CLINICOPATHOLOGICAL PROFILE OF SINONASAL TUMORS

A FIVE YEAR STUDY

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CERTIFICATE

This is to certify that **CLINICOPATHOLOGICAL PROFILE OF SINONASAL TUMORS – A FIVE YEAR STUDY** is a bonafide work done by **Dr. S. ASHOKKUMAR** in partial fulfillment of regulations of the Tamil Nadu Dr. M.G.R. Medical University, Chennai.

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I declare that this dissertation entitled **"CLINICO PATHOLOGICAL PROFILE OF SINO NASAL TUMORS – A FIVE YEAR STUDY"** has been done by me under the guidance and supervision of Prof. **Dr. GEETHA DEVADAS M.D., D.C.P.,** It is submitted in partial fulfillment of the requirements for the award of the M.D., Pathology degree by The Tamil Nadu Dr. M.G.R. Medical University, Chennai. This has not been submitted by me for the award of any degree or diploma from any other University.

Dr. S. ASHOKKUMAR.

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ABBREVIATIONS

PNS - Paranasal sinus

UDC - Undifferentiated carcinoma

SNUC- Sino nasal undifferentiated carcinoma

SNEC- Sino nasal neuroendocrine carcinoma

SNUC with focal NE - Sinonasal undifferentiated carcinoma with focal Neuroendocrine differentiation.

SRCT- Small round cell tumor

PNET- Primitive neuroectodermal tumor

ONB- Olfactory neuroblastoma

ITAC- Intestinal type adenocarcinoma

MEC- Mucoepidermoid carcinoma

CONTENTS

INTRODUCTION

INTRODUCTION

The nasal cavity and paranasal sinuses including the maxillary, ethmoid, sphenoid and frontal sinuses are collectively referred to as the sinonasal tract. The sinonasal tract is anatomically and embryologically distinct from the nasopharynx. Although the sinonasal tract and nasopharynx have identical appearing ciliated respiratory epithelium, the epithelium of the sinonasal tract is ectodermally derived, while that of nasopharynx is endodermally derived. This embryologic difference may be a factor in the development of certain epithelial lesions unique to these surfaces eg.schneiderian papillomas of sinonasal tract and nasopharyngeal carcinomas.[7]

The mucosa of the nasal cavity and paranasal sinuses is often referred to as schneiderian mucosa to emphasize its ectodermal origin as opposed to the endodermal origin of the morphologically identical mucosa lining the rest of the respiratory tract. Nasal stroma is well vascularised fibromuscular tissue. This is occasionally misinterpreted as a vascular malformation or a vascular tumour. In the paranasal sinuses a layer of thin cancellous bone supports this mucosal and stromal arrangement.[8]

The nasal cavity and paranasal sinuses are exposed to a variety of infections, chemically irritating, antigenically stimulating, mechanical and traumatic influences. As a consequence of these exposures, there are formations of tumor like and truly neoplastic conditions.[9]

Although the nasal cavity and paranasal sinuses occupy a relatively small anatomic space, they are the site of origin of some of the more complex histologically diverse group of tumors of the entire human body.

These include neoplasms derived from mucosal epithelium, seromucinous glands, soft tissues, bone, cartilage, neural/neuroectodermal tissues, hematolymphoid cells and the odontogenic apparatus. Many of the tumours are similar to those found elsewhere in the body but a few such as olfactory neuroblastoma are unique to this site.[6]

Clinically sometimes it becomes quite impossible to distinguish between inflammatory conditions presenting as simple polyps, polypoidal lesions due to specific disease and polypoidal neoplasms including benign and malignant. For this reason it becomes important that all polyps and polypoidal lesions should be submitted for histopathological examination.[9]

AIMS AND OBJECTIVES

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1. To study the incidence of sino nasal tumors.

2. To analyse the age, sex and site distribution of various sino nasal tumors.

3. To analyse the histopathological types of sino nasal tumors.

4. To apply immunohistochemistry for cases with uncertain histologic diagnosis.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

ANATOMY OF NASAL CAVITY AND PARANASAL SINUSES [1, 2, 3]

NASAL CAVITY: Nasal cavity is divided into right and left halves by the nasal septum. These two halves open on the face through nares (or) nostril and communicate behind with the nasal part of the pharynx through the posterior nasal apertures.

Each half of the nasal cavity can be described as having floor, roof, a lateral wall and a medial wall. Each half of the nasal cavity consists of 3 regions: vestibular, olfactory, and respiratory.

NASAL SEPTUM: It is a median osteo cartilaginous partition between the two halves of the nasal cavity on each side. It is covered by mucous membrane and forms the medial wall of both nasal cavities. It is formed partly by bony, partly by cartilage and cuticle part.

LATERAL WALL OF NOSE: The lateral wall of nasal cavity presents three elevations formed by the superior, middle and inferior turbinates. Each turbinate is a curved part of bone, forming a hollow concave space known as meatus, in which there are openings of various paranasal sinus and nasolacrimal duct.

PARANASAL SINUSES: They are bilateral, paired air chambers which communicate with the nasal cavity. They are frontal, ethmoid, sphenoid and maxillary. Each is lined by mucoperiosteum which extends from the nasal cavity and is covered by the ciliated respiratory epithelium.

HISTOLOGY OF NASAL CAVITY AND PARANASAL SINUSES [4, 5]

Each half of the nasal cavity is divided in to 3 regions.

1) **Vestibule**: It is lined by stratified squamous epithelium.

2) **Respiratory segment**: It is lined by a ciliated pseudostratified columnar epithelium. The epithelium of respiratory segment is composed of five cell types: ciliated cells, goblet cells, brush cells, small granule cells and basal cells.

3) **Olfactory segment**: It is lined with specialized olfactory mucosa. The olfactory epithelium is tall pseudostratified columnar epithelium and is composed of following cell types:1)olfactory cells, bipolar neurons 2)supporting or sustentacular cells 3)basal cells 4)brush cells. It lacks goblet cells.

Paranasal sinuses: are extensions of the respiratory segment of the nasal cavity and are lined by respiratory epithelium.

TUMOURS OF NOSE AND PARANASAL SINUSES

Tumours of nose and paranasal sinuses were first described by Hippocrates (BC 460-370) and Galen (AD 131).[10]

Epidemiology: Malignant tumours of sinonasal tract accounts for 0.2-0.8% of all human malignancies and only 3% of malignant tumours of upper aerodigestive tract.[11] Watson, in reviewing 26000 cancer admissions at the Memorial hospital in the period 1928 to 1938, observed that 0.44% of these cases primary cancer of the maxillary sinus.

