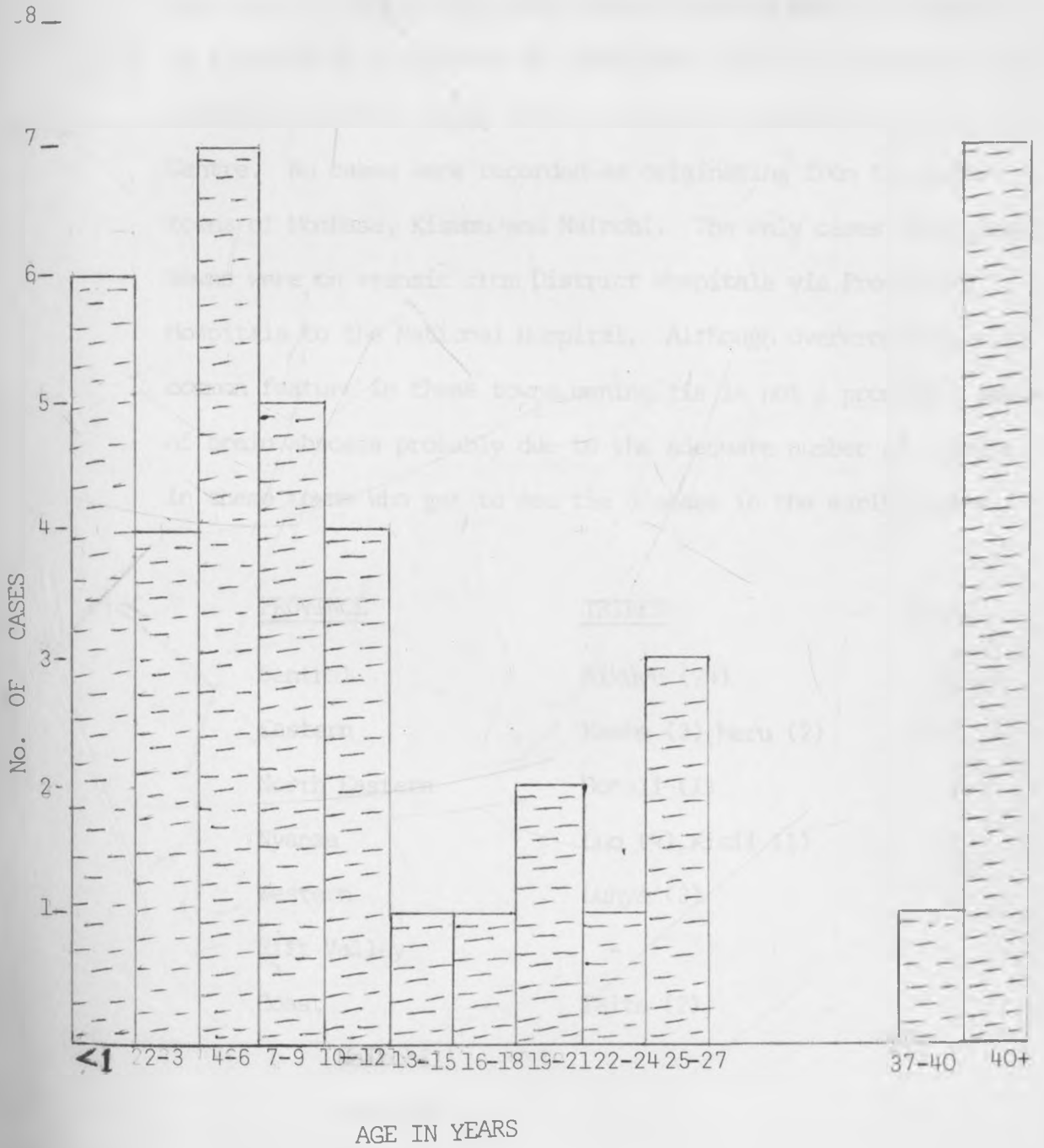
SEX AND AGE DISTRIBUTION

There were 27 males and 14 females, a ratio of approximately 2:1.

Fig 2 shows that 28 (68.3%) of the patients were under 15 years. 6 (14.6%) were infants below one year. 10 (24.4%) are below 3 years. After the age of 40 years, the incidence of brain abscess is the same as below one year. After 15 years there is a gradual decline coming down to zero at 27 years and this state is maintained for a period of ten years. The youngest patients in this series was aged two months and the oldest 70 years.

Fig. 2

AGE DISTRIBUTION OF BRAIN ABSCESSSES



GEOGRAPHICAL DISTRIBUTION

Geographical distribution does not reveal any significant features at all. In the first place Kenyatta National Hospital is situated at the centre of Kikuyuland and it is therefore quite accessible to this large tribe to whom it functions as a Health Centre. No cases were recorded as originating from the major towns of Mombasa, Kisumu and Nairobi. The only cases from these towns were on transit from District Hospitals via Provincial Hospitals to the National Hospital. Although overcrowding is a common feature in these towns, meningitis is not a prominent cause of brain abscess probably due to the adequate number of doctors in these towns who get to see the disease in the early stages.

<u>PROVINCE</u>	<u>TRIBES</u>	<u>TOTAL</u>
Central	Kikuyu (24)	24
Eastern	Kamba (3) Meru (2)	5
North Eastern	Somali (1)	1
Nyanza	Luo (4) Kisii (1)	5
Western	Luhya (3)	3
Rift Valley	-	-
Coast	Taita (2)	2
Nairobi		
Mombasa		
Kisumu		

Table I: Geographical and Racial Distribution

NB: Hospital serves only indogenous population

CLINICAL PRESENTATION

Most of the cases presented in the three main clinical types namely, acute, subacute and chronic, 17 presented in the acute form, 5 were subacute and 18 were chronic. A majority of the chronic type presented with focal signs of cerebral lesion with nothing suggestive of an infective process. These were initially diagnosed as cases of space occupying lesion.

