CLINICO-PATHOLOGICAL PROFILE OF SINONASAL MASSES AS SEEN AT THE KENYATTA NATIONAL HOSPITAL

DR. MWANGI GABRIEL KAMAU

H58/7224/2017

M.MED OTORHINOLARYNGOLOGY- HEAD AND NECK SURGERY

A dissertation to be submitted in partial fulfillment of the requirements for the award of degree of Master of Medicine in Otorhinolaryngology, Head and Neck Surgery, University of Nairobi.

June 2020

DECLARATION

I, the undersigned, hereby declare this dissertation as purely my own original work and has not been presented for a degree in any other university. Where I have used another person's work, I have carefully acknowledged and referenced.

Dr Mwangi Gabriel Kamau

Postgraduate Student – Department of Otorhinolaryngology, Head & Neck Surgery, University of Nairobi.

Signed..... Date 31/8/22

SUPERVISORS' APPROVAL

This proposal has been submitted to the University of Nairobi with our approval as supervisors.

Professor Isaac Macharia (MBChB, MMED (ORL-HNS)
Professor and Consultant Otorhinolaryngologist
Department of Surgery (ENT)
University of Nairobi

Signature..... ..... Date 30/8/22

Dr Mary Omutsani, MBChB, MMed (ENT),
Consultant Otorhinolaryngologist- Head and Neck Surgery,
Kenyatta National Hospital.

Signed..... ..... Date 30/8/2022

DEPARTMENTAL APPROVAL

This dissertation was presented at the ENT Departmental meeting at the University of Nairobi held on **24/03/2022** and is hereby submitted with the approval of the Department of Surgery

Dr. Joyce Aswani

MBChB, M. Med (ORL-HNS), Fellow Head and Neck (SA)

Senior Lecturer and Consultant Otolaryngologist,

Thematic Head Otorhinolaryngology Head and Neck Surgery

Department of Surgery

University of Nairobi

Signature… Date: 31/8/22

Dr Julius Githinji Kiboi

MBChB, M. Med (General Surgery), Fellow Neurosurgery (SA)

Senior Lecturer and Consultant Neurosurgeon

Chairman Department of Surgery

University of Nairobi

Signature..... Date: 1/9/2022

DEPARTMENT OF SURGERY
FACULTY OF HEALTH SCIENCES
P O Box 19676 - 00202 KNH
NAIROBI
Tel 020 4915043

UNIVERSITY OF NAIROBI

Declaration of Originality Form

This form must be completed and signed for all works submitted to the University for Examination.

Name of student: _DR GABRIEL KAMAU MWANGI_____

Registration Number: __H58/7224/2017_____

Faculty/School/Institute: _FACULTY OF HEALTH SCIENCES_____

Department: DEPARTMENT OF SURGERY_____

Course Name: __MASTER OF MEDICINE EAR NOSE AND THROAT HEAD AND NECK SURGERY__

Title of the work

CLINICO-PATHOLOGICAL PROFILE OF SINONASAL MASSES AS SEEN AT THE KENYATTA NATIONAL HOSPITAL

DECLARATION

1. I understand what Plagiarism is and I am aware of the University's policy in this regard.
2. I declare that this DISERTATION (Thesis, project, essay, assignment, paper,report etc) is my original work and has not been submitted elsewhere for examination, award of a degree or publication. Where other people's work, or my own work has been used, this has properly been acknowledged and referenced in accordance with the University of Nairobi's requirements.
3. I have not sought or used the services of any professional agencies to produce this work
4. I have not allowed, and shall not allow anyone to copy my work with the intention of passing it off as his/her own work
5. I understand that any false claim in respect of this work shall result in disciplinary action in accordance with University Plagiarism Policy.

Signature: _____

Date: 30/3/2022.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

CT - Computed Tomography

ENT - Ear, Nose and Throat

IHC- Immunohistochemistry

KNH - Kenyatta National Hospital

MRI - Magnetic Resonance Imaging

PPF- Pterygopalatine Fossa

SCC - Squamous cell carcinoma

SPSS - Statistical Package for Social Sciences

UON - University of Nairobi

WHO - World Health Organization

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

Background: Sinonasal masses present a spectrum of lesions found in the sinonasal tract ranging from non-neoplastic to neoplastic lesions but may have similar clinical presentation with significantly different histopathological diagnosis, management, and prognostic implications. Understanding the clinicopathological spectrum of these masses helps in optimizing clinical care.

Objective: To determine the clinico-pathological profile of sinonasal masses as seen at the Kenyatta National Hospital.

Study Design: This was a hospital based descriptive cross-sectional study.

Study Setting and population: 67 patients diagnosed with a sinonasal mass at the Otorhinolaryngology, maxillofacial, ophthalmology and oncology departments at the Kenyatta National Hospital.

Methodology: 67 patients were recruited into the study via convenience sampling technique and gave informed consent. Clinical history was recorded followed by a physical examination. Paranasal Computed Tomography Scan images were done followed by nasoendoscopy and biopsy of the mass for histology.

Results: A total of 67 patients with sinonasal masses were examined. The proportion of female and male participants was 50.7% and 49.3% respectively with a M:F ratio of approximately 1:1. Mean age of presentation 40.86 ± 20.8 years. Nasal obstruction was most common presenting complaint at 92.5% with aural complaints least at 13.4%. mean duration of symptoms was 14.54(±13.5) months. Malignant lesions and non-malignant lesions accounted for 35.8% and 64.2% respectively. Most common malignant lesion was squamous cell carcinoma with peak incidence in the fifth decade.

Conclusion: Most common etiology of sinonasal masses was non-neoplastic with inflammatory polyps predominant in the 3rd decade. Malignant sinonasal masses were common in the 5th to 8th decade, 40% of which had cervical lymphadenopathy with squamous cell carcinoma as the most prevalent histological type. Nasal obstruction followed by nasal discharge were the most common presenting symptoms. Extension beyond sinonasal tract especially with orbital involvement and cranial nerve III palsy are highly indicative of a malignant diagnosis.

1.0 CHAPTER ONE: INTRODUCTION

Background

The sinonasal tract which is composed of both the nasal cavity and the paranasal sinuses is a site of involvement of a wide variety of neoplastic and non-neoplastic lesions (1). The nasal cavity and the paranasal sinuses often function as a single unit and commonly are affected by similar pathological processes (2). A variety of masses, either neoplastic or non-neoplastic, will often be encountered in clinical practice and will have varied clinical presentation. Most common non-neoplastic lesions are inflammatory polyps and account for 2% of sinonasal masses (2). WHO reported that carcinomas of the nasal cavity and paranasal sinuses account for approximately 0.2-0.8% of all malignant neoplasms and 3% of head and neck malignancies (3). There is a low incidence of nasal and paranasal sinus cancers in most populations ranging from <1.5/100,000 in men and <1.0/100,000 in women (4).

The sinonasal tract is in close proximity to the orbital cavity, brain, skull base and surrounding tissues within the infratemporal fossa. Although the main presenting symptoms are usually nasal obstruction, rhinorrhea and epistaxis, invasion of surrounding structures may produce additional symptoms like proptosis, trismus, and lymph node enlargement (5). Adequate assessment of these patients involves physical examination together with nasoendoscopy. It is often difficult to differentiate non-neoplastic from neoplastic lesions since the constellation of symptoms is usually the same and malignant disease usually exhibits local extension and distant spread in the late stages. Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) are instrumental in evaluation of sinonasal masses to help delineate extent of disease as well as masses which are not routinely biopsied like juvenile angiofibroma due to risk of bleeding and congenital masses like encephaloceles (6).

Histopathological assessment is crucial in definitive diagnosis of these masses due to the wide variety of cells within the mucosa of the sinonasal cavity as well as structures in proximity to this tract. Immunohistochemistry helps especially in differentiating various lesions that show poor differentiation and similar morphology (7). During presentation, these lesions may be reviewed by other specialists, including ophthalmologist and maxillofacial surgeons, before referral to an otorhinolaryngologist. This study aims to identify the spectrum of clinical presentation of sinonasal masses as well as the various histopathological lesions seen in our setup and will aid in optimizing care for these patients.

2.0 LITERATURE REVIEW

2.1 Applied Anatomy of Nasal Cavity and Paranasal Sinuses

The nasal cavity proper, which excludes the nasal vestibule, begins from the limen nasi anteriorly and extends posteriorly to the choana. It is limited superiorly by the base of the skull and inferiorly by the floor of the nasal cavity formed by part of the maxilla and palatine bone anteriorly and the soft palate posteriorly (8). The nasal cavity is divided into two halves by the nasal septum creating two separate passages that communicate at the level of choana. The lateral wall of the nasal cavity demonstrates three medial projections into the nasal cavity called turbinates with corresponding meatus underneath each turbinate (9).

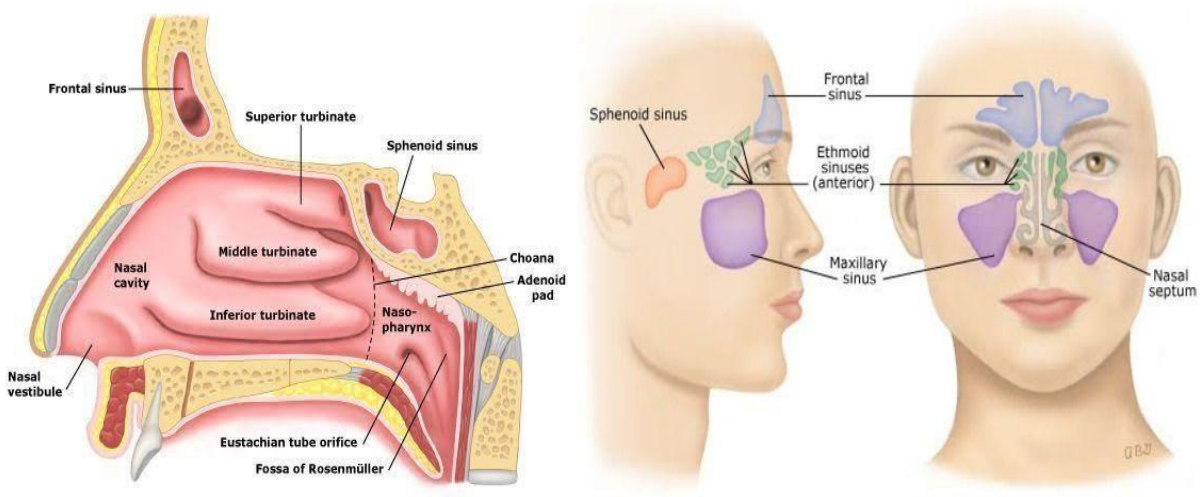


Figure 1: Lateral wall of the nasal cavity and paranasal sinuses (Adopted from UpToDate) (10)

Paranasal sinuses are named according to the bone in which they are contained. They include the frontal, ethmoidal, sphenoid, and maxillary sinuses (8). The maxillary sinus is the largest sinus, non-partitioned, pyramidal in shape. It is related to the orbit superiorly therefore lesions within the orbit may extend into the sinus and vice versa. Direct extension of lesions through the posterior wall will involve the infratemporal fossa and produce trismus and deformity. Inferior extension of lesions and erosion of alveolar bone will produce oral antral fistulas. Medially it is related to the nasal cavity therefore a lesion like antrochoanal polyp will egress into the nasal cavity through the maxillary ostia. Pterygopalatine fossa (PPF) is connected to the nasal cavity via the pterygopalatine foramen, orbital cavity via the infraorbital fissure, middle cranial fossa via the foramen rotundum and pterygoid canal, oral

cavity via the greater palatine canal and infratemporal fossa via the pterygomaxillary fissure. These routes provide pathways for locoregional spread of sinonasal masses through the pterygopalatine fossa.

Sphenoid sinus is the most posterior paranasal sinus and is in close relation to the internal carotid artery, optic nerve, and cavernous sinus. These anatomical relations are important during surgical approach as well as immediate risk for invasion by aggressive lesions (5). The ethmoid sinus is composed of multiple individual cells separated by thin-walled partitions within the ethmoid bone. Its important relations are the cribriform plate and the thin-walled lamina papyracea. Cribriform plate erosion is an early indication of anterior cranial fossa extension of a sinonasal mass. Lamina papyracea forms the medial wall of orbit and provides minimal restriction to the orbital extension of masses from ethmoidal sinuses. The frontal sinuses represent pneumatization of the frontal bone and the paired frontal sinuses are separated by inter sinus septum (9). The lymphatic drainage begins as a capillary network in the submucosal space of nasal cavity and paranasal sinuses and ends in the submandibular nodes. The submucosal capillary collector system also communicates with the submucosal lymphatic channels of the nasopharynx which drain principally to the retropharyngeal nodes (11).