Sixty percent of sinonasal tumours originate in the maxillary sinus, 20-30% in the nasal cavity, 10-15% in the ethmoid sinus, and 1% in sphenoid and frontal

sinuses.[6] When considering the paranasal sinuses alone, 77% of malignant tumors arise in the maxillary sinus, 22% in the ethmoid sinus and 1% in the sphenoid and frontal sinuses. Malignant neoplasms of this region may lead to significant morbidity and disfigurement.[6]

The incidence of cancer of the nasal cavities and paranasal sinuses (sinonasal cancer) is low in most populations (<1.5/1, 00,000 in men and <1.0/1, 00,000 in women).Higher rates are recorded in Japan and certain parts of China and India.[6]

Etiology: Although exact etiology of sinus cancer is obscure, there is relationship between long standing fistulas and nasal or sinus carcinoma. Frazell (1963), in reporting 416 cases, noted that over half of the patients had a history of prior sinus or nasal surgery. In 330 cases reported by Larsson and Maatensson (1954), 48 patients had histories of repeated surgical operations for sinusitis and nasal polyps.

Miller et al (1971) attempted to link this disease to the Epstein Barr virus. There is increased risk in wood workers, nickel industrial workers and refinery workers .The increase in risk is strongest for adenocarcinomas.[12]An association has been shown between tobacco smoking and sino nasal cancer in particular squamous cell carcinoma.[6] Exposure to thorotrast, a radioactive contrast agent, represents an additional risk factor.[6]

About ¼ of the tumours of PNS originate in the bone. Thinness of bony partition facilitates spread of malignant tumours to adjacent structures. The surface epithelium lining the nasal cavity and sinuses produces the greatest number of tumours. The respiratory epithelium produces some unique papillary lesions.

Exophytic fungiform papillomas (Ridolfi et al., Snyder and Perzin, 1972; Lasser et al, 1976) may arise anywhere but are most common on the septum.Bone destruction may occur even though the tumour is histologically benign (Skolnik et al., 1966).Radiation may account for a few malignant transformations (Mabery et al., 1965).[13]

Tumor location plays a significant role in differential diagnosis .Tumors in the region of cribriform plate and upper nasal cavity suggests diagnosis such as olfactory neuroblastoma or meningioma. Inverted schneiderian papilloma occurs predominantly along the lateral wall of the nasal cavity or the medial maxillary sinus. In lower maxilla,odontogenic lesions should be considered. Fibroosseous lesions are considered when a radiodense lesion arises from or follows the contour of bone.[6]

Modern imaging plays a key role in the evaluation of sinonasal tumours by clearly delineating the anatomy of the lesion with exact margins, in determination of surgical approach, and is an integral part of radiotherapy planning.[6] Sinonasal tumours invade the orbit through the lamina papyracea (or) roof of maxillary sinus, spreads intracranially through the roof of ethmoid and cribriform plate.[6]

WHO HISTOLOGICAL CLASSIFICATION OF TUMOURS OF NASAL CAVITY AND PARANASAL SINUSES 2005[6]

EPITHELIAL TUMOURS:

A.Malignant epithelial tumours

1. Squamous cell carcinoma

a.Verrucous squamous cell carcinoma

b.Papillary squamous cell carcinoma

c.Basaloid squamous cell carcinoma.

d.Spindle cell carcinoma.

e.Adenosquamous carcinoma

f.Acantholytic squamous cell carcinoma

2. Lymphoepithelial carcinoma

3. Sinonasal undifferentiated carcinoma

4. Adenocarcinoma

5. Salivary gland-type carcinomas

a.Adenoid cystic carcinoma

b.Acinic cell carcinoma

c.Mucoepidermoid carcinoma

d.Epithelial-myoepithelial carcinoma

e.Clear cell carcinoma N.O.S

f.Myoepithelial carcinoma

g.Carcinoma ex pleomorphic adenoma

h.Polymorphous low-grade adenocarcinoma

6. Neuroendocrine tumours

a.Typical carcinoid

b.Atypical carcinoid

c.Small cell carcinoma, neuroendocrine type

B.Benign epithelial tumours

1. Sinonasal papillomas

a.Inverted papilloma(schneiderian papilloma,Inverted type)

b.Oncocytic papilloma(schneiderian papilloma,oncocytic)

c.Exophytic papilloma(schneiderian papilloma,exophytic)

2. Salivary gland-type adenomas

a.Pleomorphic adenoma

b.Myoepithelioma

c.Oncocytoma

SOFT TISSUE TUMOURS

A. Malignant tumours

1. Fibrosarcoma
2. Malignant fibrous histiocytoma
3. Leiomyosarcoma
4. Rhabdomyosarcoma
5. Angiosarcoma
6. Malignant peripheral nerve sheath tumours

B. Borderline and low malignant tumours

1. Desmoid- type fibromatosis
2. Inflammatory myofibroblastic tumours
3. Glomangiopericytoma (sinonasal –type hemangiopericytoma)

C.Benign tumours

1. Myxoma
2. Leiomyoma
3. Haemangioma
4. Schwannoma
5. Neurofibroma
6. Meningioma

TUMOURS OF BONE AND CARTILAGE

A. Malignant tumours

1. Chondrosarcoma
2. Mesenchymal chondrosarcoma
3. Osteosarcoma
4. Chordoma

B. Benign tumours

1. Giant cell lesion
2. Giant cell tumour
3. Chondroma
4. Osteoma
5. Chondroblastoma
6. Chondromyxoid fibroma
7. Osteochondroma
8. Osteiod osteoma
9. Osteoblastoma
10. Ameloblastoma

11. Nasal chondro mesenchymal hamartoma

12. Ossifying fibroma

HAEMATOLYMPHOID TUMOURS

1. Extra nodal NK/T cell lymphoma

2. Diffuse large B cell lymphoma

3. Extra medullary plasmacytoma

4. Extra medullary myeloid sarcoma

5. Histiocytic sarcoma

6. Langerhans cell Histiocytosis

NEUROECTODERMAL

1. Ewings sarcoma

2. Primitive neuroectodermal tumour

3. Olfactory neuroblastoma

4. Melanotic neuroectodermal tumour of infancy

5. Mucosal malignant melanoma

GERM CELL TUMOURS

1. Immature teratoma

2. Teratoma with malignant transformation

3. Sinonasal yolk sac tumour(endodermal sinus tumour)

4. Sinonasal teratocarcinosarcoma

5. Mature teratoma

6. Dermoid cyst

SECONDARY TUMOURS

MALIGNANT EPITHELIAL TUMORS

1. SQUAMOUS CELL CARCINOMA[14, 15, 94,95]

Malignant epithelial neoplasms originating from mucosal epithelium of the nasal cavities (or) paranasal sinus includes keratinizing and non-keratinizing types of squamous cell carcinoma. They form 3% of malignancies of head and neck.