SYMPTOMS

Headache was the commonest presenting symptom at the time of admission. A clear history of headache was obtained from 28 (68.2%) of the patients. (Table 2).

The Common Presenting Symptoms - Table II

	<u>No.</u>
1. Headache	28
2. Nausea + Vomiting	5
3. Dysphasia	3
4. Irritability	4
5. Confusion	9
6. Lethergy	4
7. Semicoma/stupor	2
8. Seizures	5

Another common presenting symptom was confusion which was noted in 9 (21.9%) patients. Nausea with or without vomiting was the third commonest presenting symptom accounting for 5 (12.2%)

Signs

Of the signs those related to visual disturbances were the most common and were recorded in 23 (56.1%) of the cases. (Table 3)

COMMON SIGNS; Table 3

1. Eye signs	(23)
Unequal pupils	14
papilloedema	3
field defects	6
ocular muscle palsy	6
2. Meningeal signs	(12)
neck rigidity	5
Kernings sign	5
Bludniski sign	2
3. Ataxia	1
4. Hemiparesis	6
5. Coma	2
6. Pyrexia	11
7. Tachycardia	2
8. Cachexia	2

Pupillary dilatation alone accounted for 34.1%. However papilloedema, visual field defects and nystagmus were relatively uncommon. Signs of meningeal irritation were also common with 29.2%. Pyrexia was the third important sign. During the first 24 hours of hospitalization 11 (26.9%) of patients had temperatures above 100°F. 47% of the patients however had a normal temperature with only 4% showing a subnormal trend. The remaining patients had swinging atypical temperatures.

AETIOLOGY OF ABSCESS

For simplicity and convenience of analysis, the aetiological factors are classified under two main groups.

A. DIRECT SPREAD

1. Post traumatic cases namely:-
 - (a) Blunt trauma to the skull with or without fractures.
 - (b) Compound depressed fractures of skull including penetrating injuries.
 - (c) Post-operative
2. Secondary to chronic suppurative otitis media.
3. Secondary to sinus disease.
4. Secondary to meningitis.

B. HAEMATOGENOUS

1. Thoracic causes e.g. pneumonia bronchiectasis. bronchitis, empyema thoracis and lung abscess.
2. Cardiac causes congenital and acquired diseases.
3. Sepsis elsewhere e.g. carbuncles erysipellas impetigo.

C. IDIOPATHIC:- where no cause was found

Based on this classification the cases were divided accordingly (Table 4).

A <u>Direct</u>	-	32
i) Compound fracture		13
ii) Otogenic		9
iii) Post-operative		7
iv) Meningitis		2
v) Sinusitis		1
B. Haematogenous from lung only		4
C. Idiopathic		5
Total		41

Compound fracture of the skull is shown to be the principle cause of direct spread brain abscess accounting for 29.2% of the total. Of these 12.2 were due to forked jembe injury who were first treated at some other hospitals before referral to Kenyatta National Hospital. Otogenic and post-operative causes are also important with 21.9% and 19.5%, respectively. Another important aetiological association is thoracic which comprises 9.8% of cases. In general direct causes are the main problem contributing more than 75% of the brain abscess treated over the ten year period.

Most of the haematogenous causes have not been identified but thoracic causes form a third of the total. Meningitis as a cause of abscess does not seem to be a major problem.

SITE:

Pariatal lobe was the commonest site for the occurrence of brain abscesses, accounting for just over 31% (13 out of 41). Table 5.

Table 5

SITE	DIRECT					HAEMATOGENOUS		TOTAL
	OTOGENIC	SINUSITIS	COMPOUND FRACTURE	POST-OPERATIVE	MENINGITIS	THORACIC	IDIOPATHIC	
FRONTAL	-	1	4	1	-	1	-	7
PARIATAL	2	-	5	2	-	2	2	13
TEMPORAL	2	-	-	-	-	-	2	4
OCCIPITAL	-	-	2	-1	-	-	-	2
CEREBELLAR	1	-	-	-	-	1	-	2
FRONTO-PARIATAL	-	-	1	2	1	-	-	4
PARIATO-OCCIPITAL	-	-	1	2	1	-	-	4
NOT SPECIFIED	4	-	-	-	-	-	1	5
TOTAL	9	1	12	8	2	4	5	41

(Table 5)- On correlating the site with the aetiology it is seen there were more abscesses in the pariatal area and not only in the group due to direct spread but also in the group due to haematogenous spread. There were no abscesses in the fronto-pariatal region resulting from haematogenous spread. The 3 cases whose site was not specified were secondary to chronic suppurative otitis media. The compounded sites like "pariato-occipital," fronto-pariatal" are an indication that it is not always easy to determine the exact site of an intracranial abscess. There were 2 cerebellar abscesses, one due to direct spread from ear disease and the other haematogenous from undisclosed site.

INVESTIGATION

The investigations carried out on these patients are tabulated in table 6.

Table 6

<u>INVESTIGATIONS CARRIED OUT</u>	
Lumbar puncture	15
Skull X-Ray	35
Arteriography	20
Ventriculography	9
Pneumoencephalography	1
Pyography	11

Haemogram:- Results were available on 25 cases and of these only 3 patients had a significantly elevated white blood cell count. 22 had counts below 10,000/cu. mm. The three cases mentioned had counts above 15,000/cu mm.

Lumber Puncture:- was carried out in 15 (35.6%) of cases. The investigation was most of the times carried out by physicians before neurosurgical consultation.