Histologically, at the level of the vestibule, the mucosa is stratified keratinized squamous epithelium with the rest of the nasal cavity and paranasal sinuses being covered by stratified non-keratinized squamous and respiratory type pseudostratified ciliated columnar epithelium (Schneiderian epithelium) (12). Lymphoid tissue is present around the eustachian tube opening, Gerlach tonsil, and extends to nasopharynx as part of Waldeyer's ring. Olfactory epithelium is present at the region of cribriform plate and is composed of bipolar cells, sustentacular and basal cells with Bowman's glands residing beneath the mucosa (13). Lesions arising from the Schneiderian epithelium especially on the lateral wall of nasal cavity include inverted papillomas and squamous cell carcinomas. In an endoscopic autopsy study of nasal cavity, most nasal polyps appear to arise from mucosa surrounding the ostia and the osteomeatal complex region (14).

2.2 Classification of Sinonasal Masses

2.2.1 Non-neoplastic Masses

Most common non neoplastic sino-nasal masses are nasal polyps which are a result of end stage inflammatory response to chronic rhinosinusitis with an average worldwide prevalence of 1% to 4% (9). Grossly, they appear as grey translucent lobular mobile lesions with soft consistency. Four histologic variants are seen, these are the allergic, chronic inflammation, seromucinous and atypical types. Elements of non-invasive fungal infections like fungus ball are an important differential in this segment while some inflammatory conditions with a geographic predilection have been described e.g. rhinosporidiosis in India which will present with hyperplastic polypoid lesions (13). Granulomas may also occur in the sinonasal tract as a manifestation of systemic disease like in Wegener granulomatosis, foreign body reaction and pyogenic granuloma.

2.2.2 Neoplastic lesions (Refer to appendix IV).

2.2.2.1 Benign Neoplastic Lesions

These can arise from surface epithelium, minor salivary glands, lymphoid tissue, bone, cartilage, and other mesenchymal tissues. Papillomas are the most common variety and develop from ectodermally derived Schneiderian epithelium with three microscopic patterns being identified: fungiform, cylindrical cell and inverted papilloma (5). Inverted papillomas are associated with recurrence, malignant transformation (1.9-27%) and coexistence with squamous cell carcinoma and arise mostly from the lateral wall of nasal cavity (1).

2.2.2.2 Malignant Neoplastic Lesions

Majority of primary malignant sino-nasal masses are of epithelial origin and include squamous cell carcinoma (SCC), adenocarcinoma and adenoid cystic carcinoma (5). In the adult population, sinonasal SCC are most common of malignant lesions and arise from maxillary sinus in 60%-70% of cases with nasal cavity SCC accounting for 12%-25% of cases (1). Adenocarcinomas, which arise from seromucous glands of the mucosa, are the second commonest malignant lesions accounting for 10% of all malignant lesions in the sinonasal tract. Melanomas account for approximately 5% of all sinonasal masses (5). Rhabdomyosarcoma and neural derived malignancies are the commonest pediatric lesions (15).

2.3 Clinical Presentation

The clinical presentation of these patients is similar in majority of patients with nasal blockage, epistaxis, and nasal discharge as common denominator (16). Other associated symptoms include nasal itching, anosmia, sneezing, epiphora from orbital involvement and headache. The proximity of the sinonasal cavity to the orbit allows for extension of sinus or nasal pathology into the orbit. Progression and extension beyond the confines of the Sino- nasal cavity, to the brain, orbit or infratemporal fossa typically occur late and are ominous signs indicating aggressive or malignant disease (17).

2.4 Evaluation of Sino-nasal Masses

2.4.1 History and Physical Examination

This begins with history taking which encompasses duration of symptoms including but not limited to nasal discharge, nasal blockage, epistaxis, loss of smell and their attendant evolution up to the time of presentation. Risk factors form part of the inquiry as well as medication and interventions sought. Constitutional symptoms such as fever, malaise/fatigue, weight loss etc. will point to chronic illness or malignancy (18). Physical examination involves evaluation of the nasal cavity and adjacent structures to provide preliminary determination of disease extent.

Pre-interventional diagnostic nasal endoscopy using rigid or flexible endoscopes, allows enhanced illumination and magnification of sinonasal anatomy enabling assessment beyond the inferior turbinate. It helps to correlate findings on CT imaging and clinical presentation as well as evaluating the relationship between the sinonasal structures and the mass (19). Diagnostic nasal endoscopy has been proven to be adequate at identifying various sinonasal pathologies and anatomic variations which are otherwise missed or reported as normal on anterior rhinoscopy or CT imaging (20).

2.4.2 Radiological Assessment

CT imaging has become the radiological modality of choice for evaluation of sinonasal tract and surrounding regions. It is also widely available and comparably affordable (21). MRI is vital, especially for malignant lesions, in establishing the extent of invasion of surrounding tissue due to superior soft tissue attenuation. This also allows distinction between tumor and

adjacent inflammation with the high-water content of secretions and inflamed mucosa producing increased signal in T2 weighted imaging (17).

2.4.3 Histopathological Examination

Histological assessment of punch or excision biopsy specimen from a sinonasal lesion is important in assigning definitive diagnosis. Immunohistochemistry is variably incorporated in histopathology in identification of similarly appearing tumors. Undifferentiated tumors with small blue cells morphology, for example, have a varied differential diagnosis hence the need for identifying epithelial (AE1/AE3), neuroendocrine (synaptophysin, chromogranin) and muscle (myogenin, desmin) markers to get the definitive diagnosis (22).

2.5 Review of studies on clinicopathological profile sinonasal masses

Sinonasal masses are mainly classified as either neoplastic or non-neoplastic depending on the lesion. In a prospective study evaluating 110 cases presenting with sino-nasal masses at a tertiary facility in Uttarakhand, Bist et.al found the proportion of non-neoplastic versus neoplastic lesions as 60% and 40% respectively. The proportion of benign neoplastic lesions was 19.8% while malignant neoplastic lesions were 23.76% (23). This correlates closely with a prospective cross-sectional study by Agarwal et.al evaluating Sino-nasal masses across all age groups, the proportion was found to be 59.6% and 40.4% for non-neoplastic and neoplastic lesions respectively. Benign lesions represented 28.7% with malignant tumors comprising 11.7% (24). Nyabenda et.al conducted a cross-sectional descriptive study in three national referral hospitals in Rwanda which showed 45.57% and 54.43% for non-neoplastic and neoplastic lesions respectively (25). The distribution of benign versus malignant lesions in this study was 43.04% and 11.39% respectively.

Age of presentation is important in identifying possible differential diagnosis to a Sino-nasal mass. In Rwanda, Nyabenda et al found the age of presentation to be between 2-79 years with a mean age of 36.5 years. In his study, 5.1% (4 patients) presented in the 8^{th} decade and histologically had neoplastic masses with 2 of the patients having malignant squamous cell carcinoma. All malignant masses presented beyond the 5^{th} decade in this study (25). In Nigeria, Bakari et.al in a retrospective analytical review of sino-nasal masses over a five-year period showed an age presentation of 5-64 years with a median age of 33.3 years (26). Age distribution in the study by Bist et.al was between 6-80 years with a mean age of 39.4 years. The 2^{nd} decade was the commonest involved with 22.72% of the total cases (23). This is in

contrast with Agarwal et.al study where the 4th decade was most involved with 29.45% of the cases (24). The mean age of malignant neoplastic lesions was 51 years according to Bist et.al (23). This is in concordance with a prospective study done in Bangladesh by Abu Hena et.al that involved 50 patients between the ages of 3 and 80 years which also showed a mean age of 51 years for malignant lesions (27). A retrospective study in Nigeria by Alabi et.al assessing prevalence of Sino-nasal cancer showed 31% of their head and neck malignancies were sino-nasal tumors with a mean age of 51 years at diagnosis (17). In a study by Lathi et.al, squamous cell carcinoma was the most common of the malignant lesions and was mostly clustered in the 50-70 years range and rarely encountered before the 4th decade. The commonest site of involvement appears to be the maxillary sinus (28). In a retrospective study of 72 cases of carcinoma of paranasal sinuses at the KNH over a 10-year period, Mugwe et al found the mean age of presentation at 49.7years (29).

Distribution of lesions based on sex helps identify whether there exists a predilection towards a specific gender. This is however influenced by demographic patterns within a specific area including census information and other factors such as health seeking behavior of patients. The Male: Female (M: F) ratio in the study by Abu Hena et.al was as high as 3.5:1 (27) which correlated closely with Mugwe et al that demonstrated M:F ratio of 3:1 (29). This is in contrast with other studies that show a M: F ratio of 1.8:1 (23) and 1.35:1 (2). Nyabenda et al demonstrated a slightly higher female predisposition at 1:1.25 for all sinonasal masses however the M:F ratio for malignant tumors was equal (25). In a retrospective study of 42 patients with a sinonasal mass presenting in a tertiary hospital over a period of 1 year, Sachdeva et al demonstrated an almost equal distribution of non-neoplastic masses with a M:F ratio of 1.14:1 while malignant tumors had a significantly high male predilection at a ratio of 5:1 (30).

Majority of patients had more than one symptom at presentation. The most common presenting symptom was nasal obstruction in majority of the studies. Bist et.al demonstrated 87.27% with majority of the complains being unilateral at 55.45% while bilateral counted for 31.81%. Rhinorrhea was the second most common symptom at 69.09% followed by headache at 60.90% (23). In the Rwandan study by Nyabenda et al, nasal obstruction was the most common symptom at 82.3% followed by sensation of a mass in the nose at 70.89% (25). The same observation was seen in other studies albeit with varied proportions. Nasal discharge was the second most common presenting symptom at 69.09% (26). Gupta et.al in

their retrospective analytical review of 92 patients who presented to the ENT department over a 4-year period with complaints of a sinonasal mass, 94.5% of patients had nasal blockage as predominant symptom with rhinorrhea as second most symptom at 90.2% (2). Epistaxis, external nasal deformity and cheek swelling were seen to be regular presenting complain in malignant lesions (28). This was in concordance with Bakari et.al study indicating presence of epistaxis in 30.3% of their patients all above the 4th decade and majority of this population had a neoplastic lesion (26). In Bist et al, 25% patients with neoplastic lesions demonstrated proptosis at time of examination with loss of vision seen in 16% of malignant lesions. Palato-alveolar bulge was also seen in 10% of patients and indicated extension of mass out of sinonasal cavity. (23). Duration of time before consultation varied among the various studies reviewed. In Bist et al, 25% of patients presented within 3 months of symptom onset with a further 28% presenting after 1 year (23). Nyabenda et al study demonstrated that majority of participants, 37.97%, presented after 24 months of symptom onset with only 20.25% of patients presenting within 6 months of onset of symptoms (25).

Palpable cervical lymph nodes were demonstrated in 3.8% of participants, 3 patients, in the Nyabenda et al study with only 1 of these confirmed as metastatic squamous cell carcinoma (25). In a retrospective cross-sectional study by Cantu et al investigating lymph node metastases involving 704 patients with primary or recurrent malignant tumors of the paranasal sinuses at a tertiary cancer centre, 43.3% of tumors involved the ethmoid sinus while 56.7% involved the maxillary sinus. Ethmoid sinus tumors had the least frequent nodal involvement at 1.6% while 8.3% of maxillary sinus tumors demonstrated nodal involvement. Overall proportion of patients with N0 status at presentation was 94.6% (31). In KNH, only 55 cases were assessed for nodal metastases in Mugwe et al study. Of these, only 45.5% of cases had nodal involvement confirmed by fine needle aspiration cytology (29).

Histopathological assessment is important in identifying the definitive diagnosis and aid in developing treatment strategies for the presenting lesions. Among the non-neoplastic masses, nasal polyps were most common at 80.3% according to Bist et.al, angiofibroma represented the most common benign neoplasms at 35% and squamous cell carcinomas were the most common malignant neoplasm at 33.33% with majority being located in the nasal cavity. Histopathology also changed the diagnosis in 3 patients to inflammatory nasal polyps where a clinical diagnosis of inverted papilloma was made (23). In Nyabenda et al, nasal polyps comprised the majority of non-neoplastic masses at 42.9%. lobular capillary hemangioma

was the most common benign neoplastic mass at 11.39% followed by inverted papilloma at 10.12% and squamous papilloma at 8.86%. malignant lesions comprised 11.4% with squamous cell carcinoma comprising 5.06% (25). Malignant tumors of the sino-nasal cavities are generally rare with an overall incidence of 0.2%-0.8% of all cancers and 3% of all head and neck tumors according to WHO (1). In Mugwe et al study, the commonest histological finding was anaplastic carcinoma at 40.3% followed by squamous cell carcinoma at 37.5%. Adenocarcinoma and malignant melanoma were the least common at 2.8% (29).