Location:

Sinonasal squamous cell carcinoma occurs most frequently in the maxillary sinus (60-70%) followed by nasal cavity, ethmoid sinus (10-15%) sphenoid and frontal sinuses (1%). Squamous cell carcinoma of the nasal vestibule should be considered as arising from skin rather than sinonasal mucosal epithelium.

Macroscopy:

Squamous cell carcinoma may be exophytic, fungating, papillary, friable, haemorrhagic, indurated or infiltrative.

Microscopy:

The tumor cells are arranged in nests, masses or are scattered individually. Histological evidence of squamous differentiation in the form of extra and intracellular keratin and intracellular bridges is noted. The carcinoma may be well, moderately or poorly differentiated. Most tumors are moderately differentiated squamous cell carcinomas[85].

Non-keratinising (cylindrical cell, transitional) squamous carcinoma:

This distinct tumor of sinonasal tract is characterized by plexiform or ribbon like growth pattern. As the name implies keratinisation is absent.

Precursor lesions:

Precursor lesions for sinonasal tract tumors are less well defined. Schneiderian (inverted) papilloma appears to be a precursor lesion with 10% frequency of association.[16] The role of squamous metaplasia as precursor lesion is not clearly established.

Prognosis:

Patients with nasal squamous cell carcinoma generally present earlier than patients with maxillary cancers and have better prognosis than the latter group. They rarely metastasize to lymphnodes but show early recurrence. Advanced local disease worsens the prognosis.

The overall 5 years survival for nasal squamous cell carcinoma is about 60%. Squamous cell carcinoma of maxillary sinus has a more ominous prognosis and it correlates with age.

Patients with non-keratinising type of carcinoma tend to do better than keratinising type. The overall 5 year survival for maxillary sinus cancer is 42%.

VARIANTS:

a. Papillary squamous cell carcinoma:

It may present as either insitu or invasive tumor. Macroscopically, the lesion is composed of exophytic papillary structures covered by epithelium showing nuclear pleomorphism, koilocytosis and atypical mitotic figures containing cores of fibrovascular stroma[17].

b. Basaloid squamous cell carcinoma:

It is uncommon in sinonasal tract. It is an aggressive variant characterized by rounded nests of cytologically highly atypical and mitotically active basaloid epithelial cells with high nucleo-cytoplasmic ratio and hyperchromatic nuclei, comedo necrosis with focal squamous differentiation[18].

c. Spindle cell carcinoma:

It is characterized by a biphasic pattern of squamous cell carcinoma along with much larger component of malignant spindle cells reminiscent of sarcoma. Immunohistochemical or ultrastructural evidence of epithelial differentiation is required for the diagnosis. The spindle cell component is vimentin positive. Keratin positivity is scant and is difficult to demonstrate.

Other variants include verrucous carcinoma and adenosquamous carcinoma.

2. LYMPHO EPITHELIAL CARCINOMA[6]

It is a poorly differentiated squamous cell carcinoma or histologically undifferentiated carcinoma accompanied by prominent reactive lymphoplasmacytic infiltrate, morphologically similar to nasopharyngeal carcinoma with EBV association. They are more common in nasal cavity than in paranasal sinuses.

Histopathology:

The tumor infiltrates the mucosa in the form of irregular islands and sheets without a desmoplastic stroma. The tumor cells possess relatively

monotonous vesicular nucleus and prominent nucleoli. Syncitial or spindled morphology may be seen.

3. SINONASAL UNDIFFERENTIATED CARCINOMA[19, 20, 97]

Sinonasal undifferentiated carcinoma (SNUC) was originally defined as a high grade malignant epithelial neoplasm of the nasal cavity and paranasal sinuses of uncertain histogenesis with or without neuroendocrine differentiation but without evidence of squamous or glandular differentiation. It is a highly aggressive and clinicopathologically distrinct carcinoma of uncertain histogenesis that typically presents with locally extensive disease. They are negative for Epstein Barr virus by IHC and ISH.

Clinical Features:

A rare tumor, with fewer than 100 reported cases. There is male preponderance (2:1 to 3:1). The median age of presentation in the 6th decade. SNUCs generally present as large tumors involving multiple (sinonasal tract) sites and may also extend into the nasopharynx and adjacent structures including bony destruction.

Microscopy:

The cellular infiltrate consists of polygonal cells composed of medium to large sized, round to oval, hyperchromatic nuclei, inconspicuous to prominent nucleoli, and a varying amount of eosinophilic cytoplasm,mitotic activity and necrosis.

Differential diagnosis:

Primarily includes poorly differentiated squamous cell carcinoma, high grade / poorly differentiated adenocarcinoma, olfactory neuroblastoma (high grade), small cell undifferentiated neuroendocrine carcinoma, mucosal malignant melanoma, nasal type natural killer (NK) / T-Cell lymphoma and rhabdomyosarcoma. Although differences can be seen by light microscopic evaluation, often the distinction rests on the immunohistochemical profile for a given tumor.

Immunohistochemistry:

Immunocytochemical stains for pan-cytokeratin and simple keratins, including CK7, CK8, and CK19, are positive in all cases[92].The tumors are variably positive for epithelial membrane antigen, neuron-specific enolase, CD99, p53, and p63. The tumors are negative for carcinoembryonic antigen, S-100 protein, chromogranin, and synaptophysin.[93]

4. ADENOCARCINOMA [21, 22]

Historical aspects:

The early literature was deficient in reports of adenocarcinoma in the nasal region. Ringertz (1938) found 10 out of 31 glandular tumors involving the nose and paranasal sinuses representing less than 4% of all carcinoma in this region. Mc Donald and Havens (1948) reported 57 adenocarcinomas out of 95 glandular tumors while Spiro, Koss (1973) reported 49 out of 122 glandular tumors.

These are glandular malignancies of the sinonasal tract. Two main categories (according to WHO) [6] are:

a. Intestinal type adenocarcinoma.
b. Non intestinal type adenocarcinoma which is further divided into low grade and high grade sub-types.

The adenocarcinomas and salivary type carcinoma together comprise 10-20% of all sinonasal primary malignant tumors.

a. Intestinal-type adenocarcinoma (ITAC):

Patients have ranged in age from 12 to 86 years. Most series report a pronounced male predominance.

Location: ITACs involve the ethmoid sinus, nasal cavities and maxillary sinus in 40%, 27% and 20% cases respectively. In nasal cavities, the inferior and middle turbinates are sites of predilection.

