CLINICORADIOLOGICAL PATTERN AND EARLY SURGICAL OUTCOME OF PARASAGITTAL MENINGIOMAS AT THE KENYATTA NATIONAL HOSPITAL.

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H58/7084/2017

A THESIS SUBMITTED TO THE UNIVERSITY OF NAIROBI IN PARTIAL FULFILLMENT FOR THE AWARD OF A DEGREE IN THE MASTER OF MEDICINE IN NEUROSURGERY

MAY , 2023

STUDENT DECLARATION

I declare that this thesis is my original work and has not been presented elsewhere for consideration for publication or award of another degree.

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FUNDING AGENCY

None

LIST OF ABBREVIATIONS AND ACRONYMS

2D-2 Dimensional

3D-3 Dimensional

CBTRUS- Central Brain Tumour registry of the United States

CSF-Cerebrospinal Fluid

CT-Computer Tomography

DSA-Digital Subtraction Angiography

GTR-Gross Total Resection

KNH-Kenyatta National Hospital

MRI-Magnetic Resonance Imaging

MRA-Magnetic Resonance Angiography

MRV-Magnetic Resonance Venography

PSM-Parasagittal Meningioma

SSS-Superior Sagittal Sinus

SPSS-Statistical Package for Social Sciences

T1W-T1 Weighted

T2W-T2 Weighted

OPERATIONAL DEFINITIONS

Early surgical outcome: **-** defined as occurrence of any of the following complication events within 30 days of surgery: mortality, reduced consciousness level, suboptimal motor function, brain edema, venous infarcts and hemorrhage.

Pattern of parasagittal meningiomas – refers to demographic and clinical characteristics of patients with PSM including the age, sex, presenting complaint, duration of symptoms and operative procedure, and extent of resection

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ABSTRACT

BACKGROUND: Meningiomas account for 34.4% of all central nervous system (CNS) neoplasms in Kenya. According to the literature, parasagittal meningiomas occur between 16.8% and 25.6% of all meningiomas. Surgery of parasagittal meningiomas has always been challenging for the neurosurgeon because of the involvement of the Superior Sagittal Sinus and important bridging veins which may render curative surgical excision impossible. In addition, surgical morbidity may occur from injury to the bridging veins in areas of eloquent brain cortex and this provides a management challenge in comparison with other supratentorial meningiomas. The surgical intervention of these tumors is still debatable; there is disagreement about whether to entirely remove the tumor, which carries the danger of cerebral infarction and severe brain edema or to partially remove it, which carries the risk of tumor recurrence.Parasagittal meningioma patients' quality of life has improved thanks to the use of microsurgical techniques, which have raised the rate of total resections, decreased complications, and protected the Sinus and crucial cortical veins. This study sought to determine the clinicoradiological patterns and the relationship with early surgical outcomes of patients presenting with parasagittal meningiomas at Kenyatta National Hospital.

OBJECTIVE: To determine the clinicoradiological pattern and early surgical outcome of patients presenting with parasagittal meningiomas at Kenyatta National Hospital.

METHODOLOGY: This was a retrospective cohort study of 28 adult patients who were diagnosed with parasagittal meningioma and underwent surgical treatment for the same at the KNH from January 2013 to December 2022. Patients were recruited through consecutive sampling approach. Exposure data was collected on age, sex, presenting complaint, duration of symptoms, operative procedure performed, and extent of resection – whether complete or incomplete. Outcome data was collected on occurrence of a complication such as mortality, reduced consciousness level, suboptimal motor function, brain edema, venous infarcts and hemorrhage.

DATA ANALYSIS: Data collected was recorded in an excel sheet and then transferred for analysis in SPSS 26.0. Categorical data which included the patient's demographic and clinical data were examined and presented as frequencies and percentages for categorical data; for continuous data, it was examined and shown as means with standard deviation or as a median with an interquartile range. The relationship between clinical presentation, radiologic pattern, surgical management and their association with occurrence of surgical complication was analyzed with the use of Chi Square test of Independence. Student T test was used where the exposure data is continuous.

For multivariate analysis, to assess the independent risk factors for occurrence of complications, logistic regression was used. Results of the regression model were reported in Odds ratios and their 95% confidence intervals.

A statistical test was deemed significant if the p-value was less than 0.05.

RESULTS: There were more females at 57.1% than males at 42.9%. The mean age at presentation was 47.9 years with the youngest patient at 28 years and oldest at 66 years. Overall, most patients presented with headaches (80.8%) followed by seizures (60.7%) and weakness of limbs (55.6%).23.1% presented with visual symptoms and only 8.3% experienced personality changes. Anterior third tumours mostly presented with headaches and personality changes. Middle third tumours presented with seizures (58.3%) and weakness of limbs (53.9%). Posterior third tumours majority presented with headaches and visual symptoms and seizures. Majority of the tumours were located in the middle third (50%) followed by anterior third (32.1%) and posterior third accounted for 17.8%. Most tumours were large in size with 64.29% between 4cm-6cm and a further 25% being more than 6 cm. Simpson grade II resection was achieved in majority of the cases (82.14%). Mortality rate in this study was 3.70% with an overall morbidity of 17.3%. There was a positive correlation between the grade of sinus occlusion and the outcome (p value <0.001) with higher grades having suboptimal outcome interms of motor function

CONCLUSION: Majority of the patients presenting with parasagittal meningiomas were females as compared to males. Mean age at presentation was 47.9 years.

Overall, majority of patients presented with headaches followed with seizures and weakness of limbs. Middle third tumours were the most common followed by anterior third and posterior third tumours.

Morbidity rate was higher in patients with preoperative motor deficits, middle third tumours and total sinus occlusion.

CHAPTER ONE

1.0 INTRODUCTION

Parasagittal meningioma (PSM) refers to tumors affecting the sagittal sinus, as well as the nearby convexity dura and falx. Parasagittal meningiomas, according to Cushing and Eisenhardt, are meningiomas that completely encircle the parasagittal angle and don't have any brain tissue in between them and the superior sagittal sinus. (1).

Meningiomas accounts for 39% of brain tumors in adults, making them the most frequent intracranial tumor type (2). Parasagittal location is most common of all meningiomas at 22% (3) with various literature citations giving a range of between 16.8 and 25.6% of all meningiomas (4).

Overall, meningiomas are more common in females than males. However, for parasagittal meningiomas, there is an near even sex distribution of the tumor compared to meningiomas found elsewhere with approximately 60% of parasagittal meningiomas being seen in females (5).

Depending on where they are anatomically implanted along the Superior Sagittal Sinus (SSS), the anterior, middle, or posterior third of the SSS may be where parasagittal meningiomas attach to the dura. The anterior, middle, and posterior thirds of the SSS have incidence rates of 12.8%, 69.2%, and 17.9%, respectively, with the middle region of the superior sagittal sinus being the most frequent location. (6). Right side tumors are more common than the left at 59% vs. 33.3% respectively, and with only 7.7% having bilateral malignancies (7).

The location of the PSM lesion influences the symptomatology. Patients often present with motor or sensory seizures. Contralateral hemiparesis follows after seizures then paraesthesia, papilledema, and dementia. However, unless the mass effect produces observable symptoms, tumors originating from either the anterior or posterior third may go unnoticed for extended periods of time (8). Headaches or frontal lobe syndrome are examples of anterior third symptoms. Tumors of the posterior third might present with visual anomalies, particularly homonymous hemianopsia. Even though the tumors are very small, the mass effect that middle third tumors have on the precentral gyri, postcentral gyri, and paracentral lobule encourages earlier symptomatology and makes earlier detection easier. Frequent symptoms in anterior third tumours are headaches and mental status changes each accounting for approximately 36%. In posterior third tumours, the symptoms present are usually headaches, visual symptoms, focal seizures and mental status abnormalities accounting for 36%, 21%, 21% and 21% respectively(9). Overall, headaches are the most common symptom, followed by motor findings (38.4%) and seizures (30.1%). As many as 28.2% of patients can be asymptomatic (7). Other studies have indicated that 27% of patients have seizures, 23% have headaches, and 17% have hemiparesis (10). Motor deficits have been found in 58%, with seizures occurring at 46% (11). Ahmed et al. found 88% of patients presented with headaches, seizures were 52% and contralateral hemiparesis were 44%(12).

Both significant morbidity and mortality are linked to surgery for these tumours. Mortality during surgery is estimated to be 1.85%. Overall morbidity is 29%, with cerebral edema (8.1%) and postoperative hemorrhages among the most severe sequelae (1.9%). Marginal resection, can cause temporary venous overload and complexities in venous drainage brought on by sinus stenosis. Neurologic dysfunction is common in people with malignancies in the middle third of the SSS.(13).

In order to prevent surgical disruption or thrombosis of such veins, which could cause regional venous infarction with delayed neurologic loss, every effort should be taken to preserve the bridge veins positioned across, previous to, or posterior to the tumor. Damage to the cortical veins that drain to the SSS or interruption of the SSS are frequent causes of these problems. (14).

According to a series by Colli and colleagues, 7.8% of individuals with middle third tumors experience neurological decline. Recurrence is more likely in males, grade II/III tumors, incomplete resections, and lesions with a larger penetration of the SSS (5). Those who had neurological deficits before to surgery in a series of 46 patients by Black et al. experienced a 56% full recovery and a 5.5% new deficit. (7). Other complications of surgery can include paresis and decline in the level of consciousness. Intracerebral hemorrhage, brain edema, the postoperative decline in motor function and post operative seizures have been reported. Preoperative paresis tends to increase the risk of post operative decline in motor function (15,16). Poor postoperative results for motor function are assumed to be mostly caused by cortical injuries, contusions, venous infarction, and venous system injury with subsequent cerebral edema (17,18).

The central sulcus vein was protected, and use of microsurgical techniques prevented their patients' post-operative motor weakness.(19).

The position of the tumor along the SSS affects both the clinical picture of parasagittal meningiomas and the attitude toward ligation and sinus reconstruction. Resecting an occluded sinus segment or leaving a tumor remnant that has invaded the SSS are two contentious issues in the medical treatment of parasagittal meningiomas.. The application of microsurgical techniques and preservation of the venous system is greatly emphasized in reducing complications and improving the patient’s quality of life.

In this study, we therefore intended to identify the clinical presentation, radiologic patterns, and extent of resection of the parasagittal meningiomas at Kenyatta National Hospital, and relate these to the early surgical outcomes.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Historical perspective

The earliest case of meningioma was documented by Swiss anatomist and physician Felix Platter in 1614. He characterized the tumor as an acorn-shaped, round fleshy mass the size of a medium-sized apple (20).