Initial histopathological assessment is not always conclusive, and immunohistochemistry (IHC) plays a vital role in differentiation of these masses. Bist et al demonstrated the importance of IHC where 2 masses with a diagnosis of round blue cell tumor reported as inconclusive after histopathology, were confirmed to be olfactory neuroblastoma (23). There is also considerable overlap of histologic features of sinonasal malignant tumors to those in other parts of the body. This is also seen among the malignant lesions within the sinonasal cavity where they share numerous markers. Neuroendocrine carcinoma and sinonasal undifferentiated carcinoma, for example, express pancytokeratin. However, sinonasal undifferentiated carcinoma lacks chromogranin while the former expresses both chromogranin and synaptophysin (32)

On radiological exam, Nyabenda et al demonstrated involvement of more than one region of the sinonasal cavity in 53% of the cases. Nasal cavity alone was involved in 29% while maxillary sinus involvement alone was seen in 4% of cases. This was attributed to late presentation by the patient and aggressiveness of disease. There was associated difficulty in differentiating long standing mucus from sinonasal masses on CT imaging and MRI was unavailable in these instances (25). Majority of tumors were found in the maxillary sinus at 91.6% followed by ethmoid sinus in the Mugwe et al study. No involvement of sphenoid or frontal sinus was reported (29). In Bist et al, masses were confined to nose and paranasal sinus in 65.26% with 28.2% of PNS CT scans demonstrating bony erosion all of which were malignant lesions (23). Islam et al conducted a descriptive cross-sectional study evaluating CT scan evaluation of malignant paranasal sinus masses and corelating those findings with the histopathological results. They used bone erosion, sclerosis of adjacent bone, extension to surrounding soft tissue, sinus opacification and calcification within the mass as radiological features for malignancy. They reported tissue density measurements did not aid in distinguishing malignant from benign masses. 21.1% of the masses were classified as

malignant using their radiologic criteria whereas 19.7% of the masses were classified as malignant based on histopathology. They concluded that CT scan alone when used to diagnose malignant masses, had a sensitivity of 93.3% and a specificity of 96.7% with a positive predictive value of 87.5% and a negative predictive value of 96.1% (33). In a prospective study assessing a spectrum of findings on CT images in patients with sinonasal neoplastic masses, Sivalingam et al demonstrated that most malignant lesions presented with significant bony destruction with benign lesions producing mild erosion and bony expansion (34).

2.6 Study Justification

Sinonasal masses represent a diverse spectrum of ENT diseases that are a common cause of patient morbidity and mortality. The clinical presentation is similar for both neoplastic and non-neoplastic masses and morphologically the masses are often indistinguishable. Depending on severity of disease, extension and most prominent complaint, patients may be reviewed by another specialist before appropriate referral to an otorhinolaryngologist. There is paucity of data on the pathological spectrum of sino-nasal masses as well as their clinical and radiological findings among patients presenting at the Kenyatta National Hospital. This study aims to identify the spectrum of these sinonasal masses for better understanding of their presentations, subtypes, and disease extent at presentation. This will allow early diagnosis, improve patient care, and help develop a standardized approach to diagnosis of these lesions at our institution.

2.7 Research Question

What is the clinico-pathological profile of sinonasal masses presenting at the Kenyatta National Hospital?

2.8 Broad Objective

To determine the clinico-pathological profile of different types of sino-nasal masses as seen at the KNH

2.8.1 Specific Objectives

1. To describe the clinical presentation and demographic patterns of patients with sinonasal masses seen in KNH
2. To determine the distribution of various sinonasal masses among the different demographic groups.

3. Determine pattern of sinus involvement on paranasal sinus computed tomography scan.
4. To determine the various histopathological conditions that present in the sinonasal tract.
5. To correlate radiological and histopathological findings of sinonasal masses.

3.0 METHODOLOGY

3.1 Study design

This was a hospital based descriptive cross-sectional study.

3.2 Study Setting

The study setting was Kenyatta National Hospital ENT, medical, maxillofacial, ophthalmology and oncology departments.

3.3 Study Population

The study population included patients diagnosed with sinonasal mass at the KNH ENT or presenting at the medical, maxillofacial, ophthalmology and oncology departments.

3.4 Inclusion Criteria

1. Patients who presented with a sinonasal mass at the Kenyatta National Hospital.
2. Patients who already had a histological diagnosis of a sinonasal mass and were on follow-up but not started treatment.
3. Congenital masses involving the sinonasal cavity.
4. Patients/guardians who consented and assented to the study.

3.5 Exclusion Criteria

1. Masses from the postnasal space and masses whose primary origin could not be determined.

3.6 Sample Size Determination

The sample size for this study was estimated using the Cochran formula.

$$n = \frac{Z^2 p(1-p)}{d^2}$$

Where n is the calculated sample size assuming a finite population of sino-nasal mass patients.

Z is the statistic representing 95% confidence level of confidence = 1.96

P is the prevalence of sino-nasal masses according to a study carried out in India that found the prevalence to be 3.52% (34).

d is the desired level of precision of 5%

$$n=\frac{1.96^2 \times 0.0352 \times 0.9648}{0.05^2}$$

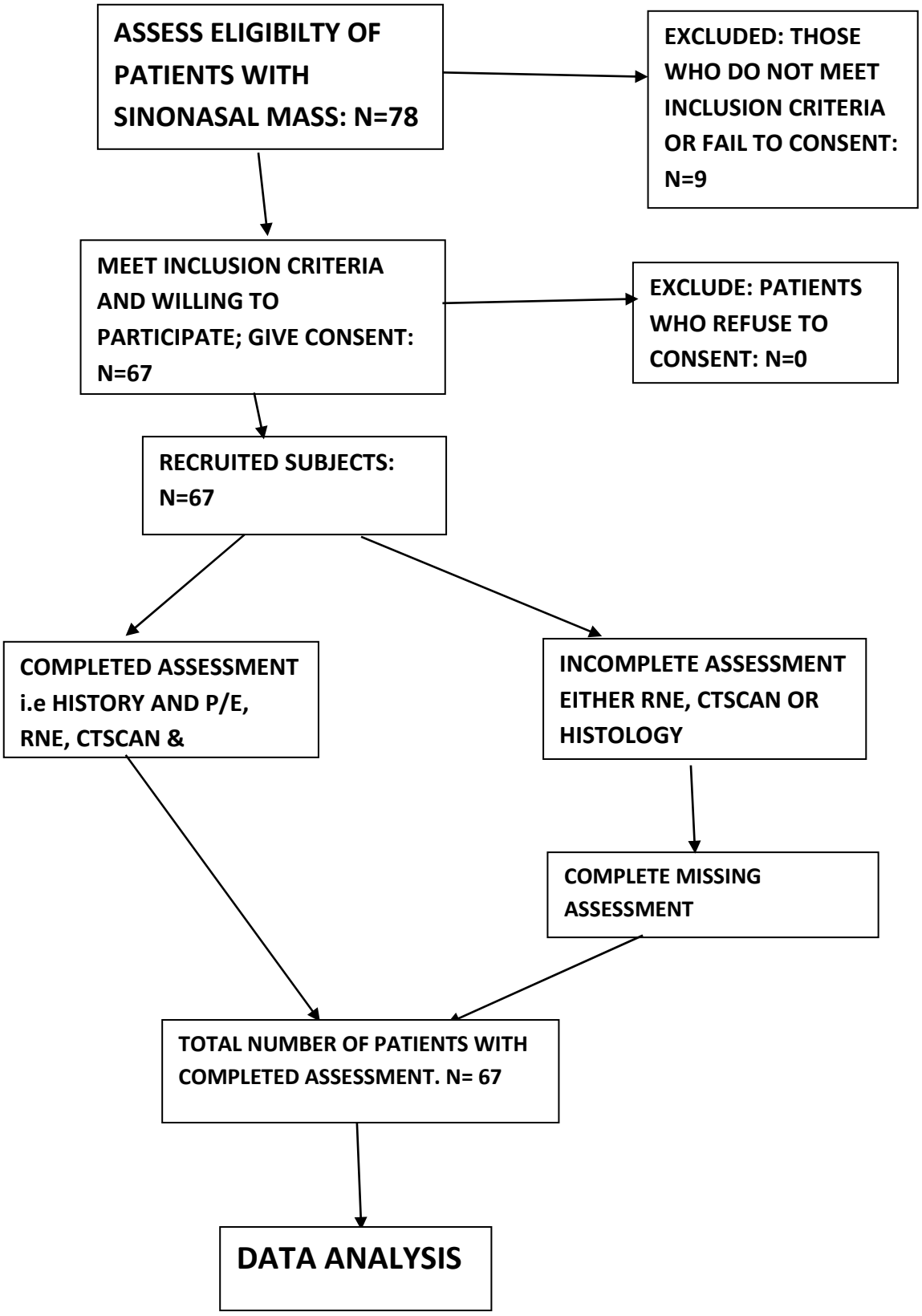
n = 52

Where n is the minimum sample size.

Therefore, a minimum of 52 participants was required however a total of 67 participants were recruited to the study.

3.7 Sampling Technique

Sampling was conducted by Convenience sampling technique.



3.8 Tools and Materials

The study tools and materials included:

1. Data collection sheet (Appendix III)
2. Thudicum nasal speculum
3. Rigid nasal endoscope-
    - Karl Storz Hopkins II 7230 AP straight forward endoscope 0^0, Germany
    - Karl Storz Hopkins II 7230 BP straight forward endoscope 30^0, Germany
4. Calibrated Karl Storz light source Power-LED 175 20161401-1, Germany
5. Oxymetazoline decongestant with local anaesthesia
6. Head light
7. Appropriate personal protective equipment

3.9 Study Duration

The study was conducted over 1 year from the time of approval by the KNH-UON Ethics and Research Committee.

3.10 Study Procedure

In this study, patients with a sinonasal mass at KNH were the target population. This included those with confirmed histological diagnosis and those assessed during their index presentation at KNH. The objectives and purpose of the study was explained by the principal researcher. If the patient/guardian understood and agreed to participate in the study, they were required to give a written informed consent and assent. Patients who met inclusion criteria were recruited to the study. The patient's history and clinical presentation was captured in the data collecting tool followed by a full physical examination as per standard clinical practice with emphasis on nose, ear, and oral exam. Patients were sent for Paranasal sinus (PNS) CT imaging then booked for rigid nasal endoscopic assessment of the mass and biopsy.

Nasal endoscopy was carried out using appropriate personal protective equipment. General anaesthesia was used during rigid nasal examination for pediatric patients. For the adult population, general or local anaesthesia was used. Rigid nasal endoscopy began with application of topical nasal decongestant which was allowed to take effect. With the head in neutral position, a 0^0 or 30^0 3mm or 4mm rigid endoscope was used for thorough examination of the nasal cavity and an adequate biopsy was taken for histopathology. Masses with

contraindication to punch biopsy were recommended for excision and the biopsy sent for histology. Masses that do not require histological confirmation e.g. nasal polyps were not biopsied.

Patients who previously had radiological imaging and histology reports were recruited but only underwent physical examination without biopsy. Those with radiological results only were also recruited and underwent nasoendoscopy and biopsy. The biopsies were submitted to the pathology department where they were fixed in 10% formalin, embedded in paraffin, and sectioned at 3-5 microns and later stained with hematoxylin and eosin. Fungal staining was also used where appropriate. Special stains for immunohistochemistry were used when diagnosis is inconclusive.

3.11 Data Collection Tool (Appendix IIIa)

Our data collection tool was in four parts. The first part captured the demographic data. The second part captured clinical and disease specific characteristics, third part captured radiological data while the fourth will contain histological diagnosis.

3.12 Data Management and Statistical Analysis

All data collected from the questionnaire was stored using non-identifiers in a database using Microsoft Excel to maintain confidentiality. The data was compiled, cross checked and rectified as per the questionnaire. The questionnaires were kept in a lockable cabinet with access restricted to the investigator and supervisors.

The data collected was analyzed using IBM SPSS version 22.0 package. Descriptive analysis for continuous variables like age involved mean, standard deviation, and range. The analysis of categorical data included calculation of percentages and frequency distribution. The significant (P) value and correlation values were determined by Fisher's Exact test by correlating two variables at a time, age, gender, risk factor, and site of tumour. $P< 0.05$ were considered significant and $P>0.05$ was considered to be insignificant. Logistic regression analysis was used to identify the degree to which various variables predicted likelihood of a malignancy.

3.13 Quality Control

A pre-test of the questionnaire was carried out to clarify grammar and language used to avoid bias and misinterpretation of the questions. The principal investigator carried out all the

interviews and physical examinations. Nasal endoscopy was carried out by the principal investigator with assistance from a senior resident in the ENT Head and Neck Program and/or consultant ENT. Biopsy specimens were reviewed by a pathologist. Pathology reports obtained from institutions outside KNH were accepted if reviewed by an in house pathologist and deemed valid. Radiological scans from institutions outside KNH were reviewed by a radiologist from KNH radiology department. Those deemed to be of poor quality were repeated. The quantitative and qualitative data collected was cross checked for any inconsistencies and outliers rectified.