Macroscopy:

ITACs present as an irregular, exophytic, pink (or) white mass bulging in the nasal cavity or PNS often with a necrotic friable appearance. Some lesions are gelatinous.

Histopathology:

Barne divided these tumors into 5 categories - Papillary, colonic, solid, mucinous and mixed.The papillary type of well differentiated adenocarcinoma which accounts for 18% of cases shows a predominance of papillary architecture with occasional tubular glands, minimal cytological atypia and rare mitotic figures. The colonic (moderately differentiated) adenocarcinoma representing 40% cases shows a predominance of tubulo glandular architecture, rare papillae, increased nuclear pleomorphism and mitotic activity. The solid type (20%) shows loss of

differentiation characterized by solid and trabecular growth with isolated tubule formation, marked increase in number of smaller cuboidal cells with nuclear pleomorphism, round vesicular nuclei, prominent nucleoli and increase in mitotic figures.

ITACs with mucinous type have two patterns. In one, there are solid clusters of cells, individual glands with intracellular mucin, signet ring cells, and short papillary fronds with or without fibrovascular core. The other pattern shows the presence of large well formed glands distended by mucus and extra cellular mucin pool separated by thin connective tissue septa creating an alveolar type pattern.[22]

b. Sinonasal non-intestinal type adenocarcinoma:

Adenocarcinoma arising in the sinonasal tract which are non-intestinal type are divided into low and high grade subtypes. It occurs in adults with slight male preponderance.They are encountered in ethmoid sinus and maxillary sinus.

Macroscopy: The appearance varies including well demarcated to poorly defined and invasive flat to exophytic or papillary growths with a tan white to pink colour and friable to firm consistency.

Histopathology:

The low grade non-intestinal type adenocarcinomas are circumscribed or invasive and have a glandular or papillary growth. Numerous uniform small glands or acini are lined by mildly pleomorphic cuboidal to columnar cells arranged in a back to back or coalescent pattern with little or no intervening stroma. The high grade non-intestinal type adenocarcinomas are invasive tumors with predominately

solid growth pattern, but glandular and papillary patterns can also be present. Tumors are characterized by moderate to marked cellular pleomorphism, high mitotic activity including atypical forms and necrosis.

Prognosis: The low grade neoplasms have an excellent prognosis while high grade neoplasms have a dismal prognosis with a 3 year survival rate of approximately 20%.[22]

4. SALIVARY GLAND-TYPE CARCINOMAS

a. Adenoid cystic carcinoma :

It is the most frequent malignant salivary gland type tumor of the sinonasal tract. The age range is wide ranging from 11 to 92 years. The majority develop in the maxillary sinus and nasal cavity. The long term prognosis is poor and 10 year survival rate is only 7%.[23]

Microscopically, it is composed of bland epithelial cells with oval nuclei and little cytoplasm. The nuclei have coarse chromatin and prominent nucleoli. Myoepithelial cells are variably present. It produces three architectural patterns - Tubular (low grade), cribriform (intermediate grade) and solid (high grade). They are usually composed of a mixture of two or three distinct patterns and tumors are graded according to the most aggressive pattern present (30% or more).[24]

b. Mucoepidermoid carcinoma(MEC):

They are rare at this site and should be distinguished from the more aggressive variants of squamous cell carcinoma especially adeno squamous carcinoma.[25]

Microscopically, MECs are composed of varying proportions of epidermoid cells, mucus-secreting cells (mucocytes), and intermediate cells, which are cells of intermediate differentiation between the other two cell types.

c. Other tumors:

A variety of other salivary gland – type carcinomas have been rarely reported in the nasal cavity and paranasal sinuses. These include epithelial-myoepithelial carcinoma,[26] malignant myoepithelioma,[27] carcinoma expleomorphic adenoma,[28] adenocarcinoma[29] and basal cell adenocarcinoma[30].

5. SINONASAL NEUROENDOCRINE CARCINOMA (SNEC)

SNECs occur at superior nasal cavity, superior turbinates, ethmoids, anterior or middle turbinates. It is a cellular tumor lacking fibrillary background. Gland formation may be seen, but the Homer – Wright rosettes are not. The tumor forms either solid sheets, ribbons, or trabeculae,or zell ballen formation. Necrosis and increased mitotic figures may be seen. Goblet cells or signet – ring cells may be seen. The main differential diagnosis is olfactory neuroblastoma. Multiple local recurrences and locoregional metastasis are seen.[31]

Immunohistochemistry: Immunohistochemical studies in a limited number of SNECs suggest that they are almost invariably positive for keratins ,with variable expression of neuronspecific enolase, chromogranin, and synaptophysin.[94]

BENIGN EPITHELIAL TUMORS

1. SINONASAL TYPE (SCHNEIDERIAN) PAPILLOMAS [7, 33, 34]

The ectodermally derived lining of the sinonasal tract, termed schneiderian membrane, may give rise to sinonasal type papillomas. Three morphological types are inverted (transitional), cylindrical (oncocytic or columnar cell) and fungiform (exophytic, septal papilloma).

Inverted papillomas are most common in the fifth to eighth decades. Inverted papillomas occur along the lateral nasal wall (middle turbinate or ethmoid recesses) with secondary extension into paranasal sinuses. Typically, the schneiderian papillomas are unilateral, but bilateral papillomas may occur.

Inverted papillomas are large, bulky, translucent masses with a red to gray colour, varying from firm to friable in consistency. Histologically, these tumors have an endophytic or "inverted" growth pattern consisting of markedly thickened bland squamous epithelial proliferation growing downward in underlying stroma. The epithelium varies in cellularity and is composed of squamous, transitional and columnar cells with admixed mucocytes and intraepithelial mucous cysts. A mixed chronic inflammatory infiltrate is seen within all layers of the surface epithelium.

Complications associated with schneiderian papillomas include recurrence (6-33%) and malignant transformation (7-10%).[34] Inverted papillomas and cylindrical cell papillomas can undergo malignant transformation and varies from 5 to 15% cases. The majority of malignancies associated with inverted papillomas are squamous cell carcinomas (keratinizing and nonkeratinizing), varying in appearance from well to poorly differentiated.

Recently in a study carried out in Japan[32], it was shown that squamous cell carcinoma antigen (SCCAI) was over expressed in sinonasal inverted papilloma tissues compared to normal nasal epithelium. It was measured by Westernblot analysis and shown as potential useful biological marker in patients with sinonasal inverted papilloma.