Analysis of cerebrospinal fluid (CSF) obtained at lumber puncture showed a rise in protein content in 60% of those tapped. Analysis of the white cell count showed that in all the patients whose CSF was examined there was some increase in the cell count.

Table 7: LUMBER PUNCTURE RESULTS IN 15 PATIENTS
WITH BRAIN ABSCESS

<u>LP FINDINGS</u>	<u>No. OF CASES</u>
Opening pressure less than 200	5
300	5
more than 300	5
Protein:- Less than 50	7
50-100	3
more than 100	5
White Blood Cells 0-5	6
6-100	3
more than 100	6

The increase ranged from 43 WBC/cu mm, mainly lymphocytes to 1700 WBC/cu mm. 90% of which were lymphocytes. However only two patients had counts above 1000 WBC/cu mm and these had meningitis in addition to abscess. Both the meningitis and the abscess were of otogenic aetiology.

Skull X-ray was done routinely on all patients suspected of having a brain abscess. Of the special radiological investigations carotid angiogram was most commonly done. Pneumoencephalography was performed in one patient whose abscess

RESULTS OF TREATMENT

Follow up records were available for 37 out of the forty one patients. 12 died in the post operative period, a mortality of 29.2%. 6 (14.6%) recovered completely, while 15 (36.6%) had some form of residual permanent deformity ranging from blindness to hemiparesis. Epilepsy was recorded in 4 (9.7%) patients.

Table 10: RESULTS OF TREATMENT

<u>RESULTS</u>	<u>No. OF CASES</u>
Complete recovery	6
Residual permanent deformity	15
- Hemiparesis -	13
- Blindness	2
Epilepsy	4
Death	12
Not known	4
Total	<hr/> 41 <hr/>

was difficult to locate. All the pyograms were done intra-operatively to demarcate the abscess cavity after aspiration and for subsequent assessment of the size of the cavity during the follow up period.

BACTERIOLOGY

To determine whether an abscess was pyogenic, fungal or tuberculous a combination of culturing the organism from the abscess pus and histological examination of the abscess wall was carried out. From this series, only pyogenic organisms were isolated. Of these staphylococcus were isolated more frequently (Table 8).

Table 8: ORGANISMS ISOLATED FROM ABSCESS PUS

<u>ORGANISMS</u>	<u>No. OF CASES</u>
Staphylococcus aureus	9
Proteus	3
Pseudomonas	2
Klebsiella	2
Mixed growth	2
Staphylococcus albus	1
E. Coli	1
Citrobacter	1
Pneumococci	1
No growth obtained	20
Total	41

Other organisms isolated were proteus and pseudomonas pyocaenea both of which were associated with otogenic abscesses. Two abscesses grew mixed growth. One grew S. Albus, E. Coli and citrobacter and the other grew proteus and pseudomonas.

In none of the cases was streptococcus grown. In nearly half the cases no organisms were isolated.

TREATMENT

Several types of operative procedures were used. All the patients received systemic antibiotics and those who underwent aspiration received intracavitary antibiotics.

The following operative procedures were undertaken -Table 9:

<u>OPERATION</u>	<u>NO. OF CASES</u>
Primary aspiration	11
Repeated aspiration	6
Repeated aspiration + excision	8
Primary Excision	16

Table 9- DISTRIBUTION OF OPERATIVE PROCEDURE

Primary excision was carried out in 16 patients with no recurrence while primary aspiration was successfully carried out in 11 patients. Six patients required repeated aspiration before the disease could be cured. The maximum number of aspirations done on a patient was eight. However 8 patients never settled with repeated aspiration and had to undergo excision of the abscess. In all those cases where aspiration was carried out myodil was introduced into the abscess cavity to demarcate the post-operative size of the cavity by subsequent roentgenography.

DISCUSSION

Brain abscess is not a common disease. About ten cases a year is an approximate figure for a large neurosurgical unit was suggested by Tutton in 1953. Tutton further suggested that fewer cases were occurring as a result of early administration of antibiotics and also as a result of healthy living conditions of the lower classes which provided most of the cases. However in 1977 Jefferson and Koegh pointed out that there is no convincing evidence to date indicating that the incidence of brain abscess was declining. Earlier in 1973 Beller and Morgan in different publications made contrary suggestions stating that it was in fact increasing.

The number of cases from Kenyatta National Hospital over the past ten years was 41. The average yearly incidence is 4 cases and although there is some lack of uniformity over the ten year period this is not gross except for 1978. This year has the peak incidence of 8 cases approaching the 10 cases per year suggested by Tutton. The aetiological causes of these cases do not explain the apparent hike. There were three cases secondary to chronic suppurative otitis media, two were post-operative, one was from compound depressed fracture and two from unknown cause.

From the Manchester series of Tutton the peak number of cases was 22 in 1945, out of which only two were as a result of war injuries. Oxford figures (Pennybacker 1951) also show a peak in 1945/46. Harries and Hollingworth (1953) showed that in 1945/46 there was a decline in body weight of the population which was directly related to a lowered caloric intake. Tutton suggested the documented poor nutrition resulting into poor health as a possible explanation for the increased incidence of brain abscess in

1945. To support this point Tutton argues that of the many thousands of cases with chronic suppurative otitis media only a few ever develop a cerebral abscess. If malnutrition is such an important factor for the development of brain abscess as Tutton suggests our incidence would be higher than documented as we have a high incidence of malnourished patients with chronic suppurative otitis media.