3.14 Ethical Considerations

The study was carried out after approval by the KNH/UON Ethics and Research Committee. Informed consent was obtained from the patient, if they are 18years old and above, or from the guardian, if they are less than 18 years old, after explaining to them the objectives, methodology, risks, and benefits of the study. The participants who opted out of the study continued to receive care without discrimination.

All patients' information was held in confidence and was for the purpose for which this study is intended for only. Procedures undertaken during the study were per standard protocol for investigating sinonasal masses. There was no extra cost encountered by the patient other than that for standard protocol management of sinonasal mass.

There was no conflict of interest in this study.

3.15 Study Result Dissemination Plan

The findings of the study shall be disseminated to the Kenyatta National Hospital, University of Nairobi, and Cancer Diseases Hospital, presented in medical conferences, and published in medical journals and public media where necessary for the benefit of the medical profession and the lay public. A soft copy of the dissertation will be available at the UoN e-repository on the UoN website **(http://erepository.uonbi.ac.ke**). Hard copies of the study will be available at the UoN Department of Surgery, College of Health Sciences Library, and the ENT department library. A manuscript will be prepared and submitted for publication in a journal as part of the fulfillment of Master of Medicine in Otorhinolaryngology, Head and Neck Surgery.

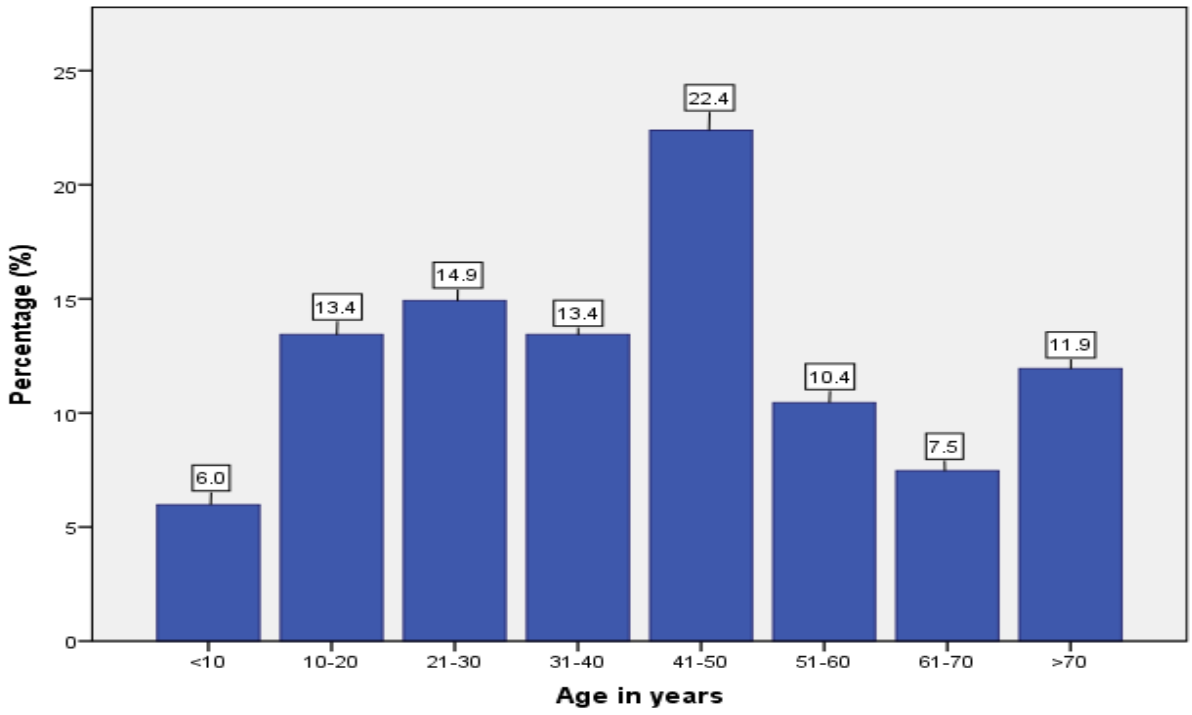
4.0 RESULTS

4.1 Demographic Information

Data collected was normally distributed as determined by the Shapiro-Wilk test. The data was analyzed using frequency tables and charts. Fisher's exact test was used to establish association between sinonasal masses and respective variables

A total of 67 patients were included in the study. Of these, the proportion of female and male participants was 50.7% and 49.3% respectively with a M:F ratio of approximately 1:1. The age range of patients was from 1 to 83 years with a mean age of 40.86 ± 20.8 years.

Figure 3: Age distribution of study population



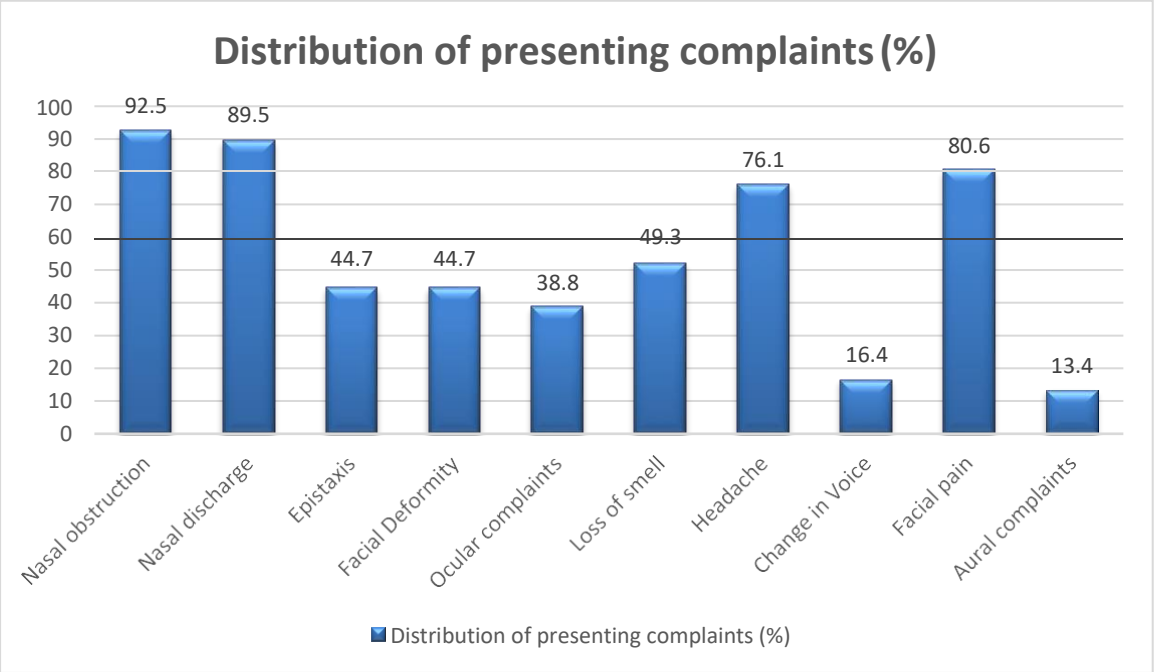
4.2 Clinical Presentation

4.2.1 Presenting Symptoms

Majority of patients presented with multiple symptoms with nasal obstruction being the commonest complaint noted in 92.5% followed by nasal discharge at 89.5%. Aural complaints were the least reported complaints at 13.4%. Majority of nasal discharge was

bilateral at 52.2% with nasal obstruction showing an equal distribution between unilateral and bilateral cases at 46.2%, however, the majority of epistaxis and facial deformity complaints were unilateral at 34.3% and 38.8% respectively.

Figure 4: Distribution of presenting complaints



4.2.2 Duration of symptoms

The range of presentation of symptoms was between 3 to 60 months with nasal obstruction and nasal discharge accounting for the longest duration. The mean duration of nasal obstruction and nasal discharge symptoms was 14.54 (±13.5) and 12.13 (±13.3) months respectively. Mean duration of symptoms for epistaxis was 3.17(±1.95) months and 4.73(±2.81) months for deformity.

4.3 Physical Examination

The most common physical examination finding was nasal mass at 85.1% followed by cranial nerve dysfunction at 62.7%. Majority of cases of orbital and cheek deformity were unilateral at 32.8% and 7.4% respectively compared to 2.9% and 0% with bilateral deformity involving the respective sites. 34.3% of patients with orbital deformity presented with proptosis. Palpable cervical lymphadenopathy was present in 14.9% of patients involving I, II and III cervical lymph node levels. Of these, 70% (7 patients) involved level II with more than half, (4 patients), being bilateral. Level I accounted for 20% (2 patients) of palpable lymph nodes

with level III seen in only 10% (1patient). Cranial nerve involvement was present in 62.7% of patients of which 31.3% exhibited either single or multiple cranial nerve deficits each. Most commonly involved cranial nerves were I, II and III at 49.3%, 11.9% and 22.4% respectively. However, cranial nerve I deficits were based on symptomatic reporting of loss of smell. Only 8 patients (11.9%) of those with cranial nerve II complaints were evaluated by an ophthalmologist to define the extent of deficit. Trismus was the least common finding at 4.5% with palatal deformity and abnormal otoscopic findings demonstrated in 8.9% of patients each.

Table 1: Distribution of physical findings and their frequency

	Frequency	Percentage (%)
Nasal mass visible	57	85.1
Cranial nerve involvement	42	62.7
Septal deformity	21	31.3
Orbital deformity	24	35.8
External nasal deformity	18	26.9
Abnormal nasal mucosa	11	16.4
Cervical lymphadenopathy	10	14.9
Palatal deformity	6	8.9
Abnormal otoscopic exam	6	8.9
Cheek deformity	5	7.5
Trismus	3	4.5

Table 2: Frequency and distribution of cranial nerve involvement

Cranial nerves	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
frequency	33	8	15	6	14	6	0	0	2	2	0	1
%	49.3	11.9	22.4	8.9	20.9	8.9	0	0	2.9	2.9	0	1.5

Table 3: Location of mass on nasoendoscopy and laterality

Site	Frequency of involvement (%)	Laterality	
		Right	Left
Floor of nasal cavity	8 (11.9%)	7 (10.4%)	1 (1.5%)
Inferior turbinate	37(55.2%)	29 (43.3%)	14 (20.9%)
Middle turbinate	54 (80.6%)	44 (65.7%)	33 (49.3%)
Middle meatus	59 (88.1%)	48 (71.6%)	39 (58.2%)

Table 3 demonstrates the frequency of involvement of various subsites on nasoendoscopy as a proportion of total number of patients. All patients had nasoendoscopy done. Majority of nasal masses were seen to involve the middle turbinate and middle meatus at 80.6% and 88.1% respectively with frequency of involvement of the right side higher in all subsites compared to the left.

4.4 Radiological findings

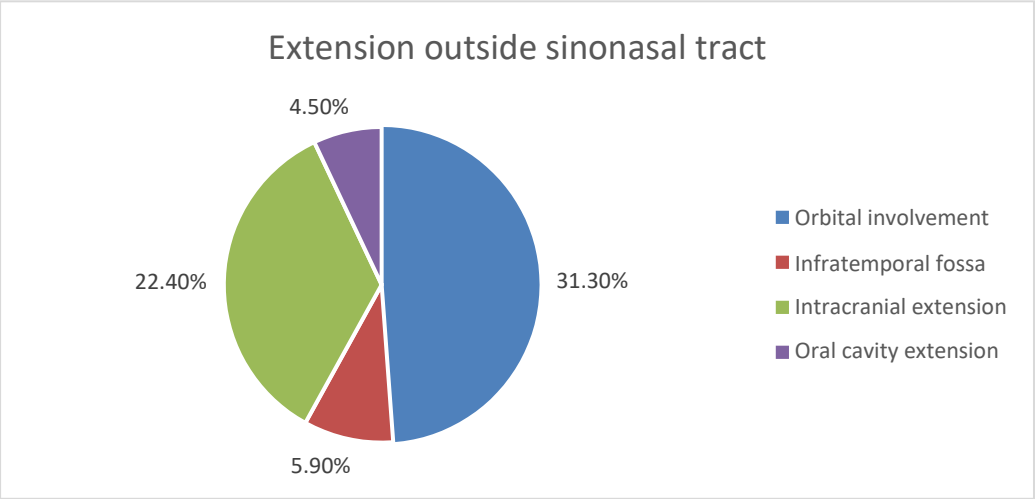
4.4.1 Sinonasal cavity involvement

Table 4: Frequency of involvement of sinonasal cavity sites and laterality

Location	Frequency as % of total (n=67)	Laterality	
		Unilateral	Bilateral
Maxillary sinus	53 (79.1%)	38 (56.7%)	15 (22.3%)
Ethmoid sinus	59 (88.1%)	22 (32. 8%)	33 (49.3%)
Frontal sinus	22 (32.8%)	12 (17.9%)	10 (14.9%)
Sphenoid sinus	22 (32.8%)	13 (19.4%)	9 (13.4%)
Nasal cavity	55 (82.1%)	35 (52.2%)	20 (29.9%)

Involvement of sinonasal tract was reported where a discrete mass was seen or opacification in images where a discrete mass could not be delineated. In our study, involvement was seen in decreasing frequency in ethmoid sinus, nasal cavity and maxillary sinus at 88.1%, 82.1% and 79.1% with frontal and sphenoid sinus demonstrating involvement in approximately a third of the cases. Majority of ethmoid sinus involvement was bilateral at 49.3% with maxillary sinus and nasal cavity demonstrating higher incidence of unilateral involvement at 56.7% and 52.2% respectively

Figure 5: Frequency of extension outside the sinonasal tract



Extra-sinonasal tract involvement had a higher incidence in the orbital cavity at 31.3% followed by intracranial extension at 22.4% as seen in Figure 4. This mirrored finding of bony erosion seen on the CT scans with erosion of lamina papyracea seen in 29.9% of cases with cribriform plate erosion involving 23.9%. Hard palate involvement was the least documented of the cases with 9% of which half (4.5%) showed oral cavity extension of sinonasal mass.