II. SOFT TISSUE TUMORS

1. MALIGNANT TUMORS

a. Fibrosarcoma[37]:

These tumors are rare (<3%) of all non-epithelial tumors. Most arise in one or more paranasal sinuses, while origination confined to the nasal cavity alone is less common. The tumors are circumscribed,unencapsulated and fleshy.Spindle cells are arranged in herring bone pattern and in fascicles.

b. Rhabdomyosarcoma (RMS):

The embryonal subtype predominates in children while the alveolar subtype predominates in adults. The pleomorphic subtype is rare[41]. In adults, RMS is more common in the ethmoid sinuses followed by maxillary sinuses and nasopharynx.[42]

Alveolar RMS has fibrous septa separating clusters of loosely cohesive groups of small to medium sized round tumor cells with hyperchromatic nuclei and scant eosinophilic cytoplasm. Multinucleated giant cells with overlapping peripheral nuclei are often present.Other variants includes botryoid and pleomorphic type.[43]

Other sarcomas such as Leiomyosarcoma,[40] Malignant fibrous histiocytoma[38,39] angiosarcoma[44] and MPNST[45] have been reported, but rare in the sinonasal tract.

2. BORDERLINE AND LOW MALIGNANT POTENTIAL TUMORS

a. Desmoid-type fibromatosis:

Sinonasal tract is uncommonly involved. The maxillary sinus and turbinates are visually affected.[46] An infiltrative growth pattern with low to moderate cellularity comprising broad fascicles of bland looking spindle cells and collagen fibers arranged in uniform direction. Keloid like collagen may be seen[47].

b. Inflammatory myofibroblastic tumor:

Uncommonly occurs in the sinonasal tract[48].

c. Glomangiopericytoma (Sinonasal – type hemangiopericytoma):

These comprise <0.5% of all neoplasms. Most frequently arise unilaterally in the nasal cavity. All ages can be affected (in utero to 86 years) but the peak is in the 7th decade[49].

These tumors are composed of uniform, ovoid or spindle cells forming tight aggregates with little intervening stromal collagen. High grade hemangiopericytomas is this region can metastasize, so these should be distinguished from low grade forms and angiofibroma[50].These tumors are indolent in their behavior[6].

3. BENIGN TUMORS

a. Hemangiomas [51,7]

Although hemangiomas are common lesions of the head and neck (Batsakis and Rice, 1901 a, b), those of the nasal cavity and PNS are rare. A review of English literature until 1990 revealed only 62 cases of septal hemongiomas and 32 cases of maxillary sinus hemangioma (Sheppard and Michelson, 1990). However hemangiomas of the maxillary sinus need to be considered in the preoperative diagnosis since surgery and even biopsy can lead to a sudden loss of large quantities of blood (Engel et al., 1990).[58]

Hemangiomas are benign vascular lesions (Batsakis, 1984). Lobular capillary hemangioma (LCH) most often found in the anterior portion of the nasal septum in an area referred to as Little's area or Kisselbach's triangle; the second most common sinonasal location is from the turbinates.

The gross appearance of LCH is a smooth, lobulated, polypoid red mass measuring upto 1.5cm in diameter.

Histologically, LCH is characterized by submucosal vascular proliferation arranged in lobules or clusters composed of central capillaries and small ramifying tributaries.

b. Schwannoma:

Less than 4% schwannomas involve the nasal cavity and paranasal sinuses and occur in middle aged adults with an equal gender distribution .Most commonly involves the ethmoid and maxillary sinuses followed by the nasal cavity, sphenoid and frontal sinuses.

Gross:

They measure up to 7 cm, nonencapsulated and are globular firm to rubbery, yellow tan masses. Cut surfaces show tan grey, yellowish solid to myxoid and cystic tissue, with haemorrhage.

Histopathology:

Tumor is composed of cellular Antoni A areas with Verocay bodies and hypocellular myxoid Antoni B areas .The cells are fusiform with elongated fibrillary cytoplasm and buckled to spindled nuclei with little pleomorphism. Small to medium sized vessels with ectasia, thrombosis and perivascular hyalinization are seen in the Antoni B area. Extensive degenerating changes can occur. Malignant transformation is exceptional.[52,53]

c) Craniopharyngioma

Rarely, craniopharyngiomas arise in the the nasal cavity and the sphenoid, ethmoid and maxillary sinus. The microscopic appearance is similar to that of sellar adamantinomatous craniopharyngiomas with their epithelial lobules, peripheral palisading, and internally loose epithelial cells reminiscent of stellate reticulum.

Other benign tumors include leiomyoma, neurofibroma,[54] meningioma,[55] myxoma and salivary gland type of adenomas.[35, 36]

III. TUMORS OF BONE AND CARTILAGE

A. MALIGNANT TUMORS

1. Chondrosarcoma:[56,57] Chondrosarcomas account for less than 16% of all sarcomas of the nasal cavity, paranasal sinuses and nasopharnyx. Chondrosarcoma affects older adults with male predilection.

Histopathology:

Chondrosarcomas are often lobulated and show round to oval cells in lacunae with a blue chondroid matrix with myxoid change. Increased cellularity and permeation of the intertrabecular spaces of bone distinguish them from chondroma.

2. Osteosarcoma:

They are extremely rare in nasal cavity and paranasal sinuses. In the maxilla, alveolar ridge and antrum are predominantly involved.[58,59]

3. Chordoma:

Chordomas sometimes appear as a mass in the nasopharynx or nasal cavity.[60] The cells have vacuolated cytoplasm (physalipherous), situated in myxoid stroma.

B. BENIGN TUMORS

1. Giant Cell Lesion: (Giant Cell granuloma, giant cell reparative granuloma)

The lesion consists of spindle, ovoid or round histiocyte like cells set in a well vascularised fibrous tissue. The cells are mononuclear, binuclear and trinuclear, and they may form giant cells with approximately 10 to 20 nuclei. The giant cells may aggregate in groups of 6 to 12 cells.[61]

2. Giant Cell Tumor[62]:

The skull, sphenoid, ethmoid and temporal bone are almost exclusively involved. Clinical symptoms depend on the site of occurrence. The tumor is characterized by abundant multinucleated osteoclast giant cells, with up to 50-100 nuclei that are evenly distributed among sheets of stromal cells.

3. Ameloblastoma: [64, 65, 66]

Ameloblastomas are very rare in the sinonasal tract and nasopharyx. These are commonly seen in mandible but 15-20% occurs in maxilla. These represent 1% of odontogenic lesions. S.P.Tyagi (1993) reported a case of ameloblastoma presenting as a nasal polyp in a 60 years old male which recurred twice.