In their series from Wayne University, Gurdjian and Webster (1957) reported 22 cases of intracerebral abscess in twelve years, an incidence of approximately 2 cases per year. In 1959, Ballantine and Shealy published 83 cases over a 20 year period from 1936-1956 an incidence of approximately 4 cases per year. Similar incidence was reported by Morgan et al (1973), who reported 88 cases over 26 years. Jefferson and Koegh (1973) reported lower incidence of 49 cases in 20 years. Beller et al (1973) reported 87 cases in 30 years. Higher annual incidences of 28 cases was reported by Garfield (1969). The incidence quoted by Samson (1973) 4; De Louvois (1977) 5; Kao (1973) 3; and Carey et al (1971) 4; is in agreement with the other reported series except a few. More recently Jourbert and Stephanov (1977) reported 23 cases diagnosed in one year computerized axial tomography. The above data does not indicate that the incidence of brain abscess has changed significantly during the antibiotic era as also pointed out by Jefferson and Koegh (1977). Fluctuations in the reported incidence occur over a wide range from 2 - 23 cases per year. Nevertheless the incidence of 4 cases per year reported in this series compares well with those of other workers.

More than 75% of the patients were presented in the acute and chronic forms of the disease. In both forms, headache was the commonest presenting symptom and a clear history was obtained in (68.2%) of the cases. However in some, especially the chronic form patients presented with focal signs of cerebral lesion with little to suggest an infective aetiology. Confusion was frequently noted in all forms of the disease and was commonly associated with nausea and vomiting.

Visual disturbances were the most common signs of which pupillary dilatation was the commonest. However, visual field defects, papilloedema and nystagmus were relatively uncommon.

Jefferson and Koegh (1977) reported similar findings in their series of 49 cases of brain abscess. From 22 of these was obtained a clear history of headache, nausea and vomiting. The only difference between the two series is the frequent association of headaches, nausea and vomiting with papilloedema. Morgan et al (1973) in their series of 88 cases of brain abscess also had similar findings. They recorded 70 cases complaining of headache, 66 with alteration in the level of consciousness as evidenced by confusion or lethargy, semicomatose or stupor, coma or unresponsiveness. Here again papilloedema was uncommon and was reported in only 23 patients.

Jefferson and Koegh (1977) state that in most of their patients it was possible to suspect an intracranial abscess from the past or present history of chronic otitis media or chronic sinusitis. This fact was highlighted in all the cases with abscess from these aetiologies. Although pyrexia was the third commonest finding, its value as a diagnostic guide is highly questionable. During the first twenty four hours following admission 26.9% of the patients had temperatures above 100°F.

47% had a normal temperature and only 4 showed a subnormal trend. The rest of the patients had low grade atypical temperature. Morgan et al found 50% of their patients had a normal temperature 24 hours after admission and 44% had temperatures above 100°F. Lord Brain in his book "Diseases of the nervous system" writes "in acute cases an irregular pyrexia is the rule but in chronic cases the temperature may be intermittently raised but is often subnormal".

Cerebral abscesses are always secondary to a focus of infection in the body. Usually the focus is never identified hence the term primary brain abscess.

On aetiological basis, abscesses arise and spread by direct contiguity or from direct dissemination by blood stream. The first group by an infection from about the head are termed direct spread abscesses and the second from infection elsewhere in the body haematogenous. The haematogenous type is divided into those which arise from the chest, thoracic and those which arise from outside the chest, extrathoracic. There are differences in the pathology and prognosis of the two latter types, Tutton (1973). In chronic thoracic infections, multiple abscesses occur in about 50% of cases (Charrier and Farcedoa 1936) whilst in the extrathoracic group multiple abscesses are very rare and the focus of infection usually clear up quickly.

In this series, the direct spread group was the main cause accounting for 29.6% . Of these, compound fractures of the skull, otogenic and post operative were the main causes in that frequency. Of the compound depressed fractures subgroup forehead injury is the commonest subgroup accounting for five out of twelve cases. There was one iatrogenic case following

a ventricular tap for hydrocephalus. In the haematogenous group, thoracic causes comprise only 9.8% while the primary site was not identified in a majority of them.

Among the direct spread types, the otogenic abscesses were fairly constant in position. Two were parietal, two temporal and one cerebellar. There were four otogenic abscesses whose sites were not specified. The one 'sinusitis' abscess was classically frontal. The post-operative and other post-traumatic abscess were more randomly distributed; there were three parieto-occipital, two fronto-parietal, two parietal and one frontal.

The haematogenous abscesses can literally occur anywhere as seen in this series. Four were in parietal lobe, three in the temporal, one was parieto-occipital and one whose site was not specified.

Haematogenous abscesses commonly lodge in the parietal lobe and are rare in the subtentorial compartment. However cases occur in the pons, basal ganglia and brain stem. Classically the affected emboli are supposed to arrive via the arterial system. Batson (1940) and Collis (1945) suggested a retrograde spread via the valveless vertebral veins but proof of this is not yet available.

As described by Tutton, the direct spread types essentially spread inwards from the infected parieties and involve the adjacent cerebral matter or cerebellum. Otogenic, sinusitis and osteomyelitis abscess have an attachment to the parieties similar to a stalk or peak from where the infection travels by perivascular or intravascular pathways. Occasionally, in otogenic abscess and sometimes in temporal abscesses, the abscess has a

broad base and cases are known where intermittent spontaneous drainage to the exterior has occurred through a fistula. The primary fixation of the direct spread abscess is the pivot on which they enlarge or under treatment contract. In otogenic temporal abscess, the site of origin is the attic roof and the vessels concerned are the veins of Torltsch whose foramina can be seen in a dry skull. The abscess extends upwards in the third temporal convolution towards the temporal horn of the ventricle. In cerebellar abscess, the site of origin is usually the Trautman's triangle and the abscess commonly forms in the transverse fissure of the cerebellum. Very rarely an otogenic temporal abscess arises from abnormal cells in the root of the zygoma and is thus more anteriorly placed.