4.5 Histopathology

Non-malignant cases accounted for 62.7% of cases with malignant cases accounting for 37.3%. Figure 5 below demonstrates the distribution of the various histological categories in the study population.

Table 5: Distribution of non-malignant sinonasal lesions

Histology and diagnosis		**Frequency**
Inflammatory polyp	Allergic fungal rhinosinusitis	3 (4.5%)
	Chronic rhinosinusitis	14 (20.9%)
	Invasive fungal rhinosinusitis	3 (4.5%)
Mucocele		3 (4.5%)
Osteoma		1 (1.5%)
Nasal dermoid		1 (1.5%)
Inverted papilloma		7 (10.4)
Antrochoanal polyp		7 (10.4%)
Encephalocele		1 (1.5%)
Capillary hemangioma		1 (1.5%)
Solitary fibrous tumor		1 (1.5%)

Table 6: Distribution of malignant sinonasal lesions

Histology		Frequency
Squamous cell carcinoma	Invasive papillary	1 (1.5%)
	Moderately differentiated	4 (6.0%)
	Poorly differentiated	4 (6.0%)
	Basaloid	1 (1.5%)
Adenocarcinoma	Intestinal type	1 (1.5%)
	Low grade mucinous	1 (1.5%)
Olfactory Neuroblastoma		2 (3.0%)
Sinonasal neuroectodermal tumor		1 (1.5%)
Undifferentiated sinonasal carcinoma		2 (3.0%)
Spindle cell tumor		1 (1.5 %)
Malignant mucosal melanoma		3 (4.4%)
Biphenotypic sarcoma		1 (1.5%)
Malignant high grade small round cell tumor		1 (1.5%)
Mucoepidermoid carcinoma		1 (1.5%)
Sinonasal Rhabdomyosarcoma		1 (1.5%)

Tables 5 and 6 above show the distribution of malignant and non-malignant masses based on histopathology. Among the non-malignant cases, inflammatory polyps accounted for the majority of cases with 29.9% followed by inverted papillomas and antrochoanal polyps at 10.4 each. Squamous cell carcinoma represented the majority of malignant lesions accounting for 14.9% of all lesions with moderately and poorly differentiated variants having equal distribution at 6.0% each. Majority of malignant masses presented at an advanced stage with T3 being the least stage of tumor presentation. T4b disease was seen in 16.4% of cases followed by T4a disease at 14.9% while T3 disease accounted for 6% of malignant cases. Nodal involvement was mostly bilateral with N2c accounting for 7.5% of cases. Metastatic disease was only seen in 2% of cases.

Table 7: Distribution of histopathology results in various age groups

Age (years)	Histopathology result		Total	p-value =
	Non-malignant	Malignant		
0-10	3 (4.4%)	1 (1.5%)	4 (6.0%)	0.01
11-20	6 (9.0%)	3 (4.5%)	9 (13.4%)	
21-30	9 (13.4%)	1 (1.5%)	10 (14.9%)	
31-40	7 (10.5%)	2 (3.0%)	9 (13.4%)	
41-50	9 (13.4%)	6 (8.9%)	15 (22.5%)	
51-60	3 (4.5%)	4 (6.0%)	7 (10.4%)	
61-70	2 (3.0%)	3 (4.4%)	5 (7.5%)	
71-80	3 (4.5%)	4 (6.0%)	7 (10.4%)	
>81	0 (0%)	1 (1.5%)	1 (1.5%)	
Total	42 (62.7%)	25 (37.3%)	67 (100%)	

Considering all sinonasal masses in this study, lesions seen in the 5th decade accounted for 22.5% of all cases followed by the 3rd decade with 14.9% of cases. Within the malignant mass group, the majority of cases were seen in the 5th decade at 8.9% of total cases followed by 6th and 7th decades at 6.0% each with a mean age of 48.6 years. On the other hand, majority of inflammatory masses were seen in the 3rd decade (13.4%) closely followed by the 5th and 4th decades at 8.9% and 7.5% respectively. Only one case was seen in the 9th decade and was malignant in origin. There is an association between age distribution and various histology with spearman p value = 0.0l

Immunohistochemistry (IHC) was used to determine diagnosis in patients with inconclusive preliminary histology. 9 (13.4%) out of 67 patients had inconclusive histology which required immunohistochemistry. Most common initial histology requiring IHC in our study were malignant high grade small round cells 2 (3%), spindle cell tumor 2 (3%) and undifferentiated sinonasal carcinoma 2 (3%). Only 5 (7.5%) had IHC done with the rest missing out due to misplaced specimens. Table 8 below shows a comparison between the preliminary histology and the resultant diagnosis after immunohistochemistry.

Table 8: Bivariate analysis between malignant histological diagnosis and radiological and cranial nerve findings

Variable	Malignant lesion	Non-malignant lesion	Odds Ratio (OR)	P value
Maxillary sinus involvement	6	47	1.006	0.993
Frontal sinus involvement	12	10	2.46	0.094
Sphenoidal sinus involvement	13	9	4.46	0.007
Nasal cavity involvement	21	35	0.97	0.96
Orbital cavity involvement	17	3	13.27	<0.001
Cribriform plate erosion	13	3	15.76	<0.001
Lamina papyracea erosion	17	3	19.5	<0.001
Nasal septum erosion	8	1	21.0	0.006
Sinus wall erosion	17	7	8.75	<0.001
Extension outside sinonasal tract	14	0	58.8	<0.001
CN I deficit	16	17	3.05	0.036
CN II deficit	13	5	6.167	0.002
CN III deficit	14	1	24.23	<0.001
CN V deficit	11	3	11.28	0.001

Table 8 above describes the association between various radiological and physical examination findings and histological diagnosis. There is an association between involvement of paranasal sinus and finding of malignant sinonasal mass with p value of <0.05 seen in all except frontal sinus and maxillary sinus which showed no association with a p value of 0.094 and 0.993 respectively. Similarly, nasal cavity involvement of paranasal sinus CT scan showed no association with malignant histological diagnosis with a p value of 0.96. Other variables such as orbital cavity involvement, extension outside the sinonasal tract, cranial nerve deficit, and erosion of cribriform, lamina papyracea nasal septum and sinus wall all showing significant association.

The variables in Table 8 showing significant association (p value <0.05) were subjected to multivariate analysis. The data on histological diagnosis was first converted to binary data i.e., malignant vs non-malignant diagnosis. The variables were subjected to logistic

regression analysis through a forward stepwise method to control for the confounding variables. Table 9 below shows the variables that fit the logistic regression model.

Table 9: Logistic regression analysis of independent determinants of malignancy

Variables	**Crude Odds ratio**		**Adjusted Odds ratio**	
	Value	p-value	Value	p-value
Lamina papyracea erosion	19.5	<0.001	1.727897	0.799
Extension outside sinonasal tract	58.8	<0.001	190.5065	0.003
CN III deficit	24.23	<0.001	59.5255	0.031
Orbital cavity involvement	13.27	<0.001	91.11773	0.038
Nasal septum erosion	21	0.006	8.158379	0.204

After controlling for confounders, orbital cavity involvement, extension outside the sinonasal cavity and cranial nerve III deficit were found to be the only independent determinants of malignancy status by a factor of 91, 190 and 59 times respectively. This was significant as demonstrated by the p values of 0.038, 0.003 and 0.031 respectively.

CHAPTER 5: DISCUSSION

Sinonasal masses offer a wide variety of pathological entities that affect the entire spectrum of age groups. In our study, the age range was between 1 and 83 years with a mean age of 40.86 ± 20.8 years. This almost mirrors the study by Bist et al who found an age distribution between 6 and 80 years with a mean age of 39.4 years (23). In Rwanda, Nyabenda et al found the average age of presentation to be 2-79 years with a mean age of 36.5 years (25). In a retrospective analytical study over five years in Nigeria, Bakari et al found the age range to be between 5-64 years with a median age of 33.3 years (26). The difference in mean age between Bakari et al and this study can be accounted for by the lack of participants in the 8^{th} and 9^{th} decades. In a retrospective study of 72 cases of carcinoma of paranasal sinuses over a 10-year period, Mugwe et al found the mean age of presentation to be 49.7years with an age range of 10-80 years (29). This difference may be attributed to the fact that our study included non-malignant masses which tend to have earlier age of presentation, hence lowering the mean age.

The male to female (M: F) ratio in our study was approximately equal at 1:1. This was almost similar to Nyabenda et al study which demonstrated a M: F ratio of 1:1.25 for all sinonasal masses and Bakari et al at 1:1.12 (25,26). In a prospective cross-sectional study by Abu Hena et al of 50 cases with sinonasal masses, the M: F ratio was 3.5:1 (27). The higher M:F ratio compared to our study, might be attributed to fewer cases in their study as well as population demographics in their region. The M: F ratio for malignant lesions for our study was 1.4:1. This was in contrast to Mugwe et al's study that demonstrated a high M: F ratio of 3:1. This can be attributed to the size of the study population with the latter accounting for 72 cases of malignant lesions while our study only had 25. The M:F ratio for non-neoplastic cases was 1:1.26 in our study.

Nasal obstruction was the most common presenting complaint in our study at 92.5% followed by nasal discharge at 89.5%. A similar pattern was seen in Bist et al's study with nasal obstruction accounting for 87.27% while nasal discharge had 69.1% (23). In Talukder et al study, the majority of presenting symptoms were secondary to nasal obstruction (95%) with nasal discharge second at 48% (36). However, in contrast to their study where facial pain and headache each accounted for 3% and 15%, our study demonstrated higher proportions of this variables at 80.6% and 76.1% respectively. Visible nasal mass was the most prevalent physical examination finding at 85.1% followed by cranial nerve deficits with cranial nerve I

most prevalent at 49.3%. Cervical lymphadenopathy was reported in 14.9% of cases all of which were seen in malignant neoplasms thus approximately 40% of malignant cases had cervical lymphadenopathy. This is in contrast to Cantu et al who demonstrated nodal involvement in 5.4% of study participants with primary or recurrent malignancies of paranasal sinuses (31). This can be attributed to their large study sample of 704 participants. Mugwe et al study demonstrated nodal involvement in 45.5% of participants (29). Viran et al, while assessing risk factors for nodal involvement in patients with sinonasal squamous cell carcinoma, found nodal involvement at presentation to be 13.2% (37). Although the values may appear relatively similar to our study, the latter was conducted at a database level with 6448 participants. In addition, nodal involvement in our study was assessed only on physical examination whereas Viran et al used both physical examination and radiological evidence to assign nodal involvement hence not comparable.

Sinonasal cavity involvement on CT scan was seen in decreasing frequency in the ethmoid sinus, nasal cavity, and maxillary sinus at 88.1%, 82.1% and 79.1% respectively for all masses assessed. Sphenoid sinus involvement and frontal sinus were involved in only a third of cases. Mugwe et al demonstrated maxillary antral involvement in 91.6% compared to 2.8% involvement of ethmoid sinus. In his study no involvement of frontal or sphenoid sinus were reported (29). In Nyabenda et al study, more than one subsite of sinonasal tract (53%) was involved with sole maxillary sinus involvement in 4% of the cases.