Histopathology:

A wide variety of histological patterns have been described (Asisenberg, 1953). The two main forms are follicular and plexiform variants. The follicular variant is the commonest and mimics the enamel organ in the developing tooth. It consists of sharply circumscribed epithelial islands with a palisaded border of tall

columnar cells (Ameloblasts) which enclose a more loosely arranged cellular component, resembling a stellate reticulum. Squamous metaplasia may occur in the central areas sometimes proceeding to the formation of epithelial pearls. The plexiform type consists of thin branching epithelial cords enclosing numerous spaces and presenting a cribriform pattern which may be confused with cribriform adenocarcinoma. Some of the cords may be expanded to contain stellate cells; and a mixture of plexiform and follicular pattern may occur. The connective tissue stroma is of a loose character and often relatively acellular. Other variants include acanthomatous, mucoepidemoid, granular cell and hemangiomatous. At times, different variants can be seen in the same tumor.Recurrence is fairly common.

4.Ossifying Fibroma (OF)[67]: Synonyms are cementifying fibroma, cemento ossifying fibroma, juvenile (active / aggressive) ossifying fibroma. A description of a mandible tumor in a 35 year old female consistent with OF has been reported earlier (Menzel, 1972). Oral pathologists have traditionally classified these lesions on the basis of whether they are odontogenic or non-odontogenic in origin.Juvenile trabecular ossifying fibroma (JTOF) and Juvenile Psammomatoid ossifying fibroma (JPOF) are two histologic variants of ossifying fibroma. OF is mostly seen in the posterior mandible. JPOF mainly occurs in the bony walls of the paranasal sinuses whereas in JTOF, the maxilla is the site of predilection.

They most commonly occur in the 2^{nd} to 4^{th} decades with a predilection for females.

Histopathology:

Ossifying fibroma is composed of fibrous tissue that varies in cellularity from areas with closely packed cells to sparsely cellular areas within the same lesion. The mineralized component may consist of woven bone, lamellar bone and acellular to poorly cellular basophilic and smoothly contoured deposits thought to be cementum.

Other rare benign bone and cartilage tumors include osteoid osteoma,[63,7] chondroma, chondroblastoma,[68,69] chondromyxoid fibroma, osteochondroma, osteoblastoma and nasal chondro mesenchymal hamartoma.[70]

IV. HAEMATOLYMPHOID TUMORS

1. Non-Hodgkin Lymphoma (NHL): Malignant lymphoma is the second most common malignancy of the nasal cavity and paranasal sinuses following squamous cell carcinoma. It accounts for 14% of all cancers in these sites.[71] Although many types of NHL can occur in the nasal cavity, the most common lymphoma type is extranodal/NK/T-cell lymphoma of nasal type, especially in Asian population.[98] Other peripheral T-cell lymphomas, such as anaplastic large cell lymphoma can also occur in the sinonasal region. Lymphoma presenting in the paranasal sinuses are frequently B-celllymphomas, with diffuse large B-cell lymphoma (DLBCL) is being the most common. Other B-cell lymphomas include Burkitt's lymphoma,follicular lymphoma,extranodal marginal zone B-cell lymphoma of MALT type and mantle cell lymphoma.[72]

2. Extramedullary plasmacytoma: Extramedullary plasmacytoma of the sinonasal region is histologically similar to plasmacytoma of bone or multiple myeloma. Most frequent sites of involvement in the head and neck region are nasal cavity, paranasal sinuses and nasopharynx.[73, 74]

Grossly, the tumors are raised submucosal lesions with fleshy, dark red-grey surfaces, primarily involving the nasal cavity.

Other tumors include extramedullary myeloid sarcoma[75], histiocytic sarcoma[76] and Langerhans cell histiocytosis[77].

V. NEUROECTODERMAL TUMORS

1. Ewing sarcoma and primitive neuroectodermal tumor (ES/PNET)

These are interrelated primitive tumors, the majority of which possess rearrangements of the EWS gene 22q12 to 11q24. In the head and neck, both may rarely occur in osseous and intraosseous location. Sinonasal ES/PNET is rare. ES/PNET are histologically similar and composed of uniform, small round malignant cells with little cytoplasm.Immunoprofile includes reactivity for CD99 and vimentin.[6]

2. Olfactory neuroblastoma[78]:

Olfactory neuroblastoma is described as uncommon tumor of nasal cavity, comprising about 3% all true nasal tumors.[79] Berger et al (1924) reported the first case of olfactory neuroblastoma. It is slow growing but locally aggressive malignant tumor of nasal cavity. It is also called olfactory neuroepithelioma and olfactory neural neoplasm. It is found predominantly in adolescents and Mendeloff

(1957) reported the age range of patient between 8-79 years. The most common site of origin is in the upper nasal cavity in the region of the cribriform plate.[80]

Gross appearances:

Olfactory neuroblastomas grossly appear Glistening, mucosa covered, soft, gray, pink to brown, polypoid mass sometimes friable and hemorrhagic on manipulation. The mass varies from 1 cm to a bulky, massive tumor involving the entire nasal cavity. Cut section is gritty to cut.[81]

Histopathology:

Tumor is composed of relatively uniform cells, slightly larger than lymphocytes, with round to oval nuclei, either fine or coarse chromation, occasional prominent nucleoli and scanty cytoplasm. Nuclear pleomorphism is minimal and few mitoses are seen. The cells are embedded within a fibrillary background that corresponds to neuronal processes formed by the most differentiated of tumor cells. Homer-Wright rosettes (pseudorosettes) and Flexner-Wintersteiner rosettes are evidence of true olfactory differentiation. Lamellated calcifications may be seen.

Immunohistochemistry:

Immunohistochemical studies have shown that the cells of ONBs express neuron-specific enolase, CD56, synaptophysin and chromogranin. The periphery of the cell nests shows S-100 protein–positive spindle or stellate cells (sustentacular cells), which may be sparse in poorly differentiated, high-grade ONBs. Neurofilament protein and class III beta-tubulin are seen within the

cytoplasm and fibrillary matrix.[83] ONBs are usually negative for CK; however, focal immunoreactivity may be found in approximately 20% to 25% of tumors,[82,83,84] generally in areas with epithelial differentiation.