The frontal sinusitis abscesses are usually attached to the posterior walls of the frontal sinus low down and medially or more commonly to the orbital roof because the orbital extension of the frontal sinus is so often chronically infected and this is also where communicating veins from the parietal to the brain are found. In this series, compound fractures of the skull are recorded as the commonest source of primary infection and middle ear disease ranks a close second but infection of the paranasal air sinuses is not an important aetiological source. This is similar to the findings of Shaw and Russell (1975) and Jefferson and Koegh (1977) except for the fact that paranasal sinuses are shown to be still important foci of infection in these two later series.

However Martin (1973) and Wright and Grimaldi (1973) reported that both middle ear disease and paranasal sinuses were no longer important causes of brain abscess and they attributed this to the antibiotic control.

In the era before antibiotics, the commonest organisms found in brain abscesses were staphylococcus, streptococcus and pneumococcus (Schreiber, 1941; Pennybacker, 1948). This was more so in abscesses occurring as a result of middle ear disease. Shaw and Russel (1975) noted that, the middle ear disease organisms are usually gram negative bacilli and suggest that this is due to the widespread use of antibiotics in infected ear and upper respiratory tract diseases. The findings in this series show that while staphylococcus was the commonest organism isolated from brain abscess, none of the specimens grew streptococcus. However proteus and pseudomonas were isolated from three and two patients respectively who had abscesses secondary to middle ear disease. Another finding from abscesses occurring as a result of middle ear disease is culturing of mixed organisms from the same pus as was recorded in 2 cases. Pneumococci were cultured in one patient who had a thoracic form of infection. No fungi were isolated. Negative cultures were frequently found in patients who had received preoperations antibiotics. Similar findings were reported by Morgan et al (1973).

The first important consideration in the management of a brain abscess involves diagnosis and localisation of the lesion. Clinical impression may lead to the diagnosis especially in patients with a focus of infection around the head. Neurological signs and symptoms may localize the abscess.

The spinal fluid examination may reveal an increase in cells usually with a predominance of polymorphonuclear series but lymphocytes may also predominate. Protein may be increased sometimes to such a degree as to suggest a block. Sugar is not decreased in brain abscesses and normal levels are usually recorded.

Chlorides are not usually decreased either . All these findings occurred in this series in varying proportions and it is now possible to conclude that lumbar puncture provides negligible diagnostic help and it is potentially dangerous (Morgan, 1973, Samson and Clark, 1973). Jefferson and Koegh (1977) have strongly recommended that lumbar puncture should not be performed in suspected cases of brain abscess and the correct procedure of immediate referral to a neurosurgical unit should strictly /be observed. They stressed the importance of this procedure by documenting one death 48 hours after the procedure and two other deaths resulting from complications of coning.

Other diagnostic methods are recommended and are usually resorted to. These include skull X-ray, electroencephalography, ventriculography and more recently computerized axial tomography (CAT). Pyography is often used intra-operative where drainage procedures are used for treatment. In this series skull X-rays were reviewed in 35 patients having been done as a routine procedure. Arteriography was done in twenty patients and in all of them information suggestive of a space occupying lesion was obtained. In nine patients localisation of the abscess could not be done with certainty and ventriculography was done in these nine. Hence, arteriography was found to be the most reliable of the available procedures. Isotope scan and electroencephalography were not used in any of our patients. Facilities for computerized axial tomography (CAT) are not available here at present. Although arteriography is the most important single procedure in this series ventriculography was found to be a useful method in the localisation of difficult abscesses. In this series positive contrast ventriculography using Conray was performed.

Tutton (1953) recommended the use of electroencephalography to arteriography or ventriculography. Morgan et al (1973) found ventriculography superior to arteriography for localisation of abscess. Other workers have recommended isotope scan. Probably the best compromise is that suggested by Morgan of having a fixed policy and program for diagnostic procedures; start with brain scan, followed by arteriography, and finally by ventriculography. This of course is the same order of procedure as in other mass lesions of the head. When a cerebellar lesion is suspected he recommends the order to be brain scan, ventriculography and finally arteriography for obvious reasons.

The introduction of computerized tomography(CT) in surgical neurology has revolutionized the investigation of intracranial abscess. Joubert and Stephanov were able to diagnose 23 cases of brain abscess in one year with proper localization and follow up. They report that the degree of accuracy is superior to that of isotope scan, ventriculography or arteriography. By using CT scan intracranial space-occupying lesions can be demonstrated directly as a result of differences in density between these lesions and adjacent brain tissues, or they may be demonstrated indirectly through the presence of perifocal cerebral oedema or shifts in such intracranial structures as the internal and external cerebral spinal fluid spaces and physiological calcifications. Diagnosis of an intracranial brain lesion can be extremely difficult if these criteria are not fulfilled in the CT scan.

In brain abscesses ring blush appearances in the contrast enhanced CT scan is found in 86% of cases, (E Kazner et al (1978)

but it is not specific for this lesion. It has been described in gliomas (54%) and metastases (King and Ambrose 1977); Robertson et al, (1977), in infection of the brain (Yock Jr. and Marshall (1977) in haematomas Zimmerman et al (1977) and in post-operative cases (Hyman et al 1977). Other limitations in the use of CT-scan in the diagnosis of brain abscess and other intracranial space occupying lesion have been documented. For example abscesses less than 2 mm. will most likely be missed (McAllister et al 1978). Grumme et al (1978) gives the critical size as 1.5 cm. Another limitation is that accurate anatomical localization may be difficult especially the high convexity and fronto-parietal regions. The main difficulty in this respect is the lack of bony and intracranial landmarks to serve as reference points for each scan section. Logue (1977) suggested that an isotope scan is a better method of showing the relationship between the abscess and the skull topography.