Antoine Louis, a renowned French military surgeon in 1774 published about fungoid tumors of the dura (21). The first person to record the existence of granules in these tumors was Virchow in 1863, who gave them the name "psammoma bodies.” According to Al-Rodhan et al., meningiomas were initially identified in the 18th and 19th centuries if they resulted in anomalies in the overlying skull that could be seen and felt (22)

John Cleland, a professor of anatomy at Glasgow University, discovered two tumors in the dissecting room in 1864. These tumors may have originated from the arachnoid rather than the dura. Both tumors were shown to have their origins in the right frontal region, close to the superior sagittal sinus, and the cribriform plate of the ethmoid, respectively. In 1915, Cushing and Weed reaffirmed Clelands' hypothesis that meningiomas developed from clusters of arachnoid cells. (23).

Parasagittal meningiomas, according to Cushing and Eisenhardt, are meningiomas that completely encircle the parasagittal angle and don't have any brain tissue in between them and the superior sagittal sinus. One, two, or all of the SSS walls may be affected by these tumors, which may or may not entirely obstruct flow (1).

2.2 Epidemiology

Meningiomas are the most frequent intracranial tumor, accounting for 39 percent of adult brain tumors, according to the most recent data from the Central Brain Tumor Registry of the United States. (2).

Locally, a study by Mwang'ombe et al. on Brain Tumours at Kenyatta National Hospital, showed the incidence of meningiomas to be 34.4%(24). A follow-up study by Wahome et al. on Patterns of brain tumors in Kenyatta National Hospital showed meningiomas were the most common tumor at 41% (25).

Cushing and Eisenhardt found that the parasagittal position accounts for 22 percent of all meningiomas in their examination of 295 cases (26). The incidence of parasagittal meningiomas, according to the literature, ranges from 16.8 to 25.6 percent of all meningiomas (1).

The bulk of tumors are diagnosed in females, however parasagittal meningiomas have a more evenly distributed gender distribution than meningiomas found elsewhere. In contrast to the 80% of cranial base, 70% of all supratentorial, and 90% of spinal meningiomas that are found in females, around 60% of parasagittal meningiomas are seen in females (5).

Olivecrona divided parasagittal meningiomas into different groups based on where they anatomically inserted along the SSS. Aware of the distinct effects of sinus blockage in each region, he separated the superior sagittal sinus into the anterior, middle, and posterior thirds. The middle portion is where parasagittal meningiomas most usually have a dural connection. Only 9% to 29.6% of parasagittal tumors are found along the posterior third of the SSS, while 15–34% of parasagittal meningiomas are found along the first third of the SSS (26).

In a clinical study by Black and colleagues, tumors were found to affect the anterior, middle, and posterior thirds of the SSS in 12.8 percent, 69.2 percent, and 17.9 percent of cases, respectively. In this cohort, right side tumours were more common (59% vs. 33.3%), and only 7.7% of individuals had bilateral tumours. (7).

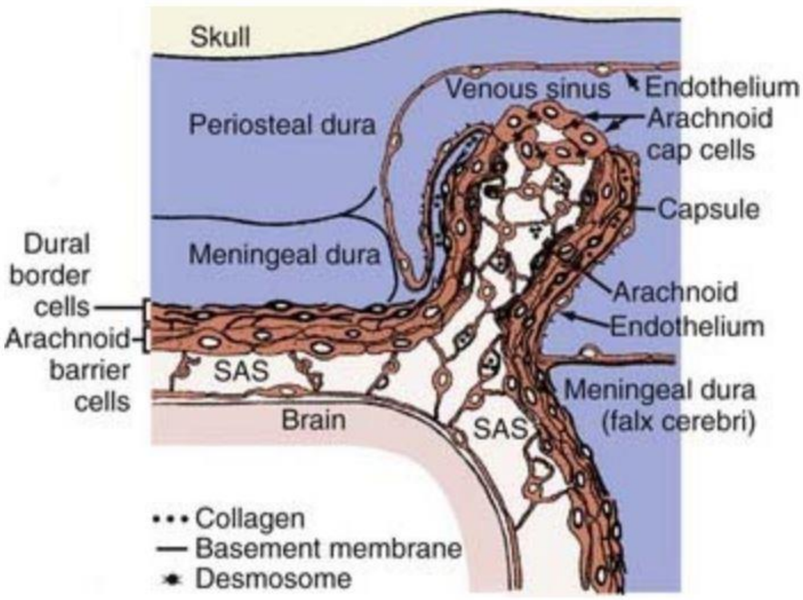
According to Kang et al., middle third parasagittal meningiomas range from 37 to 70%, anterior third meningiomas range from 15 to 42%, and posterior third meningiomas range from 9 to 16% (27).

Petterson et al reported an incidence of 49% for middle third parasagittal meningiomas,37% for the anterior third, and 14 % for the posterior third(28). This was almost similar to Caroli and colleagues who reported 56% of middle third parasagittal meningiomas,41% for the anterior third, and 14% of anterior third parasagittal meningiomas(11).

2.3 Pathology

The arachnoid cap cell is thought to be the cell that gives rise to meningiomas. The venous sinuses are invaded by the arachnoid villi. The arachnoid villi in their entirety or in part are in touch with the venous endothelium. There is a fibrous capsule covering the remaining granulation. The superior sagittal sinus region has the highest density of arachnoid villi, which is followed by the, cavernous sinus, lamina cribrosa, tuberculum sellae, and foramen magnum. Pacchionian bodies and arachnoid granulations are enlarged and more noticeable variants of arachnoid villi.

(Fig 1)



(*From Haines DE, Frederickson RG. The meninges. In: Al-Mefty O, ed. Meningiomas. New York: Raven Press; 1991:9*(29))

Arachnoid granulations are denser in areas where parasagittal meningiomas frequently develop, and about 15% of tumors exhibit invasion of the SSS (30).

2.4 Clinical Presentation

The location of the lesion in relation to the central sulcus is mostly responsible for the symptomatology. Patients often present with motor or sensory seizures, as Cushing had demonstrated in his account of General Leonard Woods's case. Contralateral hemiparesis follows after seizures then paraesthesia, papilledema, and dementia (31).

However, unless the mass effect produces observable symptoms, tumors originating from either the anterior or posterior third may go unnoticed for extended periods of time. Frontal lobe syndrome or headaches are symptoms in the anterior third. Visual abnormalities, particularly homonymous hemianopsia, can be a symptom of posterior third tumors. Even though the tumors are very small, the mass effect that middle third tumors have on the precentral gyri, postcentral gyri, and paracentral lobule leads to earlier symptomatology and makes earlier detection easier. (18).

In an array of 154 parasagittal meningiomas, the frequent symptoms in anterior third tumours were headaches and mental status changes each accounting for 36%. In posterior third tumours, the symptoms present were headaches, visual symptoms, focal seizures and mental status abnormalities accounting for 36%, 21%, 21% and 21% respectively(9).

In a research by Black et al. on coupled convexity and parasagittal meningiomas, seizures (30.1%) and motor findings (38.4%) were the most frequent symptoms. Of the patients, 28.2% had no symptoms. (7).

According to Gatterbaeur et al., 27% of patients had seizures, 23% had headaches, and 17% had hemiparesis (10). 58% of people had motor deficits, and 46% had seizures, according to Caroli et al. (11). Ahmed et al. found 88% of patients presented with headaches, seizures were 52% and contralateral hemiparesis were 44%(12).

Fig 2

	Location along the Superior Sagittal Sinus			
	Anterior Third (50 cases)	Middle Third (89 cases)	Posterior Third (14 cases)	Total (153 cases)
Focal seizures	1 (2%)	29 (33%)	3 (21%)	33 (22%)
Generalized seizures	13 (26%)	10 (11%)	-	23 (15%)
Headache	18 (36%)	9 (10%)	5 (36%)	32 (21%)
Confusion/cognitive decline	18 (36%)	6 (7%)	3 (21%)	27 (18%)
Monoparesis (leg)	2 (4%)	23 (26%)	-	25 (16%)
Hemiparesis	-	6 (7%)	2 (14%)	8 (5%)
Monoparesis (arm)	1 (2%)	1 (1%)	-	2 (1%)
Visual symptoms	1 (2%)	4 (5%)	3 (21%)	8 (5%)
Calvarial deformity	6 (12%)	2 (2%)	-	8 (5%)
Dysphasia	-	4 (4%)	-	4 (3%)
Stroke	-	2 (2%)	-	2 (1%)
Vertigo	-	1 (1%)	-	1 (1%)
Other symptoms	7 (14%)	11 (12%)	3 (21%)	21 (14%)

Adapted from Gauthier-Smith (9)

2.5 Anatomical considerations

The SSS exhibits a basic triangle form in cross-section that slowly enlarges as it approaches the posterior third (32). The SSS attaches laterally to intradural venous lacunae on the dura mater on either side, which are frequently accompanied by arachnoid granulations. These are the subarachnoid space invaginations that resemble mushrooms and protrude into the sinuses, allowing CSF to flow there. The villi are known as Pacchioni's granulations when they are quite large and can be seen with the unaided eye. These granulations can occasionally be seen on magnetic resonance imaging as a filling defect or a mass inside a significant dural sinus. The majority of cerebral venous drainage occurs in each hemisphere through eight to twelve exterior medial cortical veins and a similar number of internal cortical veins. (26).

According to angiographic studies on 100 patients by Apuzzo et al., the majority of parasagittal veins (70%) connect to the SSS in a region of the sinus between the coronal suture and 2 cm behind it (33). Venous tributaries reached the sinus in 53 of the 100 SSS that Yamamoto and associates angiographically assessed, and in 76 percent of those cases, they did so within 2 cm of the coronal suture. (34).

The anterior half of the SSS is easier to surgically explore because it is narrower, contains fewer related pacchionian bodies, venous lacunae, and contiguous cortical veins entering the sinus than the posterior half.

In 242 parasagittal meningioma cases, Tigliev et al. looked into the collateral venous blood flow. According to this study, collateral drainage through cortical veins was present in 67 percent of cases of middle or posterior third tumors but only in 52.1% of cases of anterior third tumors, which had collateral blood flow through them. Regardless of where along the sinus the collateral blood flow occurred, 56% of individuals had extracerebral veins (35).

According to Oka et al., the superficial cerebral veins can be divided into four groups. The tentorial group drains into the lateral or transverse tentorial sinus,the sphenoid group, which drains into the sphenoparietal or cavernous sinus, the falcine group, which drains into the inferior sagittal sinus and the superior sagittal group empties into the SSS. Collateral routes between the superior sagittal group and the sphenoidal group, the superior sagittal group and the tentorial group, and the superior sagittal group and the falcine group were generated by end-to-end anastomoses of the superficial cortical veins. (36).

The findings of these investigations demonstrate that sacrifice of the middle third of the SSS considerably modifies venous return while removal of the anterior third of the sinus generally has minimal effect on the entire hemisphere's venous drainage. However, compromised conduit thickness and the cortical region that it drains through, closely correlate with the genuine consequence of these modifications. When venous systems in the posterior third are disrupted, venous drainage is less constrained than when structures in the middle third are sacrificed (32,37).