Majority of sinonasal malignancies seen were of squamous cell carcinoma at 15%. This is in contrast to Mugwe et al study which reported anaplastic carcinoma as most prevalent at 40.3% with squamous cell carcinoma second most common with 37.5% (29) in his study, the incidence of malignant lesions was highest in the 6^{th} decade (23.6%) followed by the 5^{th} decade (20.8%) whereas our study demonstrated higher incidence of malignant lesions in 5^{th} decade at 8.9%. Nasal polyps were the most common of non-malignant category accounting for 37.3%. Patients who presented with nasal polyps had similar histology with varied final diagnosis. Of this group, 20.9% was secondary to chronic rhinosinusitis. Approximately 9% were suspicious for fungal elements and tested positive on potassium hydroxide fungal staining. This finding when interpreted in conjunction with CT scan invasion or remodeling allowed for diagnosis of invasive fungal sinusitis vs allergic fungal sinusitis at 4.4% each. Antrochoanal polyps and inverted papilloma represented the most common benign sinonasal at 10.4% each.

Immunohistochemistry was used in specimens with inconclusive histology. In our study, specimens requiring IHC were seen in the 2nd and 5th decades of life. In only one patient did IHC contribute to influencing change of treatment protocol. In that instance, a diagnosis of olfactory neuroblastoma was changed to plasmablastic lymphoma which would not require surgery but chemotherapy as the modality of treatment. In our study the stage of presentation of malignant lesions was stage IV at 31.3% of cases with stage III at 6%. This was similar to Mahalingappa et al's study that showed stage IV disease in 50% of their cases and only 20% had stage III disease at presentation (38). Similarly, Haque et al demonstrated stage IV disease in 40% of study cases however stage III was seen in increasing incidence at 32.5% (39). Thus, our study corresponds with the observed pattern of advanced stage of presentation of sinonasal malignancies.

Bivariate and multivariate analysis was used in our study population to assess the independent determinants for malignant diagnosis. The independent variables included sinus involvement, bone erosion seen on CT scan and presence of extension beyond the sinonasal tract which in this case focused on intracranial, infratemporal fossa and intraoral extension. Only orbital cavity involvement, extension beyond sinonasal tract and cranial nerve III deficits were significant independent determinants of a malignant diagnosis. We were unable to find other studies that looked into this kind of correlation for comparison.

5.2: Conclusion

Most common etiology of sinonasal masses are non-neoplastic with inflammatory polyps being predominant and common in the 3rd decade. Malignant sinonasal masses were common in the 5th to 8th decade, 40% of which had cervical lymphadenopathy with squamous cell carcinoma as the most prevalent histological type. Nasal obstruction followed by nasal discharge were the most common presenting symptoms in both malignant and non-malignant cases. Extension beyond sinonasal tract especially with orbital involvement and cranial nerve III palsy were the only independent determinants of a malignant diagnosis.

5.3: Recommendations

Histopathology should be used for proper identification of histological patterns of sinonasal masses with immunohistochemistry indicated for inconclusive histology.

5.4 Limitations of study

Involvement of paranasal sinuses and nasal cavity was also influenced by the degree of opacification of various parts of the sinonasal tract on CT scan. Opacification would also be due to poor mucus drainage hence the true picture of sinonasal cavity involvement may not be fully elucidated.

Cranial nerve I deficit was a symptomatic report of loss of smell and definitive tests of smell were not used thus the true extent of cranial nerve deficit was not identified.

TIMELINE

Year	2020												2021							2022
Month Activity	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	March
Concept development	■	■	■																	
Proposal Writing				■	■	■														
Proposal presentation							■													
Ethics Approval								■	■											
Data Collection										■	■	■	■	■	■	■	■	■		
Data Analysis																			■	
Presentation of Results																				■

BUDGET

ITEM	**TOTAL COST (Ksh.)**
Stationery	**15000**
Statistician fee	**35000**
Binding services	**5000**
Dissemination costs	**10000**
Personal protective equipment	**16000**
Miscellaneous	**20000**
Total cost	**101000**

Cost of study was met by the principal investigator.

REFERENCES

1. El-Naggar A, Chan J, Rubin Grandis J et al. WHO classification of head and neck tumours. 4th ed. International Agency for Research on Cancer (IARC); 2017;11-60.
2. Gupta R, Moupachi S, Poorey V. Sinonasal Masses: A Retrospective Analysis. Indian Journal of Otolaryngology and Head & Neck Surgery. 2012;65(1):52-56.
3. Flint, Paul W, Bruce H Haughey, Valerie J Lund, John K Niparko, and Marci M Lesperance. *Cumming Otolaryngology--Head And Neck Surgery*. 6th ed. Saunders, Elsevier, 2015;740-51.
4. Rodriguez D, Orscheln E, Koch B. Masses of the Nose, Nasal Cavity, and Nasopharynx in Children. RadioGraphics. 2017;37(6):1704-1730.
5. Mane P, Agale S. Clinicopathological study of Sinonasal Masses. Annals of Pathology and Laboratory Medicine. 2017;4(3):A261-A267.
6. Thompson L, Franchi A. New tumor entities in the 4th edition of the World Health Organization classification of head and neck tumors: Nasal cavity, paranasal sinuses and skull base. Virchows Archiv. 2017;472(3):315-330.
7. Barnes L, Eveson J, Reichart P et al. World Health Organization classification of tumours. Lyon: IARC Publications; 2005;10-80.
8. Cox J, Cox J, Ang K. Radiation oncology. 9th ed. Philadelphia: Mosby/Elsevier; 2010.
9. Sataloff R, Hartnick C. Sataloff's Comprehensive textbook of Otolaryngology, Head and Neck surgery. Jaypee; 2016;273-284.
10. Tumors of the nasal cavity - UpToDate [Internet]. [cited 2020 Jul 11]. Available from: https://www.uptodate.com/contents/tumors-of-the-nasal-cavity?search=tumors%20of%20the%20nasal%20cavity&source=search_result&selectedTitle=1~150&usage_type=default&display_rank=1
11. Pan W, Suami H, Corlett R, Ashton M. Lymphatic drainage of the nasal fossae and nasopharynx: Preliminary anatomical and radiological study with clinical implications. Head & Neck. 2009;31(1):52-57.
12. Junqueira L, Carneiro J. Basic histology. 15th ed. New York: McGraw-Hill Companies, Inc.; 2010;349-50.
13. Rosai J, Ackerman L, Rosai J. Rosai and Ackerman's surgical pathology. 10th ed. Edinburgh: Mosby; 2011;291-97.
14. Larsen P, Tos M. Origin of Nasal Polyps: An Endoscopic Autopsy Study. The Laryngoscope. 2004;114(4):710-719.

15. Gerth D, Tashiro J, Thaller S. Pediatric Sinonasal Tumors in the United States: Incidence and Outcomes. Journal of Surgical Research. 2014;186(2):676.

16. Alabi B, Afolabi O, Omokanye H et al. Clinical presentation and outcome of sinonasal tumors in a Nigerian Tertiary Hospital – 6-year review. Nigerian Medical Journal. 2017;58(3):92.

17. Raghavan P, Phillips C. Magnetic Resonance Imaging of Sinonasal Malignancies. Topics in Magnetic Resonance Imaging. 2007;18(4):259-267.

18. Lee K. Essential Otolaryngology. 11th ed. Blacklick: McGraw-Hill Publishing; 2012.

19. Vining E, Yanagisawa K, Yanagisawa E. The Importance of Preoperative Nasal Endoscopy in Patients with Sinonasal Disease. The Laryngoscope. 1993;103(5):512-519.

20. K Maru Y, Gupta Y. Nasal Endoscopy Versus Other Diagnostic Tools in Sinonasal Diseases. Indian Journal of Otolaryngology and Head & Neck Surgery. 2014;68(2):202-206.

21. Kandukuri R, Phatak S. Evaluation of Sinonasal Diseases by Computed Tomography. Journal of Clinical and Diagnostic Research. 2016;9-12.

22. Thompson L. Small round blue cell tumors of the sinonasal tract: a differential diagnosis approach. Modern Pathology. 2017;30(S1):S1-S26.

23. Bist S, Kusum A, Varshney S et al. Clinico-pathological profile of sinonasal masses: An experience in tertiary care hospital of Uttarakhand. National Journal of Maxillofacial Surgery. 2012;3(2):180.

24. Agarwal P, Panigrahi R. Sinonasal Mass—a Recent Study of Its Clinicopathological Profile. Indian Journal of Surgical Oncology. 2016;8(2):123-127.

25. Nyabyenda V. Clinico-pathological profile of sinonasal masses in Rwanda referral hospitals [Postgraduate]. University of Rwanda; 2016;16-26.

26. Bakari A, Afolabi O, Adoga A et al. Clinico-pathological profile of sinonasal masses: an experience in national ear care center Kaduna, Nigeria. BMC Research Notes. 2010;3(1).

27. Humayun A, Huq A, Ahmed S et al. Clinicopathological study of sinonasal masses. Bangladesh Journal of Otorhinolaryngology. 2010;16(1):15-22.

28. Lathi A, Syed M, Kalakoti P et al. Clinico-pathological profle of sinonasal masses: a study from a tertiary care hospital of India. Acta Otorhinolaryngologica Italica. 2011;31.

29. Peter M, Singh Bal I, Herbert Ouma O. A Retrospective Study of Carcinomas of the Paranasal Sinuses at The Kenyatta National Hospital Between January 1980 to December 1989 [Postgraduate]. University of Nairobi; 1991;34-42.

30. Sachdeva K, Naskar S. A Study of Neoplastic and Non-neoplastic Sinonasal Masses at a Tertiary Center. Clinical Rhinology An International Journal. 2017 Jan 1;10:66–9.

31. Cantù G, Bimbi G, Miceli R et al. Lymph Node Metastases in Malignant Tumors of the Paranasal Sinuses. Archives of Otolaryngology–Head & Neck Surgery. 2008;134(2):170.

32. Devi CP, Devi KM, Kumar P et al. Diagnostic challenges in malignant tumors of nasal cavity and paranasal sinuses. J Oral Maxillofac Pathol. 2019;23(3):378–82.

33. Islam T, Al-Azad S, Khondker L, Akhter S. CT evaluation of malignant PNS mass and histopathological correlation. Bangabandhu Sheikh Mujib Medical University Journal. 2016;6(1):33.

34. Sivalingam J, Sarawagi R, Raghuwanshi S et al. Sinonasal Neoplasia - Clinicopathological Profile And Importance of Computed Tomography. J Clin Diagn Res. 2015 Jun;9(6):TC01-04

35. Bhattacharyya R, Chakrabarti I, Giri I et al. A clinicopathological study of masses arising from sinonasal tract and nasopharynx in north Bengal population with special reference to neoplasms. The Egyptian Journal of Otolaryngology. 2015;31(2):98.

36. Talukder, D., Sarker, S., Ahasan, S., Haque, M., Arefin, M., Musabbir, N., Rahman, C. and Kabir, S., 2020. An Overview of Sino-nasal masses: A study from Dhaka Medical College Hospital. *Journal of Dhaka Medical College*, 28(1), pp.49-53.

37. Ranasinghe, V., Stubbs, V., Reny, D., Fathy, R., Brant, J. and Newman, J., 2020. Predictors of nodal metastasis in sinonasal squamous cell carcinoma: A national cancer database analysis. *World Journal of Otorhinolaryngology - Head and Neck Surgery*, 6(2), pp.137-141.

38. Mahalingappa, Y. and Khalil, H., 2014. Sinonasal malignancy: presentation and outcomes. *The Journal of Laryngology & Otology*, 128(7), pp.654-657.

39. Haque, M., Ali, M., Harun-Ar-Rashid, M., Islam, M., Rahman, M. and Chowdhury, M., 2014. Presentation of sinonasal carcinoma. *Bangladesh Journal of Otorhinolaryngology*, 19(2), pp.99-103.

APPENDICES

Appendix I (a): General Information Sheet

Participant study number: ….....

Study title: CLINICO-PATHOLOGICAL PROFILE OF SINONASAL MASSES AS SEEN IN KENYATTA NATIONAL HOSPITAL

Principle Investigator: Dr. Mwangi Kamau (postgraduate student in Ear, Nose and Throat surgery, University of Nairobi)

Supervisors: Prof. Herbert Oburra

Prof Muthure Macharia

Dr. Mary Omutsani

Introduction

Sino-nasal masses comprise a wide spectrum of conditions involving the paranasal sinuses and the nasal cavity and range from non-neoplastic to neoplastic lesions. They are a cause of considerable morbidity and mortality and often have non-specific symptoms at time of presentation. They are associated with distressing symptoms like nasal obstruction can also result in various complications that may affect a patient's quality of life.

We request your participation in this research study as we seek to establish the clinical and pathological patterns of this masses to enable optimal patient care.

We ask that you go through this form and ask any questions that you may have before agreeing to participate in this study.

Purpose of the study

The aim of this study is to determine the clinico-pathological profile of sino-nasal masses in our setup. The outcome of this study will be used to provide data for planning of resources and raising clinicians' index of suspicion.