3. Mucosal malignant melanoma:

Sinonasal melanomas represent less than 3.6% of sinonasal tumors; less than 2.5% of all malignant melanomas occur in the sinonasal tract. They are more common in the nasal cavity (especially septum) than in the paranasal sinuses. The antrum is involved in 80% of cases, usually together with the nasal cavity. Rare cases developed in the ethmoids; the frontal and sphenoid sinuses are virtually never primarily affected.[85] The age range is predominantly 50 to 70 years. Grossly sinonasal melanomas vary in colour from white to gray, brown or black. Microscopically, they manifest a myriad of patterns composed of varying cell types including epithelioid, sarcomatoid, plasmacytoid or clear cell. Tumor cells grow in sheets or nests of variable size and are polygonal and many have vesicular nuclei and prominent nucleoli. In a few cases, spindle cells predominate, mimicking sarcoma. The amount of melanin varies considerably.[86] The prognosis is generally poor because of advanced local disease.[87]

Immunohistochemistry:

Melanomas are usually positive for vimentin, S-100 (95%), HMB-45 (98%), and other melanocytic markers (tyrosinase, MART1/A103, microphthalmia transcription marker). In amelanotic tumors, the use of these stains may be helpful in establishing a definitive diagnosis.

VI. GERM CELL TUMORS[88, 89, 90, 91]

Germ cell tumors of sinonasal tract include immature teratoma, teratoma with malignant transformation, yolk sac tumor, teratocarcinoma, mature teratoma and dermoid cyst. The incidence of these tumors is exceedingly rare with very few reported cases.

VII. SECONDARY TUMORS [65, 6]

Metastasis to the nasal cavity and paranasal sinuses are rare and may occur in any age group. 50% of secondaries in the region of nose and PNS were derived from primary renal cell carcinoma. In order of frequency, metastatic tumors of nose and PNS arise from kidney, bronchus, urogenital and gastrointestinal tract.

MATERIALS AND METHODS

MATERIALS AND METHODS

The surgical specimens received in the Institute of Pathology, Madras Medical College, Chennai from the Upgraded Institute of Otorhinolaryngology, Government General Hospital, Chennai during the period of January 2007 to October 2011 formed the material for this study. Small biopsy specimens and excision biopsy specimens and resection specimens were included. Inadequate or unrepresentative biopsy material was excluded from the study.

The clinical features such as age and sex of the patient, site of lesion and type of surgery done were noted.

The tissues were routinely processed and paraffin blocks were made and histological sections of 5 to 6 micrometer were taken in Leica microtome and routinely stained with hematoxylin and eosin stains. Special stains - periodic acid schiff (PAS), reticulin and Masson Fontana were done wherever necessary. Microphotographs were taken. Immunostains were done wherever found necessary.

MICROSCOPIC ANALYSIS

The microscopic analyses were done from all the available slides. These included the histological pattern, cellular features, pleomorphism, mitosis, necrosis, vascularity and secondary changes. Diagnosis was made and the tumors were classified as benign or malignant.

IMMUNOHISTOCHEMISTRY (IHC)

Immunohistochemistry (IHC) refers to the process of localizing antigens in a tissue section by binding specifically with antibodies. Cases for IHC were selected after viewing the H & E sections. Slides were coated with chrome alum, and subjected to Antigen Retrival using the Microwave technique with buffer solution. Slides were then treated by HRP (Horsh radish peroxidase) polymer technique.

HRP POLYMER TECHNIQUE

The coated slides were taken through the following steps

1. Treatment with peroxidase block-for incubation of endogenous peroxidase in the tissue for 20 minutes, washed in PBS buffer for 5 minutes.

2. Applications of power block O-to block nonspecific antigen-antibody reactions for 20 minutes. The excess power block was blot dried.

3. Applications of primary antibody - murine antibodies for 60 minutes. Washed in PBS buffer for 5 minutes.

4. Applications of super enhancer for 30 minutes which increased the sensitivity of antigen – antibody reaction thereby enhancing the final reaction product.

5. Application of SS label - Secondary antibody from goat with the tagged horse radish peroxidase enzyme for 30 minutes. Washed in PBS buffer.

6. Application of DAB (Diaminobenzidine) Chromogen for 5 minutes-which was cleared by the enzyme to give the colored product at antigen sites. Washed in distilled water for 5 minutes.

7. The slides were then counter stained with hematoxylin. Slides were air dried and mounted with DPX (Dibutylpthalate Xylene).

Undifferentiated malignant neoplasms of the sinonasal tract include SNUC, SNEC, Olfactory neuroblastoma, Mucosal malignant melanoma, Lymphoma, PNET, Rhabdomyosarcoma. Often they are clinically aggressive and share clinical and light microscopic features, which make differentiation of one from the other virtually impossible without the use of immunohistochemistry. Nevertheless, differentiating these tumors has clinical importance because advances in therapeutic intervention may increase survival with good quality of life, and in some instances may achieve a cure.

For undifferentiated malignant neoplasms and small round cell tumors panel of immunohistochemical markers were used that include: Cytokeratin, Synaptophysin, Neuron specific enolase, CD 99, vimentin, CD 45, Desmin, S100, HMB 45.

OBSERVATION AND RESULTS

OBSERVATION AND RESULTS

All tumors of nasal cavity and paranasal sinuses received at the Institute of Pathology Madras Medical College, Chennai from January 2007 to October 2011 were included in this study. A Total of 200 tumors were reported. Histopathological examination revealed that 107 (53.5%) were malignant and 93 (46.5%) were benign with an overall incidence of 0.45%. Epithelial tumors (144) predominated with a 72% over nonepithelial tumors (56) with a 28%. The ratio of epithelial to nonepithelial tumors was 2.57:1. Presentation of the tumors was equal in right and left sides.

TABLE-1: **Distribution of tumors of Nasal cavity, Paranasal sinuses according to the incidence, sex ratio, age and site of presentation**

Diagnosis	**No. of Cases**	**%**	**M:F**	**Peak Age (decade)**	**Nasal Cavity**		**PNS**	
					No	**%**	**No**	**%**
Benign Tumors								
Inverted papilloma	40	43.01	1.6:1	5&7	37	45.12	3	27.27
Hemangioma	27	29.03	2:1	2&4	26	31.70	1	9.09
Hemangiopericytoma	7	7.53	2.5:1	5	5	6.09	2	18.18
Schwannoma	6	6.45	1:1	4	5	6.09	1	9.09
Ossifying Fibroma	5	5.38	1.5:1	3&4	3	3.65	2	18.18
Exophytic Papilloma	3	3.23	M only	3	3	3.65		0
Ameloblastoma	2	2.15	M only	4&5	1	1.21	1	9.09
Craniopharyngioma	1	1.08	M only	2	1	1.21		0
Oncocytic Papilloma	1	1.08	M only	3	1	1.21		0
Osteoid Osteoma	1	1.08	M only	2		0	1	9.09
Total	**93**				**82**		**11**	