2.6 Classifications

An eight-subtype surgical classification scheme for parasagittal meningiomas was introduced by Bonnal and Brotchi in 1978. This categorization has now been revised and now includes five tumor categories to aid resection approaches (38). Type I lesions only adhere to the external aspect of sinus wall. Type II lesions enter through the lateral recess of the SSS. Type III lesions penetrate the one wall of the SSS. While type IV cancers have already entered two sinus walls, their patency is unaffected, type V tumors extend beyond the midline and infiltrate all of the sinus walls, resulting in full occlusion.

Fig 3

Type I	Tumor is attached to the outer surface of the sinus
Type II	Tumor enters the lateral recess of the SSS
Type III	Tumor invades one wall of the SSS
Type IV	Tumor invades two walls of a still patent sinus
Type V	Tumor spreads over the midline, invades the three walls, and occludes the SSS

Adapted from Hancq et al(30)

Similar classifications from Sindou and Alvernia have been presented, based on six categories, to help with preoperative planning and surgical decision-making. Type I lesions have an exterior surface connection to the sinus wall but no wall rupture or intrasinusal invasion. Lesions classified as type II have a tumor that invades the lateral recess but not the lateral wall. The ipsilateral sinus wall has been invaded by type III lesions.Type IV lesions have infiltrated both the SSS's lateral wall and roof. Types V and VI, depending on whether one free wall is present, represent a total sinus occlusion (19).

Fig 4

Type I	Tumor attaches to the outer surface of the sinus wall
Type II	Tumor fragment inside the lateral recess
Type III	Tumor invades the ipsilateral wall
Type IV	Tumor invades the lateral wall and roof
Type V	Complete sinus occlusion with one free wall
Type VI	Complete sinus occlusion without any free walls

From Sindou and Alvernia(19)

2.7 Diagnostic evaluation

2.7.1 Computed tomography

The use of computed tomography (CT) is highly helpful for planning the craniotomy flap when either hyperostotic or lytic calvarial alterations are anticipated. Using CT data, accurate prosthetic implants for cranioplasty can be created when a tumor has penetrated the bone flap(30). The tumour would be isodense or hyperdense to gray matter with contrast uptake on contrast-enhanced CT scan.

2.7.2 MRI/MRA/MRV

The preferred test for evaluating parasagittal meningiomas is MRI, both with and without contrast. A tumor's size, consistency, relationship to the surrounding cerebral cortex, meninges, falx, and vascular structures are all shown by an MRI. MRA and contrast-enhanced MRI are currently accepted as the gold standard in most facilities (30). In T1W pictures, meningiomas are frequently isointense (60–65 percent) or slightly hypointense (30–35 percent), whereas in T2W and proton density imaging, they are isointense (50–60 percent), hyperintense (40–40 percent), and hypointense (10 percent). Compared to CT brain scans, T2W pictures are significantly more effective at displaying the peritumoral edemas. The accurate, noninvasive view of the arterial and venous architecture provided by MRA makes it easier to analyze sinus invasion and patency as well as to see the patterns of collateral venous drainage that form after sinus closure. Due to its noninvasiveness and capacity to identify multidirectional flow, MRA has several advantages over DSA. Three-dimensional (3-D) phase contrast sequences can provide more accurate information on the anatomy of the cerebral venous system than two-dimensional (2-D) phase contrast imaging can, according to research (30). In one study, MRV was utilized to add preoperative information on venous infiltration by detecting up to 87 percent of the collateral venous anastomoses generated by parasagittal meningiomas. (39).

The flow direction in a particular vascular system can also be determined using further image restoration techniques from 2-D and 3-D images. When compared to digital subtraction angiography (DSA), the MRA data might occasionally fall short, especially when it comes to verifying sinus patency and visualizing the tumor's arterial supply in cases of severe obstruction where sinus flow is sparse and slow. Therefore, in situations requiring clarity or where embolization may occur, both therapies are utilized in a complementary manner.

2.7.3 Digital Subtraction Angiography

Meningiomas more than 5 cm in diameter can benefit from preemptive surgical devascularization by selective embolization by identifying the arterial branches that feed the tumor, which may come from the anterior or middle cerebral arteries(7). DSA is an invasive diagnostic technique with variable morbidity risks that can vary considerably between healthcare providers and treatment settings, hence many surgeons rarely advocate its use unless preoperative embolization is being taken into consideration.

2.8 Management outline

Careful history-taking and clinical observations should be part of the patient's initial examination. MRI brain scans are frequently the only radiographic tests required for patients. When specific bone information is required, a CT brain is obtained. Angiography is utilized when embolization is a possibility and when more information is required about a patient arterial and venous systems.MR Angiogram, MR Venogram, and MRI are all used. Surgery, radiation therapy, surgery and radiotherapy combined, and observation by conventional clinical and MRI examination are some of the potential treatment options. The patient's expectations, together with any potential risks and long- and short-term advantages, should be taken into consideration while choosing the course of therapy.

Numerous patients' deteriorating neurological condition, radiographic proof of a surgically treatable tumor, and the conclusion that this course of therapy is feasible with acceptable risk all lead to the necessity of surgery. The management option, however, may prove challenging in some patients due to minimal or nonprogressive symptoms, an indolent nature, a history of some meningiomas, risks associated with the treatment due to the location, the development of new radio-surgical treatments, the long-term effects of which many are still unknown, and incidental discovery of asymptomatic lesions.

The excision of the meningioma, together with the affected dura and bone, is the surgery's main goal. The single most crucial prognostic factor is how completely the tumor was surgically removed. Surgical judgment, which takes into account that the priority is to maintain and enhance the functionality, must constantly be used to moderate this goal.

In some patients where complete excision of the meningiomas poses a high risk of morbidity, it is safe to retain portion of the tumor and to monitor the patient with clinical assessments and MRI scans, do another surgery later, or administer radiation therapy as necessary. According to Black and colleagues, the advantages of radical excision and grafting have also been questioned in light of the long-term recurrence of sinus-invading malignancies seen by multiple high-volume institutions. (7).

Hancq and colleagues advise leaving the intrasinusal tumor alone and undertaking yearly MRI/MRA follow-up with adjuvant radiosurgery if tumor progression is discovered for tumors infiltrating a sinus that is largely patent. (40). They only remove intrasinusal tumors from lesions where the sinuses have been entirely destroyed and where venous drainage has been gradually restored over time by strong collateral flow. The authors have shared this therapy protocol, which is still being used by multiple centers (14,41).
The status of the superior sagittal sinus is assessed using MRI brain. MR or conventional angiography can be used to map the connections between the cortical veins and the superior sagittal sinus. The decision of how to treat the superior sagittal sinus after surgery depends on this information. Preoperative management includes steroid administration, surgical setup, flap marking, preoperative assessment for surgical removal, and additional follow-up and care.

2.8.1 Surgical management of Parasagittal meningiomas

The location of the tumor largely dictates how the patient will be positioned during surgical treatment. The patient is positioned so that the highest point on his or her body is the scalp above the meningioma's epicenter. For meningiomas anterior to the coronal suture, the patient is lying on his or her back with the head slightly lifted. A bicoronal incision is used. For the tumor at the coronal and in the middle third of the superior sagittal sinus, the patient is lying supine with the head raised. The scalp above the core of the meningioma should be the highest position. With the anterior limb near the hairline and the posterior limb far beyond the meningiomas, a U-shaped incision 2 cm across the midline is used. The skin flap may be turned forward rather than laterally for some tumors near the coronal suture. The patient is positioned in the lateral position, the head is elevated, and the head is tilted to the side such that the tumor's center is the topmost point. This is done in the posterior one-third location. Typically, a U-shaped incision is made. The skin is carefully lifted together with the underlying tissue, including the pericranial tissue. When planning the incision and elevation of the scalp flap, prominent scalp and diploic veins must be taken into account since they may generate brisk bleeding and early obliteration of this collateral flow may result in severe cerebral edema. The superior sagittal sinus and the bone flap's side on either side of the base are both where the burr holes are situated. Additional burr holes may be made near the tumor if there is bone involvement, and the bone flap may occasionally be rotated around a portion of the tumour's attachment to the bone. Coagulation is used to limit bleeding from the meningeal arteries while the bone is raised, and gelfoam or surgicel is used to reduce bleeding from the superior sagittal sinus. Since the dura is opened anterior to the tumor, this is the most common way to view or feel the parasagittal tumor. The surgeon next makes a circumferential incision that bends laterally and posteriorly around the tumor, staying at least 1 cm away from any implicated dura. Particular care is taken when treating the central third tumor to avert harm to the cortical veins. The tumor is still connected to the dura (40).

The dura is then cut on the opposite side if the sinus is going to be resected, and the sinus is then tied anteriorly and laterally to the tumor. In some instances, the falx is now divided inferior to the tumor. The SSS should be ligated in anterior third meningiomas even when it is still patent. Since the cerebral venous infarction that would likely occur in the sensory-motor cortex prevents the sinus from being safely excised in middle or posterior third tumors when it is patent, only a subtotal excision may be advised(30).

In many people, the tumor only affects the lateral or edge of the sinus, which can be surgically removed. The dura is initially sliced parallel to the sinus when the sinus is not going to be excised, leaving a little plaque of tumor attached. After the tumor has been removed, the surgeon returns to take care of the affected sinus. The tumor is decompressed inside. Gradually, the tumor's capsule is reflected into the decompression zone. The tumor is separated as the arachnoidal, pial attachments are gradually divided circumferentially. The surgeon applies traction to the tumor while avoiding retraction of the brain tissue as much as feasible. The surgeon must take into account the anterior cerebral artery branches that may be connected to the deep surfaces of a big tumor. All bridging veins must be carefully preserved, and most writers advise against sacrificing a vein when a tumor has entered it and cannot be effectively removed with gentle dissection. This is particularly true where hypertrophic veins often enter the sinus at the tumor's anterior and posterior margins. To prevent a fatal venous hemorrhagic stroke in the eloquent cortex, the surgeon must be ready for a venous repair should critical venous structures (such as the rolandic veins) be damaged during dissection. After the tumor crushing the brain has been removed and lined with surgicell, the dural defect is repaired with a graft of pericranial tissue from the scalp flap, fascia lata, or a dural substitute. If there is significant tumor-induced hyperostosis, the bone flap should be replaced with a cranioplasty using methylmethacrylate, titanium mesh, or another reconstructive material.

2.8.2 Extent of surgical resection

Simpsons grading, which is used to gauge the extent of resection during meningioma surgery, has a significant impact on tumor recurrence. For grades I–IV resections in his initial series, the recurrence rates at 10 years were 9%, 19%, 29%, and 44%. (4,42,43). Since parasagittal and falcine meningiomas have greater rates of recurrence, complete excision of these meningiomas is not always possible(5,14).