Description of the study

Once you have accepted to take part in this study, you will be allowed to enquire further regarding the study and raise any concerns you may have. Once you are satisfied with the answers you have received you will be required to sign a consent form. The principal investigator will give you a questionnaire to fill that will capture your demographic data and clinical history. A head and neck examination including assessment of nasal cavity will be carried for these patients followed by nasal endoscopy and biopsy of the mass. We will then review your Paranasal sinus CT images.

Risks involved

This study will not affect you negatively in any way and there are no hidden charges in your participation. Treatment shall not be withdrawn if you do not participate.

Benefits

This will enable us to acquire vital data about different types of lesions in the nasal cavity and paranasal sinuses. It will also get a definitive diagnosis to allow planning for subsequent treatment and optimize care for our patients.

Costs and compensation

There will be no extra cost incurred for participating in this study other than usual charges for consultation, imaging and biopsy. No inducement or compensation will be provided.

Confidentiality

Your name will not appear in any of the documents and only a code number will be used as an identification marker.

Rights as a participant

You can voluntarily withdraw from the study at any time without any penalty.

Ethical issues

All the information that you give us will be used for this research study only. Only the researcher and the supervisors are privy to your raw information. Confidentiality will be maintained as no names will appear in the data collection sheet. All hard copy data will be

stored safely in a lockable cabinet in the Department of Surgery, UoN. All soft copy data will be password protected.

This proposal will be reviewed and approved by the KNH/UoN-ERC. It will be submitted to them through the Chairman of the Department of Surgery at the School of Medicine of the University after approval by my university supervisors.

Investigator's declaration

I as the principal investigator declare that no financial payments were received or made either to the supervisors or Kenyatta National Hospital nor received from any pharmaceutical companies or any other quarter to finance this study.

Please feel free to seek additional information through the contacts given below:

Principal investigator:

Dr. Mwangi Gabriel Kamau
Registrar E.N.T, Head and Neck Surgery
Department of Surgery
School of Medicine, UON
Email: kamaugabriel88@gmail.com
Mobile phone: 0727704835

Supervisors

Prof. Herbert Oburra
Professor E.N.T Head and Neck Surgeon
Senior Lecturer
The University of Nairobi, Department of Surgery
Email: oburra@uonbi.ac.ke

Professor Isaac Macharia (MBChB, MMED (ORL-HNS)
Professor and Consultant Otorhinolaryngologist
Department of Surgery (ENT)
University of Nairobi
Email: immuthure@gmail.com

Dr. Mary Omutsani
Consultant E.N.T Head and Neck Surgeon
Kenyatta National Hospital
Email: utsani@yahoo.com

Secretary, K.N.H/UoN-ERC
P.O. Box 20723 K.N.H, Nairobi
00202 Tel 020726300-9
Email: uonknh-erc@uonbi.ac.ke
Website:
http://www.erc.uonbi.ac.ke

Researcher's statement

I, the undersigned, have fully explained the relevant details of this research study to the participant named above and believe that the participant has understood and has willingly and freely given his/her consent.

Researcher's Name: _____

Date:_____**Signature**: _____

Appendix I (b): Patient consent form

I……freely give consent to take part in the study conducted by Dr. Mwangi Gabriel Kamau, the nature of which has been explained to me. I have been informed and have understood that my participation is entirely voluntary. I comprehend that if I so wish I can freely withdraw from the study and this will not in any way alter the care being given to me. The results of the study may directly be of benefit to me, my kin and other patients.

Signature/ Thumbprint

(self)……

Date……

Statement by the witness (where applicable)

I have witnessed the accurate reading of the consent form to the participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Name of witness……

Signature of witness/ Thumb Print …….

Date……

Appendix II (a): Faharasa/Dibaji

Utangulizi

Sino-nasal masses inaashiria aina za uvimbe zinazoadhiri sehemu ya pua na mianzi au shimo zilizoko kwenye mifupa ya uso. Hizi zaweza kuwa na sababu kadha wa kadha kama vile saratani na zisizosababishwa na saratani. Mara nyingi jinsi magonjwa haya yanavyomkabili mtu hufanana sana na ni vigumu mtu kutofautisha magonjwa yanayosababishwa na yasiyosababishwa na saratani.

Tunakuomba ushiriki katika utafiti huu wa kufumbua kiwango cha maambukizi haya ili tuweze kuimarisha afya ya waadhiriwa.

Tunakuomba usome fomu hii na uulize maswali yoyote ambayo unaweza kuwa nayo kabla ya kukubali kushiriki katika utafiti huu.

Sababu za utafiti

Kusudi la utafiti huu ni kutambua kiwango cha maambukizi, mifumo ya kidemografia na pia matatizo yanayo sababishwa na huu ugonjwa. Matokeo ya utafiti huu yatatumika kutengeneza dimbwi la data litakalo tumiwa kwa uundaji wa sera.

Maelezo ya Utafiti

Baada ya kupitia kwa kina maelezo haya kuhusu utafiti huu, utaruhusiwa kuuliza maswali yoyote na kuongeza matatizo yoyote ambayo unaweza kuwa nayo. Utakaporidhika na majibu uliyopokea utahitaji kutia sahihi fomu ya idhini. Mtafiti mkuu atakupa dodoso litakalochukua historia ya kidemografia na historia ya ugonjwa . Uchunguzi wa kichwa na shingo utafanyika na kwa wagonjwa watahitajika kuchukuliwa kipimo kutoka kwenye uvimbe huo ili iweze kuangaliwa kwa kina katika maabara yetu. Mgonjwa atahitaji kupigwa picha ya Paranasal sinus CT scan, itakayo ripotiwa.

Hatari zinazohusika

Utafiti huu hautakuathiri vibaya kwa namna yoyote na hakuna mashtaka yaliyofichika katika ushiriki wako. Matibabu hayataondolewa ukidinda kushiriki katika utafiti huu.

Faida

Taarifa tunayopata itatusaidia kuongeza maarifa kuhusa huu ugonjwa pamoja na kutengeneza dimbwi la data litakalo tumika kwa uundaji wa sera.

Siri

Jina lako halitaonekana kwenye nyaraka yoyote na namba ya nambari tu ndio itatumika kama alama ya utambulizi.

Matumizi ya Data

Kama habari zote za kisayansi tunatafuta kushiriki matokeo yetu na watu wengine wanaofanya masomo kama hayo. Kwa hiyo, matokeo yatatolewa katika mikutano ya kisayansi na kuchapishwa katika majarida ya kisayansi.

Uhuru

Unaweza kujiondoa kwa hiari yako wakati wowote bila adhabu yoyote.

Tamko la Mtaalam

Mimi kama mchunguzi mkuu natangaza kuwa hakuna malipo ya kifedha niliyopokea wala wasimamizi au hospitali ya Taifa ya Kenyatta kutoka kwa kampuni yoyote ya dawa au robo nyingine yoyote ili kujifunza utafiti huu.

Tafadhali jisikie huru kutafuta maelezo ya ziada kupitia anwani zilizopewa chini;

Mtafiti Mkuu:

Dr Mwangi Kamau

E.N.T, Kichwa Na Upasuaji wa shingo

Idara ya Upasuaji

Shule ya Matibabu, UoN

Barua pepe: kamaugabriel88@gmail.com

Simu ya mkononi: 0727704835

Wasimamizi:

Prof. Isaac Macharia

Profesa E.N.T, Kichwa na Upasuaji wa shingo

Mhadhiri mkuu

Chuo Kikuu cha Nairobi, Idara ya Upasuaji

Barua pepe: immuthure@gmail.com

Dr Mary Omutsani
Mshauri E.N.T, Kichwa na Upasuaji wa shingo
Hospitali ya Taifa ya Kenyatta
Barua pepe: utsani@yahoo.com

Katibu, K.N.H /UoN-ERC
S.L.P 20723 K.N.H, Nairobi 00202
Nambari ya simu 020726300-9
Barua pepe: uonknh-erc@uonbi.ac.ke
Tovuti: http://www.erc.uonbi.ac.ke

Appendix II(b): Fomu ya Makubaliano

Nimeelezwa utafiti huu kwa kina. Nimekubali kushiriki utafiti huu kwa hiari yangu. Nimepata wakati wa kuuliza maswali na nimeelewa kuwa iwaponina maswali Zaidi, ninaweza kumuuliza mtafiti mkuu au watafiti waliotajwa hapo awali.

Jina la Mshiriki…….
Sahihi ya Mshiriki…….
Tarehe……

PARENTAL CONSENT

Title: Clinico-pathological profile of sinonasal masses as seen at the Kenyatta National Hospital

Principle Investigator: Dr. Mwangi Gabriel Kamau (Postgraduate student in Ear, Nose and Throat surgery, University of Nairobi)

Supervisors: Professor Herbert Oburra

Dr. Mary Omutsani

I would like to tell you about a study being conducted by the above listed researchers. The purpose of this consent form is to give you the information you will need to help you decide whether or not your child should participate in the study. Feel free to ask any questions about the purpose of the research, what happens if your child participates in the study, the possible risks and benefits, the rights of your child as a volunteer, and anything else about the research or this form that is not clear. When we have answered all your questions to your satisfaction, you may decide if you want your child to be in the study or not. This process is called 'informed consent'. Once you understand and agree for your child to be in the study, I will request you to sign your name on this form. You should understand the general principles which apply to all participants in medical research:

i. Your child's decision to participate is entirely voluntary.
ii. Your child may withdraw from the study at any time without necessarily giving a reason for his/her withdrawal.
iii. Refusal to participate in the research will not affect the services your child is entitled to in this health facility or other facilities.

May I continue? **YES / NO**.

We will go over this information with you and you need to give permission in order for your child to participate in this study. We will give you a copy of this form for your records. Please know that once you give informed consent, your child too will be explained to as well what is intended and they too will fill an assent form to agree to be part of the study. We are asking for your consent to consider your child to participate in this study. This is a study that wants to find out the clinical and pathological profile of sinonasal masses as seen at the Kenyatta National Hospital

WHAT WILL HAPPEN IF YOU DECIDE YOU WANT YOUR CHILD TO BE IN THIS RESEARCH STUDY? If you agree for your child to participate in this study, the following things will happen: You will be interviewed by the principal investigator in a private area where you feel comfortable answering questions. The interview will last approximately 20 minutes. The interview will cover topics such as where you are coming from, your socio-economic status, review of any radiological imaging you have then examination of the nasal cavity. Examination of the nasal cavity will be done in theatre and a biopsy/ specimen of the mass will be taken for histological analysis by a pathologist. After the interview has finished, the principal investigator will ask for a telephone number where we can contact you if necessary. If you agree to provide your contact information, it will be used only by people working for this study and will never be shared with others. I may need to contact you to disseminate the results.

STUDY RISKS, HARM OR DISCOMFORT

There is no direct risk associated with this study.

STUDY BENEFITS

The study will not cost you any money. The data obtained will add to the knowledge and local data on the burden of Head and Neck cancers.

STUDY COST AND REFUND

You will not incur any costs when you participate in the study. There will be no monetary benefits for participating in the study.

RIGHT TO WITHDRAW

Your decision to have your child participate in this research is voluntary. You are free to decline or withdraw participation of your child in the study at any time without injustice or loss of benefits. Just inform the study staff and the participation of your child in the study will be stopped. You do not have to give reasons for withdrawing your child if you do not wish to do so. Withdrawal of your child from the study will not affect the services your child is otherwise entitled to in this health facility or other health facilities.

We will keep everything you tell us as confidential as possible. We will use a code number to identify your child in a password-protected computer database and will keep all of our paper records in a locked file cabinet. However, no system of protecting confidentiality can be

absolutely secure so it is still possible that someone could find out your child was in this study and could find out information about your child. Also, answering questions in the interview may be uncomfortable for you. If there are any questions you do not want to answer, you can skip them. You have the right to refuse the interview, or any questions asked during the interview. We will do everything we can to ensure that this is done in private.

If you have further questions or concerns about your child participating in this study, please call or send a text message to the study staff at the number provided at the bottom of this page. For more information about your child's rights as a research participant you may contact the Secretary/Chairperson, Kenyatta National Hospital-University of Nairobi Ethics and Research Committee Telephone No. 2726300 Ext. 44102 email uonknh_erc@uonbi.ac.ke. The study staff will pay you back for your charges to these numbers if the call is for study-related communication.

Your decision to have your child participate in this research is voluntary. You are free to decline or withdraw participation of your child in the study at any time without injustice or loss of benefits. Just inform the study staff and the participation of your child in the study will be stopped. You do not have to give reasons for withdrawing your child if you do not wish to do so. Withdrawal of your child from the study will not affect the services your child is otherwise entitled to in this health facility or other health facilities.

The person being considered for this study is unable to consent for him/herself because he or she is a minor (a person less than 18 years of age). You are being asked to give your permission to include your child in this study.