Further, differential diagnosis between an abscess and glioblastoma is a difficult exercise and one will have to rely on history and other methods of diagnosis.

In conclusion, computerized tomography has opened new dimensions for the diagnosis and early treatment of brain abscesses. However during the last few years it has been realized how difficult it can be to evaluate certain CT - findings correctly, especially the group of ring - type lesions. These to which brain abscess belongs still pose some unsolved problems even if clinical information available in the individual case is considered. Therefore optimal diagnostic information from CT necessitates close attention to clinical details and often the use of other complementary neurodiological procedures.

The methodology of surgical treatment of an acute, sub-acute or chronic brain abscess is to a large extent dictated by the individual case and attempts by various authors to develop a standard policy in this regard have been frustrated by this very fact. The methods used in the current series included aspiration, antibiotic instillation and excision. In twenty five patients where aspiration was the treatment of choice, eleven resulted in complete cure, six required repeated aspiration and in eight of them cure was not effected and excision was resorted to. One patient underwent eight repeated aspirations before cure could be achieved. Sixteen patients were treated with primary excision and cure achieved. In all these cases antibiotics were used both systemically and intracavitary.

Prior to the era of antibiotics only the chronic and encapsulated abscesses were amenable to surgery and a majority were drained by the tube method. In 1928 Dandy advocated the tapping of an abscess with a wide bore needle. Dandy's idea was not at first widely accepted, until Vincent (1937) combined aspiration with a decompressive osteoplastic flap leaving the dura intact. Aspirations were repeated until the abscess was judged to have attained a thick enough capsule for it to be excised in toto. After antibiotics became available in 1947 aspiration and introduction of antibiotics was adopted by most neurosurgeons but most still regarded it as a step to the eventual excision of the abscess. Some surgeons still honour this concept and will resort to excision only in certain specific indications. The efficacy of aspiration lies on the ability to localize the abscess accurately, the choice of the correct antibiotic and x-ray visualization of the abscess cavity at all times. In this series, recurrence rate was high among the patients

treated with aspiration and some deteriorated further and excision had to be done as a last resort. In comparison to the 16 patients successfully treated with primary excision it appears that the latter should first be considered and performed whenever feasible. The justification for routine primary excision of chronic brain abscess has been that further abscesses are not missed, the risk of recurrence of infection is lessened and possibly that late epilepsy is less likely. These arguments have been refuted by Tutton (1953). Tutton further points out that excision inflicts severe damage and carries an additional mortality of about 5 per cent. He suggested the following as guidelines to excision:

- (a) Chronic post-traumatic abscesses which always have complicated cavities (usually collapsed) and a sinus on the skin.
- (b) Chronic small thickly encapsulated abscesses when first seen in whom aspiration is impracticable.
- (c) Cases with two or more known discreet abscesses.
- (d) Cerebellar abscesses which are impossible to aspirate adequately.

Jefferson and Koegh/excised all their infratentorial /1977 abscesses as a primary procedure because the small volume of the posterior fossa increased the dangers of coning. They also excised cerebral abscesses in patients who had clinical features of coning.

The evolution of surgical therapy has been thoroughly reviewed by King and Turney who came to the conclusion in 1954 that "the choice of operative attack upon most brain abscesses by most neurosurgeons is that of complete removal". Sargent in 1928 was the first to advocate total extirpation of brain abscesses. In 1946, after reviewing 142 cases Sachs concluded "excision without

drainage is the ideal procedure". In the same year Fincher recommended total excision. Jooma, Pennybacker and Tutton in 1951 found an 8 percent recurrence of abscesses treated by aspiration or drainage. They emphasized the fact that aspiration or drainage may not deal with all the loculi in multilocular abscesses and that many patients treated by aspiration will improve clinically although the abscess continues to expand.

Botteral in 1952 reported on radical excision immediate encapsulated brain abscesses. He also recommends immediate excision of a cerebellar abscess in which there is a complicating ventriculitis or meningitis. On the other hand for encapsulated supratentorial abscesses he practices repeated aspiration followed by enucleation several weeks later. He emphasizes however that in patients in coma excision should be performed if aspiration does not immediately relieve the pressure.

Later in 1957, Loeser and Scheinberg reported a review of 99 cases and concluded that the best results were obtained when the abscess was excised. In 1959 Ballantine and Shealy analysed 44 cases, of which 40 were treated surgically and they concluded that "Excision offers the best chance for cure, results in a lower morbidity and mortality, neurological deficits are lower in patients who undergo primary excision than with secondary excision. Aspiration will cure some patients but many will require other more radical surgery and some will die before other procedures will be done. There is no evidence that surgical intervention results in spread sepsis from a brain abscess if proper antibiotic treatment is used."

The question of aspiration versus excision remains unsolved in this series as with others (Jefferson and Koegh (1977), Carey et al. (1972); Morgan (1973). The difficult is to compare the

the advantages and disadvantages of various modes of management especially in a series where the number of patients is small. Suffice it to say that all brain abscesses are not alike, that they cannot all be attacked in the same manner and that one method used successfully in one type of lesion would not prove adequate for another type.

The mortality of brain abscess reported in the literature was 60% - 80% prior to antibiotics and 20% - 40% during the antibiotics era, (Ballantine HC, White JC 1953; Carey et al 1972; Garfield J., 1969, Jooma et al 1951; Kerr et al 1958; Loeser and Scheinberg 1957; McGreal 1962; Murphy Et al 1963; E. Sachs 1946; J. Pennybacker 1951).