Table 1

Grade I	Complete macroscopic removal of tumor and dural attachment with any abnormal bone
Grade II	Complete macroscopic removal of tumor with diathermy coagulation of its dural attachment
Grade III	Complete macroscopic removal of intradural tumor without resection or coagulation of its dural attachment or of any extradural extensions
Grade IV	Partial removal leaving intradural tumor in site
Grade V	Simply decompression with or without biopsy

Adapted from surgical considerations on skull base meningiomas(44)

Kobayashi and colleagues later modified the Simpson grading to come up with the Modified Kobayashi and Okudera grading that instead looked at the extent of resection at the microscopic level(44)

Table2

Grade I	Complete *microscopic* removal of tumor and dural attachment with any abnormal bone
Grade II	Complete *microscopic* removal of tumor with diathermy coagulation of its dural attachment
Grade III	Complete *microscopic* removal of intradural tumor without resection or coagulation of its dural attachment or of any extradural extensions
Grade IVA	*Intentional subtotal removal to preserve cranial nerves and/or blood vessels with complete microscopic removal of attachment*
Grade IVB	Partial removal leaving tumor less than 10% in volume
Grade V	*Partial removal leaving tumor more than 10% or decompression with or without biopsy*

Adapted from surgical considerations on skull base meningiomas(44)

2.9 Surgical outcome

Parasagittal meningioma excision causes substantial morbidity. DiMeco and associates examined 108 patients who had parasagittal meningiomas in a retrospective review. Study shows 37% of patients had Grade 1 Simpson resections, while 31% had Grade 2 resections. Grade 1 was attained in 23 of the 30 patients with total sinus obliteration, grade 2 in three, and grade 4 in four individuals. Mortality during surgery was 1.85%. Overall morbidity was 29%, with cerebral edema (8.1%) and postoperative hemorrhages among the most severe sequelae (1.9%).
According to the author's theory, transitory venous overload and complications with venous drainage brought on by sinus stenosis caused this impairment in the event of marginal resection.. Neurologic impairment was a common symptom in patients with tumors in the middle third of the SSS.

Every effort should be made to preserve the bridge veins located across, anterior to, or posterior to the tumor in order to avoid surgical disruption or thrombosis of such veins, which could result in regional venous infarction with delayed neurologic loss. These issues are often brought on by damage to the cortical veins that drain to the SSS or interruption of the SSS (14).

7.8% of patients with middle third tumours deteriorated neurologically in a series by Colli and colleagues. Males, grade II/III tumors, partial resections, and lesions with a higher penetration of the SSS were more likely to have recurrence (5).

In a series by Black et al of 46 patients, those who had neurological deficits before to surgery, 56% had full recovery and 5.5% had a new deficit (7).

In sixteen surgical cases of parasagittal and falx meningiomas by Oyama et al. In 11 cases, paresis and level of consciousness both declined right after surgery. When patients displayed preoperative paresis, motor function further declined after surgery. In one case, an intracerebral hemorrhage, and in another, freshly acquired brain edema, the postoperative decline in motor function and/or consciousness level was due to these conditions. In the other 9 cases, the symptomatic aggravation lacked a clear cause. In comparison to their preoperative status, motor function was worse in 5 cases upon discharge, whereas it was better in 3 cases. Five patients exhibited improvement after discharge, while eleven cases showed no change in consciousness from the preoperative state. Although the surgical outcome was generally poor for motor function, it was good for consciousness. Preoperative paresis patients were thought to require cautious surgery, with the surgeon accurately dissecting the arachnoid plane under a microscope to protect the arachnoid membrane (16).

Negm et al. performed a prospective analysis between 2011 and 2013 on 20 patients who underwent surgical treatment for parasagittal meningiomas. In the initial postoperative stage, 3 patients (15%) experienced temporary neurologic impairment. The motor function of the already paretic contralateral limb deteriorated in two patients with middle-third tumours. A review of their medical states three months following surgery revealed improvement. After surgery, one patient with an anterior third lesion experienced frontal symptoms; nonetheless, the patient later made a full recovery without experiencing any serious aftereffects. Flail foot, which developed in a female patient with a middle third lesion as a result of cortical lacerations received during surgery, was the sole persistent abnormality in our cohort. Even after appropriate postoperative physiotherapy, she did not get better. Additionally, postoperative seizures occurred in two individuals (10% of patients) with anterior and middle third tumors which both responded favorably to parenteral phenytoin reloading. 10% of patients had medical issues; one had a temporary chest infection and another had deep venous thrombosis.(15).

Numerous writers have noted subpar outcomes in the early postoperative period when it comes to motor function. In their study, Akira et al., found that 8 out of 16 patients experienced a decline in motor function in the early postoperative period. Six of these patients displayed hemiparesis, five had total hemiplegia, and two displayed monoparesis of the lower limb(16). According to Jian et al., 56% of their patients who had motor impairments before surgery experienced worsening motor function in the initial postoperative phase (9 patients out of 16)(45).

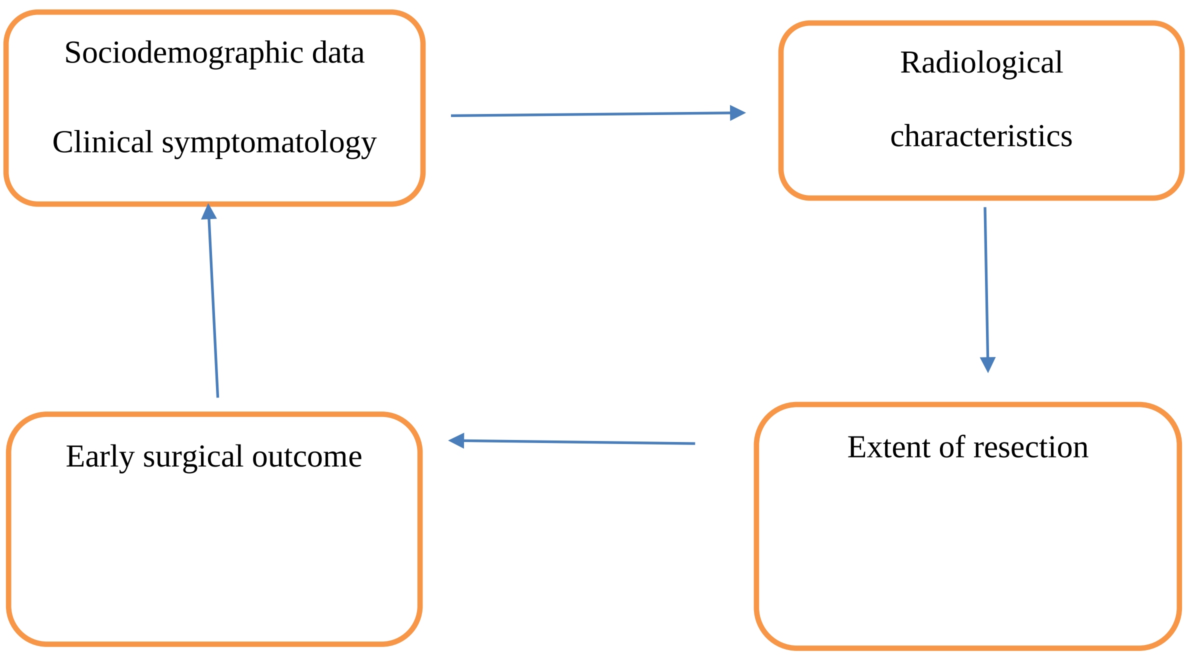
Cortical injuries, contusions, venous infarction, and venous system injury with subsequent cerebral edema are thought to be the primary causes of poor post-operative outcomes for motor function (17,18). However, post-operative radiological tests frequently fail to find any pathology (1). Akira et al. observed that radiological investigations were positive in 2 cases out of their series, which included 8 patients out of 16 who experienced a decline in motor function during the early postoperative period (16).

According to Sindou et al., using some microsurgical procedures and safeguarding the central sulcus vein from damage prevented their patients from experiencing post-operative motor weakness (19)

2.9.1 Duration of early surgical outcome

Various studies looking into the occurrence of the surgical outcomes give the duration of outcomes as 30 days post operative period. According to Corell and colleagues, 2019, the 30 day incidence of mortality was 1.5%. (46,47).

2.10 Conceptual framework



2.11 The statement of the problem.

Clinical patterns, imaging findings, and early surgical outcomes regarding parasagittal meningiomas have not been documented.

Whereas substantial literature exists in the Kenyan context on meningiomas in general, especially on the patterns of presentation, radiological patterns and surgical outcomes, there are no studies that have looked into the parasagittal meningioma. These specific group of meningiomas present a challenging management dilemma owing to their location in close proximity to the superior sagittal sinus. Their extensive resection is associated with significant morbidity yet they are prone to suboptimal resection which increases the risk of recurrence.

2.12 Study justification

There is minimal data on the surgical extent of resection and outcomes of parasagittal meningiomas. Understanding the extent of resection and the outcomes would help improve the surgical care of patients presenting with the condition. Due to limitations in equipment, resources and skills, neurosurgical surgeons in many hospitals practice excessive caution in resecting such tumors which increases the likelihood of high recurrence. This study aims to quantify the extent of resection of these tumors by local surgeons with an aim to identify gaps that limit optimal resection of such patients. This would help advise local hospital administration on the need to optimize resources to better manage such patients operatively while reducing morbidity and mortality associated with extensive surgery.

The study will also serve as a baseline for future research on the subject and provide helpful information that can lead to new research avenues. The findings of this study will also help improve the local practice guidelines and inform clinical practice.

2.13 Study question.

What are the clinocoradiological patterns and early surgical outcome of patients presenting with parasagittal meningiomas at KNH??

2.14 Study Objectives

2.14.1 Broad Objective

To determine the clinicoradiological pattern and early surgical outcome of parasagittal meningiomas in KNH

2.14.2 Specific Objectives

1. To determine the sociodemographic data, clinical presentation and radiological characteristics of patients presenting with parasagittal meningiomas at KNH

2. To determine the extent of resection of patients with parasagittal meningiomas at KNH

3. To determine the prevalence of early surgical complications following surgery for parasagittal meningiomas at KNH.

4. To determine the relationship between clinical presentation, radiological pattern, extent of resection, and early surgical outcome of patients presenting with parasagittal meningiomas at KNH

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study design

This was a retrospective cross-sectional study of adult patients who underwent treatment for parasagittal meningiomas at KNH. Exposure variables were measured at the same time as the outcome variables.

3.2 Study Site

The Kenyatta National Hospital, neurosurgical unit ward 4C, the Neurosurgical outpatient clinic, and the records department.

The hospital is located in the Upper Hill region of Nairobi, Kenya, 4 kilometers from the Central Business District. The hospital offers neurosurgical specialist services, being the largest teaching and referral hospital in East and Central Africa. Due to availability of resources such as neurosurgeons, and other supportive services such as specialist anesthesia services as well as equipment such as ICU, potentially complicated cases of meningiomas such as parasagittal meningiomas are comprehensively managed in the hospital.