Parent/guardian statement: I have read this consent form or had the information read to me. I have had the chance to discuss this research study with a study counselor. I have had my questions answered by him or her in a language that I understand. The risks and benefits have been explained to me. I understand that I will be given a copy of this consent form after signing it. I understand that my participation and that of my child in this study is voluntary and that I may choose to withdraw it any time. I understand that all efforts will be made to keep information regarding me and my child's personal identity confidential. By signing this consent form, I have not given up my child's legal rights as a participant in this research study. I voluntarily agree to my child's participation in this research study: Parent/Guardian signature /Thumb stamp:_____Date_____Parent/Guardian printed name: _____

I, the undersigned, have fully explained the relevant details of this research study to the participant named above and believe that the participant has understood and has knowingly given his/her consent. Printed

Name: _____

Date: _____

Signature: _____

Witness Printed Name _____

Signature:_____Date; _____

ASSENT FORM

Title: Clinico-pathological profile of sinonasal masses as seen at the Kenyatta National Hospital

My name is Dr. Mwangi Gabriel Kamau. I am a resident doctor in the ENT, Head and Neck Surgical Unit at KNH. I am also a student conducting a research study. Permission has been granted to undertake this study by the Kenyatta National Hospital-University of Nairobi Ethics and Research Committee (KNH-UoN ERC Protocol No._____)

A research study is when doctors collect a lot of information to learn more about something. I am trying to learn more about the different masses affecting the nasal cavity and paranasal sinuses here at Kenyatta National Hospital. There will be at least 52 other people both children and adults participating in this study.

If you agree to be part of the study, your parents/ guardian will be asked information about you. This information obtained about you will help gather information about different masses affecting people of different ages.

You can ask questions any time. You can ask now. You can ask later. You can talk to me or you can talk to someone else.

If you do not want to be in the study, you do not have to be in it. Remember being in this study is up to you and no one will be upset if you do not want to be in the study. I will also ask your parents to give permission for you to be in this study but even if your parents say "yes", you can still say "no" and decide not to be in the study.

When we are finished with this study, we will write a report about our findings. This report will not include your name or that you were in the study. If you decide to stop after we begin, that is okay too. Your parents know about the study too.

If you decide to participate in this study, please sign your name.

I ....., want to be in this research study.

Signature……Date ……

Principal investigator:

Dr. Mwangi Gabriel Kamau
Registrar E.N.T, Head and Neck Surgery
Department of Surgery
School of Medicine, UON
Email: kamaugabriel88@gmail.com
Mobile phone: 0727704835

Supervisors

Professor Isaac Macharia (MBChB, MMED (ORL-HNS)
Professor and Consultant Otorhinolaryngologist
Department of Surgery (ENT)
University of Nairobi
Email: immuthure@gmail.com

Prof. Herbert Oburra
Professor E.N.T Head and Neck Surgeon
Senior Lecturer
The University of Nairobi, Department of Surgery
Email: oburra@uonbi.ac.ke

Dr. Mary Omutsani
Consultant E.N.T Head and Neck Surgeon
Kenyatta National Hospital
Email: utsani@yahoo.com

Secretary, K.N.H/UoN-ERC
P.O. Box 20723 K.N.H, Nairobi 00202
Tel 020726300-9
Email: uonknh-erc@uonbi.ac.ke
Website: http://www.erc.uonbi.ac.ke

APPENDIX III (A): DATA COLLECTION TOOL

STUDY TITLE: CLINICO-PATHOLOGICAL PROFILE OF SINONASAL MASSES AS SEEN AT THE KENYATTA NATIONAL HOSPITAL

DEMOGRAPHIC INFORMATION

Study number ……. Date …….

BIODATA

Age …….

Sex …….

Residence ……

Tobacco use ……. Pack years…….

Alcohol consumption…….

Occupation …….

CLINICAL DATA

COMPLAINTS	**DURATION (if present)**	**UNILATERAL**	**BILATERAL**
1.Nasal Obstruction ● Present ……. ● Absent …….	**……**		
2.Nasal Discharge ● Present ……. ● Absent …….	**……**		
3.Epistaxis ● Present …… ● Absent …….	**……**		
4.Deformity ● Present…… ● Absent …….	**……**		

6. Headache
    a. Present ……
    b. Absent ……
7. Ocular complaints
    a. Diplopia YES……. NO……
    b. Proptosis YES……. NO…….
    c. Epiphora YES……. NO…….
8. Loss of smell
    a. YES ……
    b. NO ……
9. Change in voice.
    a. YES …….
    b. NO …….
10. Facial pain
    a. YES……
    b. NO…….

PHYSICAL EXAMINATION

11. External nasal deformity **YES**…… **NO**…….

	Unilateral	**Bilateral**	**None**
11.Orbital deformity			
12.Cheek deformity			

13. Anterior rhinoscopy findings
    a. Normal nasal mucosa YES…… NO…….
    b. Nasal mass visible YES……. NO…….
    c. Septal deformity YES…… NO……

14. Oral exam
    a) Trismus YES……. NO……
    b) Palatal deformity YES……. NO……

15. Otoscopy findings

a) External auditory canal NORMAL……. ABNORMAL…….

b) Tympanic membrane NORMAL……. ABNORMAL…….

c) Middle ear cavity NORMAL……. ABNORMAL…….

16. Lymphadenopathy YES……. NO……

- Level…….

17. Cranial nerve involvement

CRANIAL NERVE	YES	NO
I		
II		
III		
IV		
V		
VI		
VII		
VIII		
IX		
X		
XII		

18. Nasoendoscopy

MASS INVOLVING	RIGHT	LEFT
Floor of nasal cavity		
Inferior turbinates		
Middle turbinates		
Middle meatus		

PARANASAL CT SCAN FINDINGS:

		UNILATERAL	BILATERAL
19.Paranasal sinus Involvement	**Maxillary**		
	Ethmoid		
	Frontal		
	Sphenoid		
Nasal cavity involvement			
20. Orbital cavity Involvement	**Extension to orbit YES……. NO…….**		
	Extension to orbit apex YES ……. NO…….		

21. Bone erosion present

a) Cribriform plate YES……. NO……

b) Lamina papyracea YES……. NO…….

c) Septum YES……. NO…….

d) Hard palate YES……. NO……

e) Sinus wall YES…… NO……

22. Extension to infratemporal fossa YES…… NO……

23. Intracranial extension YES……. NO……

24. extension to oral cavity YES…… NO……

24. STAGING (where applicable) ……

25. HISTOPATHOLOGICAL DIAGNOSIS:

- Histological Diagnosis……
- Inconclusive …….
- Immunohistochemistry (if inconclusive) …….
- Fungal staining (if fungal infection suspected) …….

26. COMPLICATIONS

Locoregional complications

- Orbital complications YES…… NO…….
- Cranial complications YES……. NO…….
- Oral cavity complications YES……. NO…….
- Adjacent skin ulceration YES…… NO…….

27. FINAL DIAGNOSIS

…….

Appendix IV: CLASSIFICATION OF SINONASAL MASSES

TABLE 1: WHO Classification of Benign sinonasal tumors

Types of tissue	Subtypes	
Epithelial	Sinonasal/ Schneiderian papilloma	Inverted papilloma Oncocytic papilloma Exophytic papilloma
	Salivary gland-type adenomas	Pleomorphic adenoma Myoepithelioma Oncocytoma
Soft tissue tumors	Myxoma, Leiomyoma, Hemangioma, Schwannoma, Neurofibroma, Meningioma	
Tumors of bone and cartilage	Giant cell lesion, Giant cell tumor, Osteoma, Chondroblastoma, Chondroma, Osteoblastoma, Osteoid osteoma, Osteochondroma Chondromyxoid fibroma, Ameloblastoma, Nasal chondromesenchymal hamartoma.	
Germ cell	Mature teratoma	

TABLE 2: WHO Classification of Malignant sinonasal tumors

Type of tissue	Subtypes	
Epithelial	Squamous cell carcinoma	Verrucous, Papillary squamous, Basaloid squamous, Spindle cell, Adenosquamous, Acantholytic
	Lymphoepithelial carcinoma	
	Sinonasal undifferentiated carcinoma	
	Adenocarcinoma	Intestinal type Non-intestinal type
	Salivary gland-type carcinoma	Adenoid cystic, Acinic cell, Mucoepidermoid, Myoepithelial Epithelial-myoepithelial,

		Carcinoma ex pleomorphic adenoma, Clear cell N.O.S, Polymorphous low-grade adenocarcinoma
	Neuroendocrine	**Typical carcinoid** **Atypical carcinoid** **Scall cell carcinoma-neuroendocrine type**
Soft tissue tumors	**Malignant**	**Fibrosarcoma, Leiomyosarcoma, Malignant fibrous histiocytoma, Angiosarcoma, Rhabdomyosarcoma, Malignant peripheral nerve sheath tumor**
	Borderline malignant	**Desmoid type fibromatosis** **Inflammatory myofibroblastic tumor** **Glomangiopericytoma** **Extra pleural solitary fibrous tumor**
Bone and cartilage	**Chondrosarcoma, Mesenchymal chondrosarcoma, Chordoma, Osteosarcoma**	
Germ cell tumors	**Sinonasal teratocarcinosarcoma,** **Teratoma with malignant transformation**	
Neuroectodermal	**Sinonasal Ewing sarcoma, Olfactory neuroblastoma,** **Mucosal malignant melanoma,**	
Hematolymphoid	**Non-Hodgkin lymphoma, Diffuse large B cell lymphoma,** **Extramedullary plasmacytoma, Histiocytic sarcoma,** **Langerhans cell histiocytosis**	
Secondary tumor	**Excludes leukemias and lymphomas from other sites.** **Kidney, Lung, Breast, Prostate, Thyroid**	

sinonasal masses

ORIGINALITY REPORT

9%	4%	6%	4%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Manipal University Student Paper	1%
2	link.springer.com Internet Source	1%
3	"Pathology of the Head and Neck", Springer Science and Business Media LLC, 2016 Publication	<1%
4	www.jcdr.net Internet Source	<1%
5	www.pubmedcentral.nih.gov Internet Source	<1%
6	Submitted to University of Malaya Student Paper	<1%
7	Submitted to Higher Education Commission Pakistan Student Paper	<1%
8	edoc.site Internet Source	<1%

DEPARTMENT OF SURGERY
FACULTY OF HEALTH SCIENCES
P O Box 19676 - 00202. KNH
NAIROBI
Tel 020 4915043

9%

Confirmed

sinonasal masses

ORIGINALITY REPORT

9%	4%	6%	4%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Manipal University Student Paper	1%
2	link.springer.com Internet Source	1%
3	"Pathology of the Head and Neck", Springer Science and Business Media LLC, 2016 Publication	<1%
4	www.jcdr.net Internet Source	<1%
5	www.pubmedcentral.nih.gov Internet Source	<1%
6	Submitted to University of Malaya Student Paper	<1%
7	Submitted to Higher Education Commission Pakistan Student Paper	<1%
8	edoc.site Internet Source	<1%

31/3/22

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
Tel:(254-020) 2726300 Ext 44355

KNH-UON ERC
Email: uonknh_erc@uonbi.ac.ke
Website: http://www.erc.uonbi.ac.ke
Facebook: https://www.facebook.com/uonknh.erc
Twitter: @UONKNH_ERC https://twitter.com/UONKNH_ERC

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/112

26th March 2021

APPROVED
26 MAR 2021
KNH/UoN-ERC
P. O. BOX 20723 - 00202 NAIROBI

Dr. Mwangi Gabriel Kamau
Reg. No.H58/7224/2017
Dept. of Surgery
School of Medicine
College of Health Sciences
University of Nairobi

Dear Dr. Kamau

RESEARCH PROPOSAL – CLINICO-PATHOLOGICAL PROFILE OF SINONASAL MASSES AS SEEN AT THE KENYATTA NATIONAL HOSPITAL (P53/02/2021)

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH- UoN ERC) has reviewed and **approved** your above research proposal. The approval period is 26th March 2021 – 25th March 2022.

This approval is subject to compliance with the following requirements:

a. Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b. All changes (amendments, deviations, violations etc.) are submitted for review and approval by KNH-UoN ERC before implementation.
c. Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
d. Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
e. Clearance for export of biological specimens must be obtained from KNH- UoN ERC for each batch of shipment.
f. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
g. Submission of an *executive summary* report within 90 days upon completion of the study.

This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.

For more details consult the KNH- UoN ERC website**http://www.erc.uonbi.ac.ke**

Yours sincerely,

PROF. M. L. CHINDIA
SECRETARY, KNH-UoN ERC

c.c. The Principal, College of Health Sciences, UoN
The Senior Director, CS, KNH
The Chairperson, KNH- UoN ERC
The Assistant Director, Health Information Dept, KNH
The Dean, School of Medicine, UoN
The Chair, Dept. of Surgery, UoN
Supervisors: Prof. Herbert Oburra, Dept.of Surgery-Thematic Unit of ENT, UoN
Dr. Mary Omutsani, ENT Dept. KNH