Our mortality of 29.2% falls within the range reported by other workers during the antibiotic era, despite the fact that diagnostic aids of less sophisticated nature are used. Although the mortality figure is still high, this is probably the lowest that can so far be achieved without an improvement in these methods.

The main factors which contribute to the mortality are late diagnosis, especially in those patients who are first treated in peripheral hospitals and are received in the unit in poor pre-operative state. Other causes include associated diseases as in thoracic cases, and the site of the lesion. Tutton has indicated that although there may be a slight fall in mortality which may be associated with the use of antibiotics, it is unlikely that these will lower it below 10%. Jefferson and Koegh⁽¹⁹⁷⁷⁾ were more optimistic in their suggestion that the combination of isotope scans with the more recent computerized axial tomography(CAT) should allow an immediate reduction in mortality to 10 per cent.

Besides the high mortality the morbidity due to epilepsy, mental disorders and focal abnormalities such as aphasia, blindness, homonyms, hemianopsia, hemiplegia or hemiparesis is quite significant. Epilepsy is the most frequent complication recorded and although it was recorded in only 4 (10%) of our patients, the follow up period is probably too short to allow for a reasonable conclusion to be drawn. Seizures following surgery for abscesses as reported by other workers is 45% - 55%. Carey reported an incidence of 32%. In our series 6 (14%) patients were well enough to return to work. 15 (36%) were significantly disabled.

Carey et al (1971) had 87% of his patients with full functional ability. Garfield (1969) had 88% while Kerr (1958) had 18% significantly disabled.

CONCLUSION

The main conclusion is that brain abscess poses the same problems to us as in any other part of the world. The incidence of 4 cases per year is similar to that reported by other workers in the antibiotic era. It reflects a high degree of clinical acumen and adequate utilization of available methods of diagnosis. Of these methods arteriography was found the single most useful method.

Otogenic causes of brain abscess, though not the commonest still poses a big challenge despite the liberal use of antibiotics. Congenital cyanotic heart disease does not emerge as a significant problem. Trauma which is the commonest cause is preventable and proper health education would go along way in reducing the incidence. Worth special mention is the need for early arrival of the patient to the hospital, thorough sorting out of these patients at the accident department and proper

surgical toilet for all the uncomplicated cases. Staphylococcus is still the commonest causitive organism but fortunately it is usually sensitive to most of the available antibiotics.

The average mortality is 30 per cent a figure commonly quoted by other workers. The main factors contributing to mortality include late or failed diagnosis, site, multi-loculated cavities and resistant strains.

A fair distribution of the various treatment protocols has been adequately used. Excision method was singled out as the treatment of choice in more than $\frac{1}{3}$ of cases and also in all those difficult cases where aspiration failed to effect a cure.

REFERENCES

1. Alphen., V.H.A.: Brain abscess and subdural empyema. Factors influencing mortality.
- Journal of Neurology, Neurosurgery and Psychiatry. 39: 481-491, 1976.
2. Ballantine. (Jr), H. H., and Shealy, C.N.: The role of radical surgery in the treatment of abscesses of the brain.
- Surgery, Gynaecology and Obstetrics. 109:370-374, 1959.
3. Batson., O.B.,: Quoted by Tutton, 1953.
- Annals of Surgery. 112:138-149,1940.
4. Beller., A. J. Sahar. A. and Praiss.; Brain abscess. Review of 89 cases over a period of 30 years.
- Journal of Neurology, Neurosurgery and Psychiatry. 36; 757-768,
5. Brain's "Diseases of the Nervous System" Edited by Walton,J. N.
- Oxford medical publications. 7th Edition, 1969. pp. 380-385.
6. Carey.,M.E., Shelly., N.C. and French.,L.A.: Long term neurological residua in patients surviving brain abscess with surgery.
- Journal of Neurosurgery. 36:1-9, 1972.
7. Chakraborty.; Intracranial suppuration.
- Bulletin of Calcutta School of tropical medicine 21:17-25, 1973.
8. Crocker., E.F., Mc Laughlin and Morris., I.G.: Technetium brain scanning in the diagnosis and management of brain abscess.
- American Journal of Medicine.: 56:192-201, 1974.
9. Dandy. W.E.: The treatment of chronic abscess of brain by tapping. Preliminary note.
- Journal of American Medical Association. :87:1477,1926. Quoted by King et al, 1954).
10. Danziger., A. H., Price. and Schecter., M. M. : An analysis of 113 intracranial infections.
- Neuroradiology: 19:31-34, 1980.
11. Danziger., J.: Brain stem abscess in childhood. A case report.
- Journal of Neurosurgery: 40:391-393, 1974.
12. Fincher, E. F.; Craniotomy and total dissection as a method in the treatment of abscess of the brain.
- Annals of Surgery: 123:787, 1946. (Quoted by King et al, 1954.).
13. Franklin., G.; Cranial pneumatocoele- a clue to the diagnosis of epidural abscess.
- Archives of Neurology.; 33:372-373, 1976.
14. Garfield., J. : Management of supratentorial intracranial abscess. A review of 200 cases.
- British Medical Journal. : 2:7-11, 1969.