3.3 Study population

The target population were all parasagittal meningioma patients who had undergone surgery at the KNH and were still on follow-up within the neurosurgical unit. The study recruited patients operated for parasagittal meningioma in the ten-year period between 1st January 2013 to 31st December 2022.

3.3.1 Inclusion Criteria

1. All records of patients diagnosed with parasagittal meningioma and underwent surgery at Kenyatta National Hospital during the study period.

3.3.2 Exclusion Criteria

1. Missing relevant records of patients.

3.4. Sample size determination

The sample size was estimated using the following formula.

$$n = \frac{Z^2 x\, P(1-P)}{d^2}$$

Where:

n=is the sample size

Z=value from standard normal distribution corresponding to desired confidence level (Z=1.96 for 95% CI).

P = expected true proportion (estimated parasagittal meningiomas to be 1.85% (Incidence of mortality from the surgical intervention in Parasagittal Meningiomas (12)).

d = desired precision (0.05)

$$n_0 = \frac{1.96^2 x\, 0.0185(1-0.0185)}{0.05^2} = 28$$

3.5 Sampling Procedure

Consecutive sampling technique was employed whereby file records of every subject meeting the inclusion criteria to the study was included.

3.6. Data Collection procedure

Relevant data was retrieved manually from the patient's medical records including the clinic records, and inpatient records as indicated in the patient files. Information regarding age, sex, presenting complaint, duration of symptoms and operative procedure, and extent of resection was recorded from patient files.

3.7 Study variables

Exposure Variables: included age, sex, presenting complaint, duration of symptoms, operative procedure performed, and extent of resection – whether complete or incomplete.

Outcome variables: included occurrence of a complication such as mortality, reduced consciousness level, suboptimal motor function, brain edema, venous infarcts and hemorrhage. Such complications needed to occur within 30 days post-surgery.

3.8 Quality Assurance

The data was retrieved from patient files by a qualified medical doctor (the principal researcher) and trained research assistants who were also qualified medical officers.

A pilot study was conducted with 10% of the data to ensure its applicability in data collection.

3.9 Data management and statistical analysis:

Data collected was recorded in an excel sheet and then transferred for analysis in SPSS 26.0. For categorical data, the patient's demographic and clinical characteristics was examined and displayed as frequencies and percentages; for continuous data, it was examined and shown as means with standard deviation or as a median with an interquartile range. The relationship between clinical presentation, radiologic pattern, surgical management and their association with occurrence of surgical complication was analyzed with the use of Chi Square test of Independence. Student T test was used where the exposure data is continuous.

For multivariate analysis, to assess the independent risk factors for occurrence of complications, logistic regression was used. Odds ratios and their 95% confidence intervals were used to report the results of the regression model.

A statistical test was deemed significant if the p-value was less than 0.05.

3.10 Ethical Considerations

Permission was sought from the Ethics and Research Committee and the KNH research department to access the files. Retrieval of files was done using the ICD 10 coding system. Anonymity was ensured by assigning serial numbers to each patient.

The KNH research department and Ethics and Research Committee's approval was requested.

Serial numbers were assigned to the patients for purposes of confidentiality and all the data was secured in a drawer in the Department of Surgery.

All the data obtained will only be accessible to the researchers and destroyed upon completion of the study, after 3 years.

3.11 Study Limitations

i) Missing data from the patient’s records. However, such records were excluded from the study to minimize bias.

CHAPTER 4

Introduction

Data collected was recorded in an excel sheet and then transferred for analysis in SPSS 26.0. For categorical data, the patient's demographic and clinical characteristics was examined and displayed as frequencies and percentages; for continuous data it was examined and shown as means with standard deviation or as a median with an interquartile range. The relationship between clinical presentation, radiologic pattern, surgical management and their association with occurrence of surgical complication was analyzed with the use of Chi Square test of Independence. Student T test was used where the exposure data is continuous.

For multivariate analysis, to assess the independent risk factors for occurrence of complications, logistic regression was used. Results of the regression model were reported in Odds ratios and their 95% confidence intervals.

Statistical tests were considered significant where the p-value < 0.05.

4.1 Sociodemograghic data

Age

The mean age of the patients was 47.9 years with a standard deviation of 11.3 and a median age of 48.5 years and a range of 28 years to 66 years.

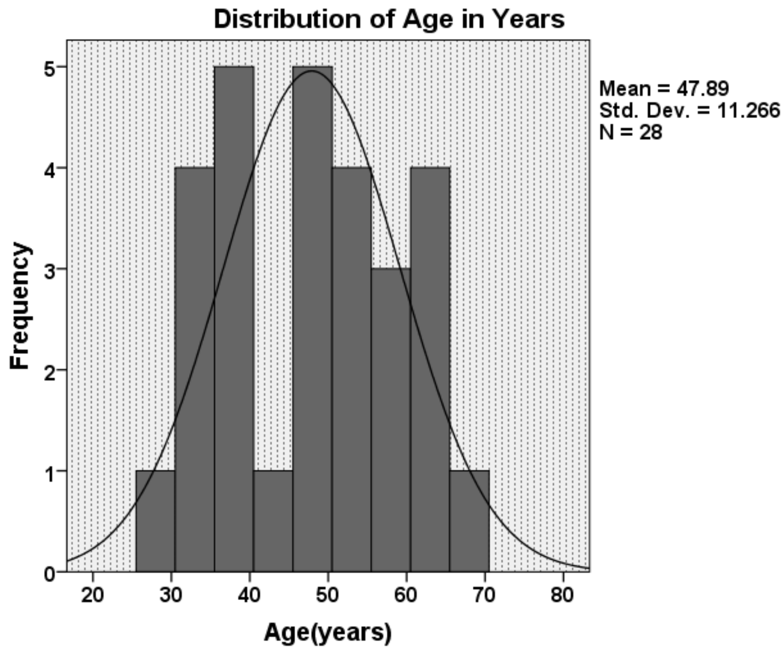


Figure 5: A bar graph illustrating patient distribution by age

Sex

There were more female 16(57.1%) than the male patients 12(42.9%).

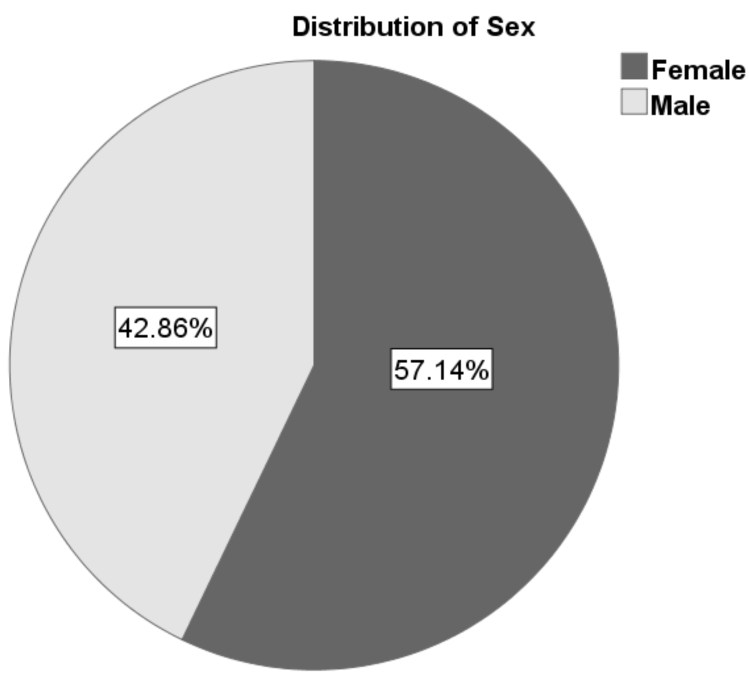


Figure 6: A pie chart illustrating patient distribution by Gender

4.2 Clinical symptomatology

Seizures

There were 17(60.7%) of the patients who had seizures and 11(39.3%) who did not experience any seizures.

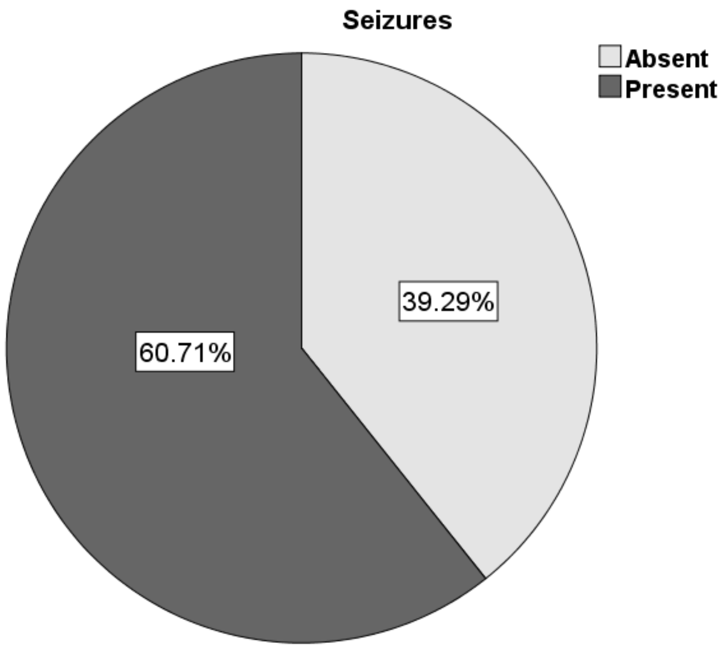


Figure 7: A pie chart illustrating the frequency of seizures

Headaches

There are 21(80.8%) of the patients who experiences headaches and 5(19.2%) of the patients did not have any headaches**.**

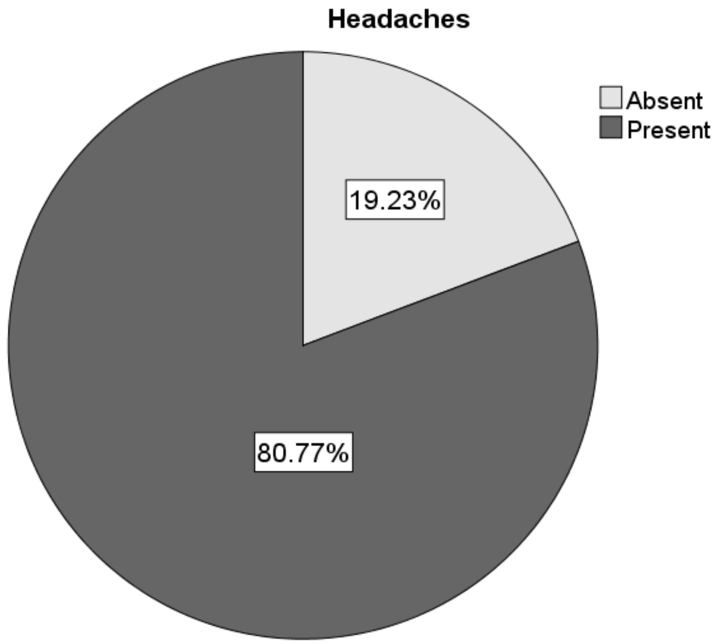


Figure 8: A pie chart illustrating frequency of headaches

Weakness of limbs

There were 15(55.6%) of the patients who experience weakness of limbs while 12(44.4%) did not have any weakness of limbs

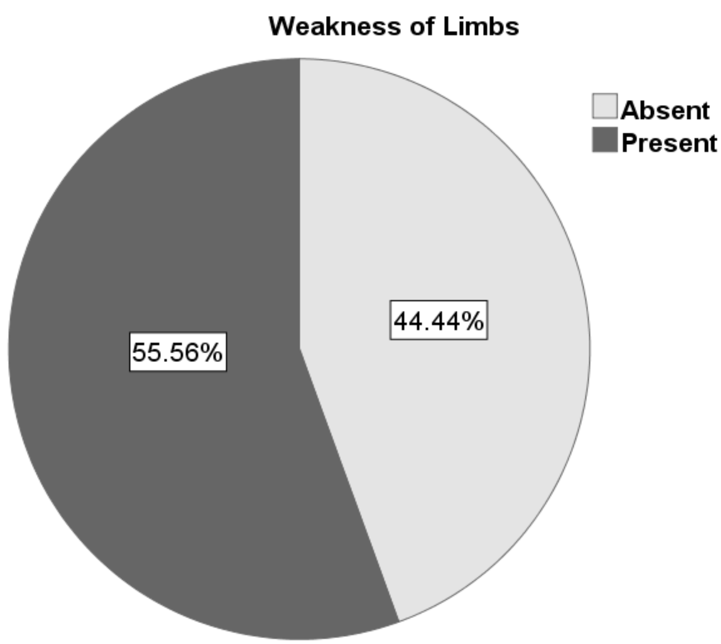


Figure 9: A pie chart illustrating frequency of motor symptoms

Visual Symptoms

The bar chart below is a representation of the visual symptoms and a majority 20(76.9%) of the patients did not experience the visual symptoms. There were only 6(23.1%)of the patients who experienced the visual symptoms.

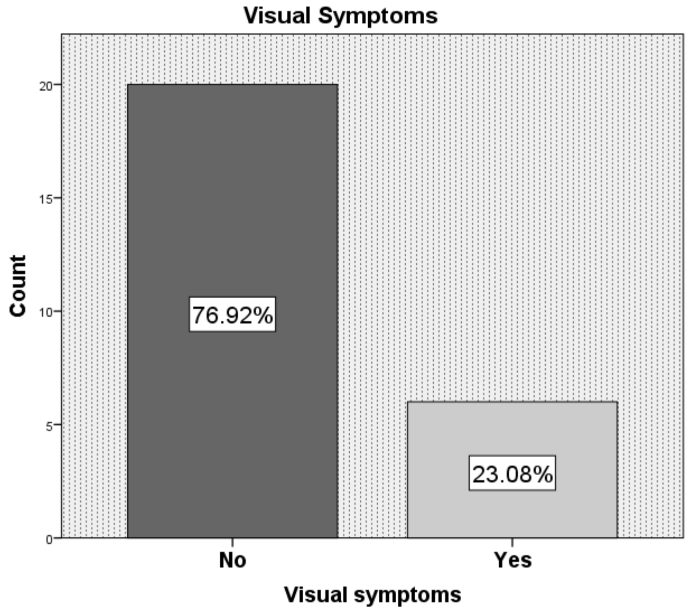


Figure 10: A bar chart illustrating the frequency of visual symptoms

Personality Changes

Majority of the patients 22(91.7%) did not experience any personality changes while only 2(8.3%) experienced personality changes

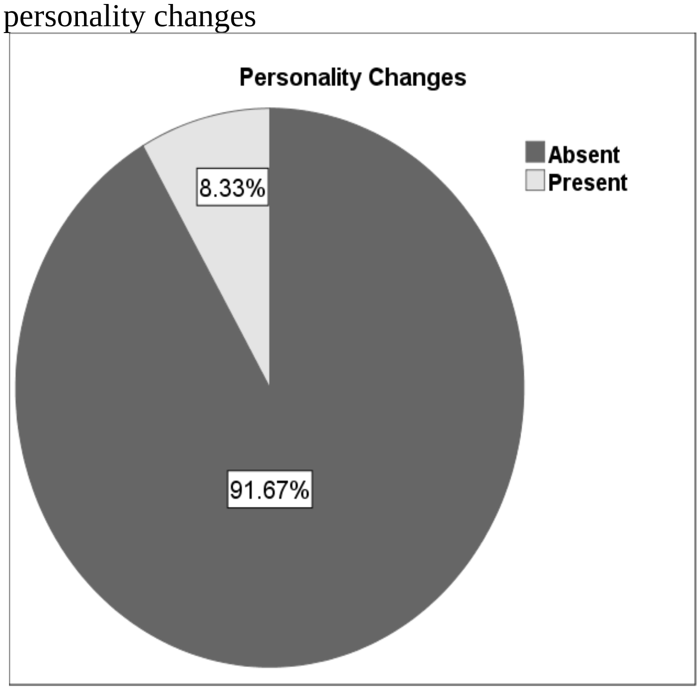


Figure 11:A pie chart illustarting frequency of visual symptoms

Sensory Changes
None of the patients 24(100%) of the patients experienced any sensory changes**.**

Other changes experiences
1 patient had urinary incontinence, 1patient experience loss of balance,1 patient lost consciousness.

Table 5: Symptomatology by tumor location

	Anterior	Middle	Posterior	Total
Seizures	4(33.3)	7 (58.3)	1 (8.3)	12 (52.2)
Headache	7 (38.9)	9 (50)	2 (11.1)	18 (78.3)
Weakness of limbs	3 (23.1)	7 (53.9)	3 (23.1)	13 (56.5)
Visual	3 (60)	2 (40)_	0 (0)	5 (21.7)
Personality changes	2 (100)	0 (0)	0 (0)	2 (8.7)
Urinary incontinence	1 (100)	0 (0)	0 (0)	1 (4.3)

4.3 Duration of Symptoms

The mean duration of symptoms in months was as follows

Symptoms	**Mean duration (months)**
Seizures	10
Headache	12.3
Weakness of limbs	7.7
Visual	5.8
Personality	3.5

changes	
Urinary incontinence	2

Table 6: A table showing the mean duration of symptoms in months

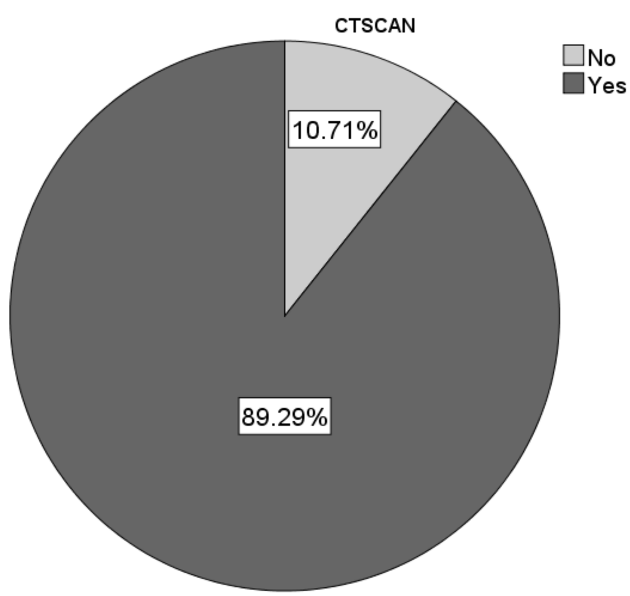
4.4 Radiologic characteristics

4.4.1 Image modality

Image Modality	Categories	Count	Percentages
CTSCAN	Yes No	25 3	89.3 10.7
MRI	Yes No	28 0	100
MRA/MRV	Yes No	26 2	92.9 7.1

Table 7: A table showing the frequency of imaging modality done

CTSCAN



4.4.2 Tumor location

Majority of the patients had a tumor located in the middle 1/3 (50%)

Tumor Location	Count	Percentages
Anterior 1/3	9	32.1%
Middle 1/3	14	50%
Posterior 1/3	5	17.8%

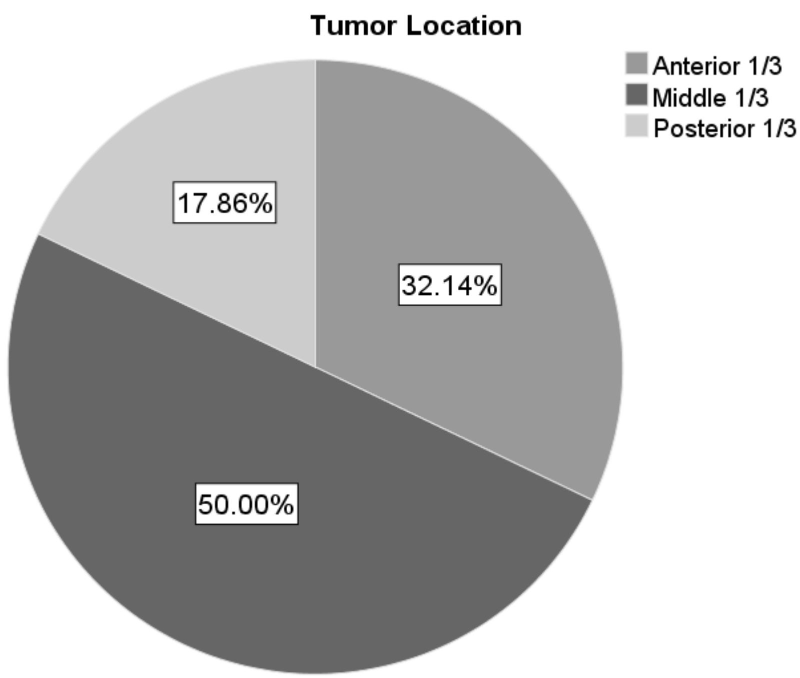


Figure 12:A pie chart showing tumour location

4.4.3 Tumor Size

Most tumors were in the category of 4cm-6cm (64.3%)