15. Gortvai, P., Louvois., J., and Hurley. R.; Incidence and mortality of abscesses of the cenral nervous system in England and Wales. - Results of a survey.
Advances in Neurosurgery.; 6:178-181, 1978.
16. Gurdjian., E. S., and Webster., J.E. : Experiences in the management of intracranial suppurations.
- Surgery, Gynaecology and Obstetrics. : 104:205-214, 1957.
17. Harries. J. M. and Hollingsworth, D. F. (Quoted by Tutton, 1953).
- British Medical Journal; 75-78, 1953.
18. Hienman. ,H.S.: Letter. - Lumbar puncture in brain abscess.
- Journal of Neurosurgery. ; 40:555-556, 1974.
19. Hoffman., J. H., Hendricks., B.E., and Hiscox, J.: Brain abscess.- study of 47 consecutive cases
- Journal of American Medical Association. : 33:172-177, 1970.
20. Jefferson., A.A., and Koegh., A. J. : Intracranial abscess.
A review of treated cases over 20 years.
- Quarterly **Journal of Medicine**. New Series.: 46:389-400,1977.
21. Jooma, O.V., Pennybacken,, J.B. and Tutton., G. K.: Brain Abscess; Aspiration, drainage or excision?
- Journal of Neurology, Neurosurgery and Psychiatry:
14:308, 1951.
22. Joubert., J.M.and Stephanov.S.: Computarized tomography and surgical treatment in intracranial suppuration. A report of 30 unselected cases of brain abscess and subdural empyema.
- Journal of Neurosurgery.; 47:73-78, 1977.
23. Karandanis., D.: Factors associated with mortality in brain abscess. Diagnostic difficulties reemphasised.
- Archives of Internal Medicine.: 135: 1145-1150, 1975.
24. Kerr., F.W.L., Meogher., N. J. and Robert., B. K.: Brain abscess - a study of 47 consecutive cases.
- Journal Medical Association of America: 168: 868-872, 1958.
25. King., E. J. and Turney, F.: Cerebral abscess. Evolution of methods of treatment.
- Annals of Surgery. : 139: 587-612, 1954.
26. Krayenbuhl., H.A. : Abscess of brain.
- Clinical Neurosurgery. : 14 : 25-44, 1966.
27. Levy., L. F. : Intracranial abscess. The shape of things to come.
- British Medical Journal. : 1455-1458, 1963.
28. Lewin., W. : Recent Advances in the management of brain abscess.
- British Medical Journal.: 631-634, 1955.
29. Loeser., Jr. E., and Scheinberg., L. : Brain abscess. A review of 99 cases.
- Neurology.: 7 : 601-609, 1957.

30. Martin., G. : Non-otogenic cerebral abscess.
- Neurology. Neurosurgery and Psychiatry.: 36: 607-609, 1973.
31. McGreal., D. A.: Brain abscess in children.
- Journal of Canadian Medical Association. : 86: 261-268,1962.
32. Morgan., H., Mathew., W. W. and Murphy., F. : Experiences with 88 cases of brain abscess.
- Journal of Neurosurgery.: 38:698-704, 1973.
33. Murphy., J.P. ; Fitzgerald., J. B. and Mayle., F. C. : Multiple bilateral brain abscess with recovery.
- Maryland Medical Journal. : 12: 557-560, 1963. (Quoted by Morgan et al, 1973.).
34. Pedly., T.A.: Letter; Lumbar puncture in brain abscess.
- Journal of Neurosurgery. : 39:679, 1973.
35. Pennybacker., J. : Brain abscess in relation to disease of the ear, nose and throat.
- Annals of Royal College of Surgeons of New England.: 7 : 105-127, 1950.
36. Pennybacker., J. : Abscesses of the brain. (Quoted by Morgan et al, 1973).
- Modern trends in Neurology. Ed. A. Felling. Hoeber, New York, 1951. pp. 717.
37. Price., A., and Danzinger., A. : Role of CT in the diagnosis and management of intracranial abscess.
- Clinical Neurology. : 29 : 571-577, 1978.
38. Quartey., G. R.: Decadron in the treatment of cerebral abscess - an experimental study.
- Journal of Neurosurgery. : 45: 301-310, 1976 (Quoted by Rosenblum et al, 1980).
39. Rosenblum., L. M., Hoff. , T. J., and Norman., D. : Non operative treatment of brain abscesses in selected high risk patients.
- Journal of Neurosurgery. : 52:217-225, 1980.
40. Sachs., E. : An analysis of brain abscess during the past 30 years.
- Surgery. : 123: 806, 1946 (Quoted by King et al, 1954).
41. Samson., D. S. and Clark., K. : A current review of brain abscess.
- American Journal of Medicine. : 54:201-210, 1973.
42. Sargent., P. : Remarks on drainage of brain abscess.
- British Medical Journal. : 2:971. 1928. (Quoted by King, 1954).
43. Schrieber., F.: The treatment of brain abscess by traction drainage.
- American Journal of Surgery. : 53 _ 188, 1941. (Quoted by King et al, 1954.).

44. Shapiro., S. L. : On the evolution of treatment of otogenic brain abscess.
- Eye, Ear, Nose and Throat manual. : 52 : 378-383, 1973.
45. Shaw., and Russell., . : Cerebellar abscess. Review of 47 cases.
- Journal of Neurology, Neurosurgery and Psychiatry. : 38: 429-435, 1975.
46. Tutton., G. K., : Cerebral abscess - the present position.
- Journal of Neurosurgery. : 47: 281-311, 1953.
47. Tyson., G. W., Welsh., E. J., Butler., B.A., Jare., A.J. and Winn., R., : Primary cerebellar nocardiosis. Report of two cases.
- Journal of Neurosurgery. : 51 : 403-414, 1979.
48. Vincent., C., David., M. and Kainaz., A.S. : (Quoted by Tutton, 1953).
- Journal Chir. Paris. : 49 : 1, 1937.
49. Whitener., D. R. : Tuberculous brain abscess. Report of a case and review of literature.
- Archives of Neurology. : 35 : 148-155, 1978.
50. Winn., R. H., Mendes., M. and Mose., P. : Production of brain abscess in the cat.
- Journal of Neurosurgery. : 51:685-690, 1979.
51. Wright., J. R. : Otogenic intracranial complications.
- Journal of laryngology and Otology.: 87: 1085-1086, 1973.