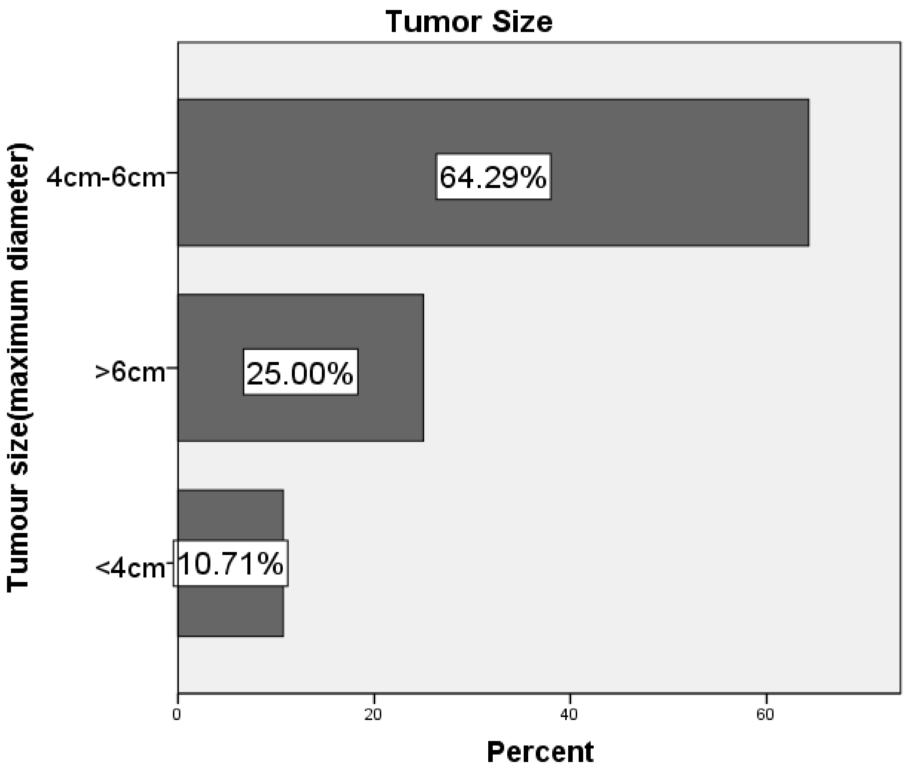


Figure 13:A bar chart showing tumour sizes

4.4.4 Surrounding Edema

Majority of tumours (89.29%) presented with surrounding edema on radiology

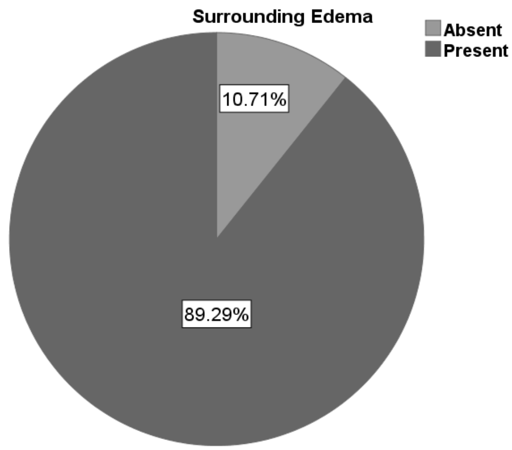
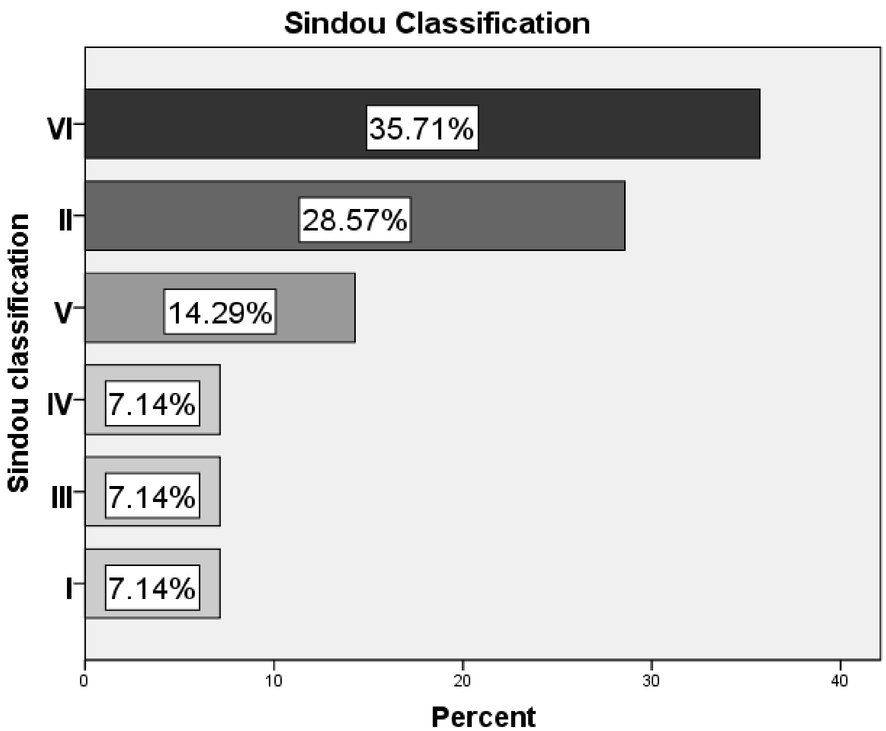


Figure 14: A pie chart showing frequency of surrounding edema

4.4.5 Extent of Superior Sagittal Sinus Invasion

Sindou classification

The sindou classification that had the most patients was VI 10(35.7%)



Sindou classification	COUNT	Percentages
I	2	7.1%
II	8	28.6%
III	2	7.1%
IV	2	7.1%
V	4	14.3%
VI	10	35.7%

Table 8:A table illustrating extent of sagittal sinus invasion

Objective
2. To determine the extent of resection of patients with parasagittal meningiomas at KNH

4.5 Extent of Resection

Simpson Grading

Most of the patients had grade II simpson grading 23(11.5%)

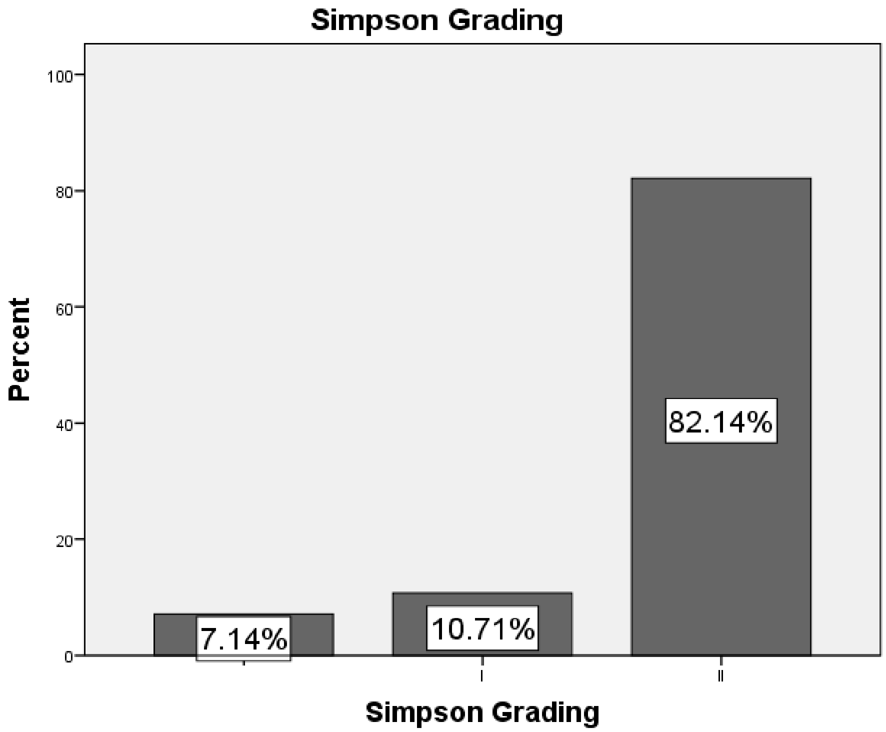


Figure 15:A bar chart illustrating extent of resection

Objective

3.To determine the prevalence of early surgical complications following surgery for parasagittal meningiomas at KNH

4.6 Outcome Variables

4.6.1 Consciousness level (gcs)

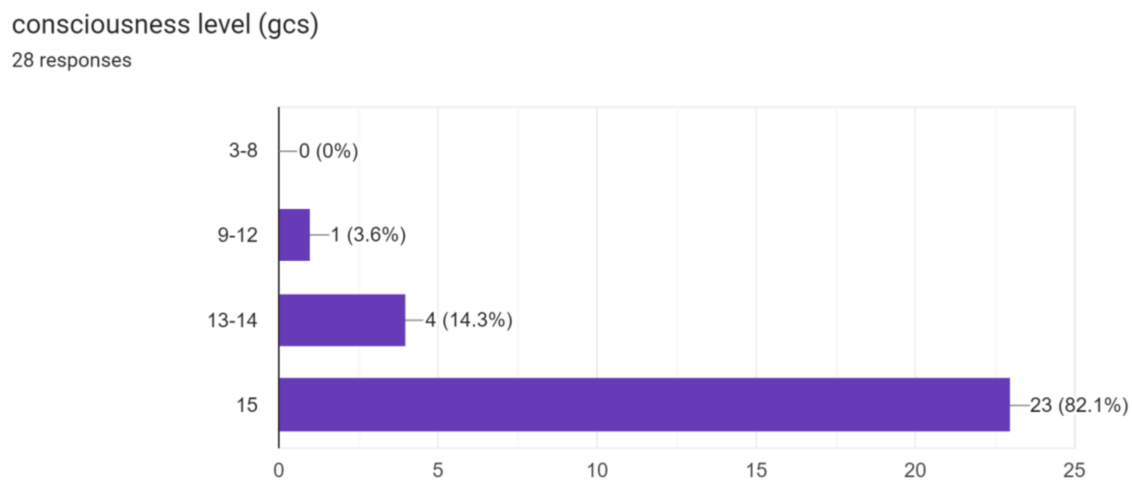


Figure 16: A bar chart showing level of consciousness

4.6.2 Mortality

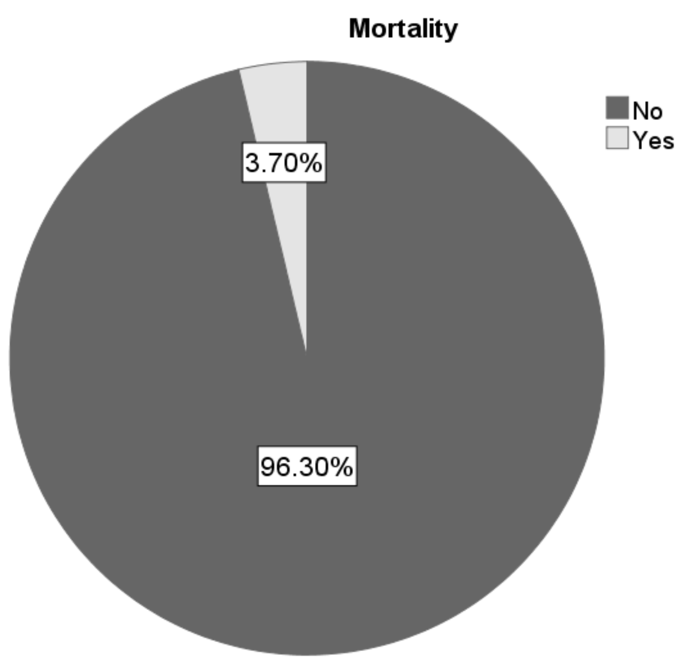


Figure17: A pie chart illustrating frequency of mortality

4.6.3 Motor function on MRC scale

Motor Function on MRC Scale

Categories	Count	Percentage
1	2	7.1
2	2	14.2
3	5	32.1
4	2	39.3
5	17	39.3

MRC effect after surgery

MRC effect after Surgery	Count	Percentage
No change	10	43.5
Decline	4	17.3
Increase	9	39.1

Table 9: A table showing motor function on MRC scale post-surgery

The table below is a summary of the outcome Variables

Variable	Categories	Count	Percentages
Consciousness level(gcs)	13-14 15	5 23	17.9 82.9
Mortality	Yes No	1 26	3.7 96.3
Venous Infarcts	Yes No	1 27	3.6 96.4
Haemo rrhage	Yes No	1 27	3.6 96.4

Variable	Categories	Count	Percentages
Brain Edema	Yes No	23 5	82.1 17.9

Table 10: A table summarizing outcome variables

Objective 4

4. To determine the relationship between clinical presentation, radiological pattern, extent of resection, and early surgical outcome of patients presenting with parasagittal meningiomas at KNH

Motor function as an outcome variable

	Motor function after surgery		P value
	Optimal	suboptimal	
Tumor location			
Anterior	7 (87.5)	1 (12.5)	0.087
Middle	7 (63.6)	4 (36.4)	
Posterior	1 (25)	3 (75)	
Tumor size’			
>6cm	2 (50)	2(50)	0.804
4 – 6 cm	11 (68.8)	5(31.3)	
<4cm	2 (66.7)	1 (33.3)	
Sindou classification			
I	1 (100)	0 (0)	<0.001
II	1 (16.7)	5 (83.3)	
III	0 (0)	2 (100)	
IV	1 (50)	1 (50)	
V	3 (100)	0 (0)	
VI	9 (100)	0 (0)	
Extent of surrounding edema			
Yes	14 (66.7)	7 (33.3)	0.585
No	1 (50)	1 (50)	
Extent of resection (Simpson)			
Grade I	3 (100)	0(0)	0.236
Grade II	11 (57.9)	8 (42.1)	

Weakness of limbs			
Yes	9 (69.2)	4 (30.8)	0.490
No	6 (60)	4 (40)	

Table 11: A table showing relationship between clinoradiologic presentation and motor function

consciousness level as an outcome

	Conscious level after surgery		P value
	<15	15	
Tumor location			
Anterior	2 (25)	6 (75)	0.660
Middle	3 (27.3)	8 (72.7)	
Posterior	0 (0)	4 (100)	
Tumor size'			
>6cm	2 (50)	2 (50)	0.192
4 – 6 cm	2 (12.5)	14 (87.5)	
<4cm	1 (33.3)	2 (66.7)	
Sindou classification			
I	0 (0)	1 (100)	0.337
II	0 (0)	6 (100)	
III	0 (0)	2 (100)	
IV	0 (0)	2 (100)	
V	1 (33.3)	2 (66.7)	
VI	4 (44.4)	5 (55.6)	
Extent of surrounding edema			
Yes	5 (23.8)	16 (76.2)	0.605
No	0 (0)	2 (100)	
Extent of resection (Simpson)			
Grade I	3 (100)	0 (0)	0.006
Grade II	2 (10.5)	17 (89.5)	
Personality changes			

Yes No	0 (0) 5 (23.8)	2 (100) 16 (76.2)	0.605

Table 12 :A table showing the relationship between clinoradiologic presentation and consciousness level

CHAPTER 5

5.0. Discussion, conclusion and Recommendations

5.1 Discussion

In this study looking at the demographic characteristics, there were more females at 57.1% than male patients 42.9%,this was comparable to the study by Colli et al. which found around 60% of parasagittal meningiomas in females(5).The mean age at presentation was 47.9 years with the youngest patient at 28 years and oldest patient at 66 years.

Overall, most patients presented with headaches (80.8%) followed by seizures (60.7%) and weakness of limbs (55.6%).23.1% presented with visual symptoms and only 8.3% experienced personality changes. This was similar to Ahmed et al. who had majority of patients presenting with headaches(88%),seizures(52%) and contralateral hemiparesis(44%)(12).Study findings differed with Gatterbaeur who had majority of patients present with seizures followed by headaches and hemiparesis(48) and Caroli's study who had majority of patients present with motor deficits followed by seizures(11).Location of the tumour in relation to the central sulcus is mostly responsible for the symptomatology. Anterior third tumours mostly presented with headaches and personality changes. Middle third tumours presented with seizures (58.3%) and weakness of limbs (53.9%). Posterior third tumours majority presented with headaches and visual symptoms and seizures.

Majority of the tumours were located in the middle third (50%) followed by anterior third (32.1%) and posterior third accounted for 17.8%. This was similar to the studies done by Black and colleagues, Kang et al., Caroli et al. and Patterson et al(7,11,28). This is postulated to be because majority of the parasagittal veins connect to the SSS in a section between the coronal suture and 2 cm behind it.

Most tumours were large in size with 64.29% between 4cm-6cm and a further 25% being more than 6 cm. This probably was a manifestation of the late presentation by the patients as evidenced by the long mean duration of symptomatology of around 12.3 months.

Simpson grade II resection was what was achieved in majority of the cases (82.14%), this was probably due to the fact that most of the tumours had total sinus occlusion.

Mortality rate in this study was 3.70% which was 1 patient, the radiological follow-up in this patient revealed brain edema and venous infarction. Overall morbidity was 17.3% with 4 patients having a decline in their power grades during the early surgical period. This was slightly lower than what DiMeco and associates found in their series at 29% but was higher than the series by Colli and colleagues who 7.8% of patients with middle third tumours deteriorated neurologically (14).

When patients displayed preoperative paresis, motor function further declined after surgery and this was thought to be because of temporary venous overload, thrombosis and damage to draining cortical veins causing regional venous infarction and brain edema.

There was a positive correlation between the grade of sinus occlusion and the outcome (p value <0.001) with higher grades having suboptimal outcome interms of motor function.

5.2 Conclusion

Majority of the patients presenting with parasagittal meningiomas were females (57.1%) as compared to males (42.9%). Mean age at presentation was 47.9 years.

Overall, majority of patients presented with headaches followed with seizures and weakness of limbs. Middle third tumours were the most common (50%) followed by anterior third (32.1%) and posterior third tumours (17.8%).

Morbidity rate was higher in patients with preoperative motor deficits, middle third tumours and total sinus occlusion.

5.3 Recommendations

1.Microsurgical techniques should be employed to preserve bridging veins located over, anterior or posterior to the tumour to avoid interruption during surgery which could lead to regional venous infarction with neurological deficits

2.Follow up beyond the early surgical period to evaluate the neurological status

Table 3: Time Frame:

ACTIVITY	Aug-2022-Sept 2022	Oct 2022-Jan 2022	Feb 2023-Mar 2023	April 2023	May 2023
Proposal development					
Ethical approval					
Data collection					
Data analysis					
Thesis submission					

Table 4: Budget:

Item	Cost (KShs.)
Research fees	5,000
Statistician	30,000
Stationary	10,000
Data Collection	10,000
Printing and binding	10,000
Total	75,000
Contingencies 10% of total	7,500
GRAND TOTAL:	82, 500

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APPENDICES

Appendix 1: Data collection tool

Study Title: CLINICORADIOLOGICAL PATTERNS AND EARLY SURGICAL OUTCOME OF PARASAGITTAL MENINGIOMAS AT KNH

SERIAL NO.

A. SOCIODEMOGRAPHIC DATA

1. AGE ☐ YEARS

2. SEX MALE ☐ FEMALE ☐

B. CLINICAL SYMPTOMATOLOGY

No.	SYMPTOMS	Occurrence	DURATION
3	Seizures	Yes / No	
4	Headache	Yes / No	
5	Weakness of limbs	Yes / No	
6	Visual symptoms	Yes / No	
7	Personality changes	Yes / No	
8	Sensory changes	Yes / No	
	Others 1)…………………	Yes / No	
	Others 2)…………………	Yes / No	
	Others 3)…………………	Yes / No	

C.RADIOLOGIC CHARACTERISTICS

9. IMAGING MODALITY DONE

CT SCAN ☐ MRI ☐ MRA ☐ MRV ☐

DSA ☐

10. TUMOUR LOCATION

ANTERIOR THIRD ☐ MIDDLE THIRD ☐ POSTERIOR ☐

THIRD

11. TUMOUR SIZE (MAXIMUM DIAMETER)

<4CM ☐ 4CM-6CM ☐ >6CM ☐

12. SINDOU CLASSIFICATION ☐

13. SURROUNDING EDEMA

YES ☐ NO ☐

D.EXTENT OF RESECTION

14. SIMPSONS GRADING ☐

15. KOBAYASHI GRADING ☐

E. EARLY POSTOPERATIVE OUTCOME

CLINICAL OUTCOME

16. MOTOR FUNCTION ON MRC SCALE ☐

17. CONSCIOUSNESS LEVEL ☐

18. MORTALITY YES ☐ NO ☐

OTHER ____________________

RADIOLOGICAL OUTCOME

19. BRAIN EDEMA YES ☐ NO ☐

20. VENOUS INFARCTS YES ☐ NO ☐

21. HAEMORRHAGE YES ☐ NO ☐

Appendix 2: Administrative Consent letter to conduct the study in the collaborating

I Dr. Kennedy Kimani, a registrar in the Department of Surgery, Neurosurgery Unit, University of Nairobi, would like to seek consent from the Research

and Administration department/Office of the Kenyatta National Hospital to Conduct a research study entitled, CLINICORADIOLOGICAL PATTERNS AND EARLY SURGICAL OUTCOME OF PARASAGITTAL MENINGIOMAS AT KNH

This study entails collecting data from past medical records of patients who underwent surgical treatment for parasagittal meningioma. Information derived from this research will go a long way in

understanding the patterns, presentation and management practices of patients presenting with the condition. This would increase understanding of this condition with aim towards optimizing care for such patients.

No patient identifying information will be collected.

Covid -19 prevention measures shall be adhered to as per the hospital's recommendations.

Results of this study will be shared with the hospital management among other stakeholders to help improve local policies and guidelines on care of patients with parasagittal Meningiomas.

……………………………………….

Hospital representative

………………………………………

Principal Investigator

In case of any queries regarding this research please contact

Who to contact

If you wish to ask any questions later, you may contact:

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Research Review and Ethical approval

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Yours sincerely,

Dr Kennedy Kimani