Diagnosis	No. of Cases	%	M:F	Peak Age (decade)	Nasal Cavity		PNS	
					No	%	No	%
Malignant Tumours								
Squamous cell carcinoma	60	56.07	2.7:1	7	30	51.72	30	61.22
SNUC	10	9.35	4:1	5	7	12.06	3	6.12
Adenoidcystic Carcinoma	8	7.48	1.6:1	7	5	8.62	3	6.12
SNEC	6	5.61	1.5:1	3&5	5	8.62	1	2.04
Adenocarcinoma	5	4.67	M only	7	3	5.17	2	4.08
Mucoepidermoid Carcinoma	5	4.67	1:1.5	5	1	1.72	4	8.16
Ameloblastic Carcinoma	2	1.87	M only	5&7		0	2	4.08
Melanoma	2	1.87	M only	4&6	2	3.44		0
Olfactory Neuroblastoma	2	1.87	1:1	2&5	1	1.72	1	2.04
Plasmacytoma	2	1.87	1:1	5&7	2	3.44		0
PNET	2	1.87	M only	2	1	1.72	1	2.04
Hemangioendotheloima	1	0.93	M only	7	1	1.72		0
Fibrosarcoma	1	0.93	M only	4		0	1	2.04
Metastasis	1	0.93	F only	5		0	1	2.04
Total	**107**				**58**		**49**	

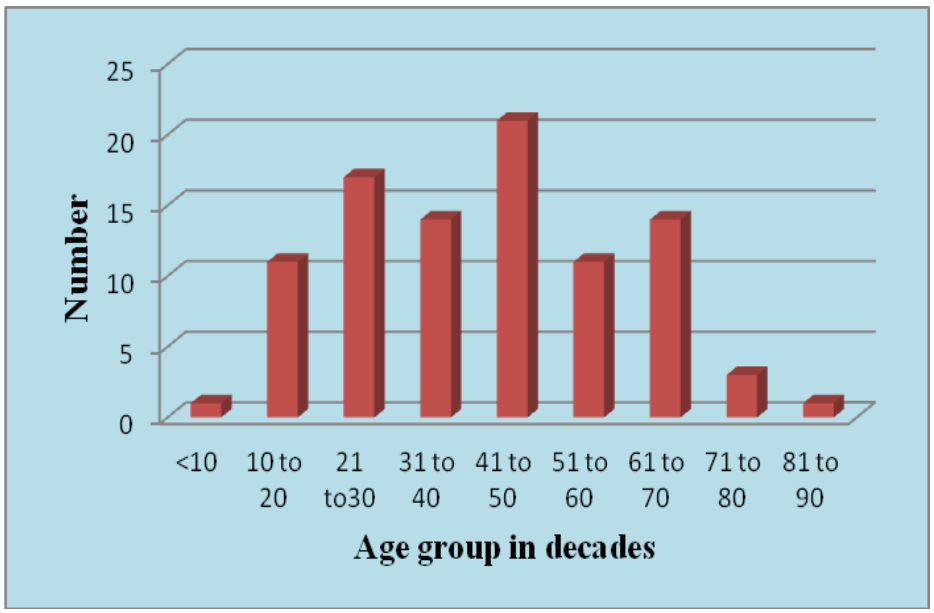
NEOPLASTIC LESIONS - BENIGN

Out of 200 samples, 93 tumors were benign with an incidence of 46.5%. It was noted that most patients with benign tumors were in the 5th decade with a mean age of 42.5 years. The male to female ratio was 1.7:1 for benign tumors. Epithelial tumors (47) constitute 50.5% and nonepithelial tumors (46) constitute 49.5% with a ratio of 1.02:1. The age of presentation of individual tumors are variable and the peak age of presentation was 5th decade followed by 3rd decade (Table 2).

TABLE-2: AGE DISTRIBUTION OF BENIGN NEOPLASMS

Age group (years)	Number	Percentage
<10	1	1.07
10 to 20	11	11.83
21 to30	17	18.28
31 to 40	14	15.05
41 to 50	**21**	**22.58**
51 to 60	11	11.83
61 to 70	14	15.05
71 to 80	3	3.23
81 to 90	1	1.07
Total	93	100

GRAPH 1: AGE DISTRIBUTION-BENIGN NEOPLASMS

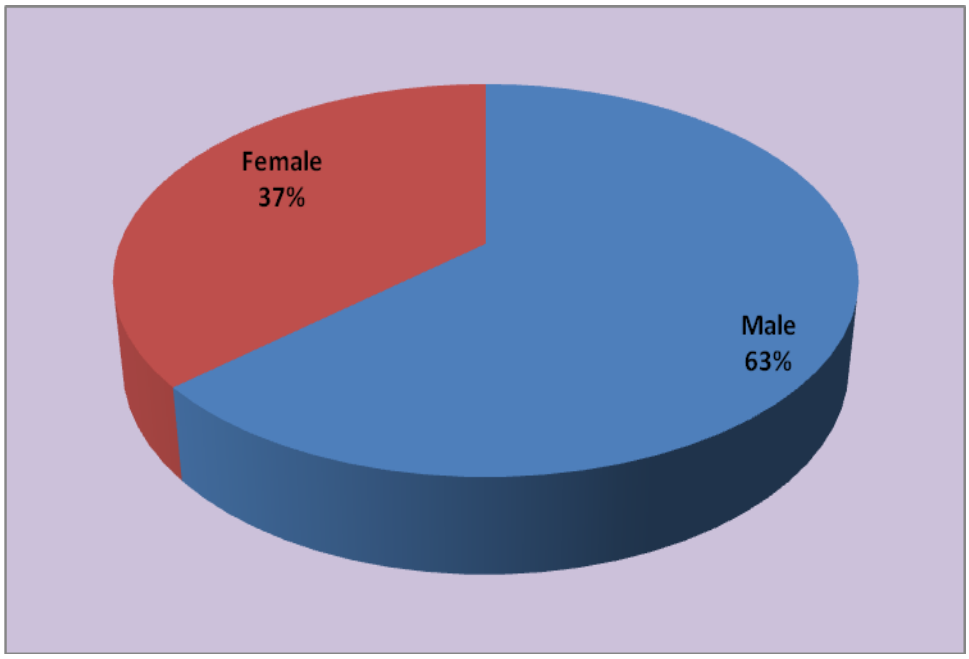


Males predominated over females with a ratio of 3:1(Table-3).

TABLE-3: SEX DISTRIBUTION OF BENIGN NEOPLASMS

Sex	**Number**	**Percentage**
Male	**59**	**63.44**
Female	34	36.56
Total	93	100

GRAPH 2: SEX DISTRIBUTION-BENIGN NEOPLASMS

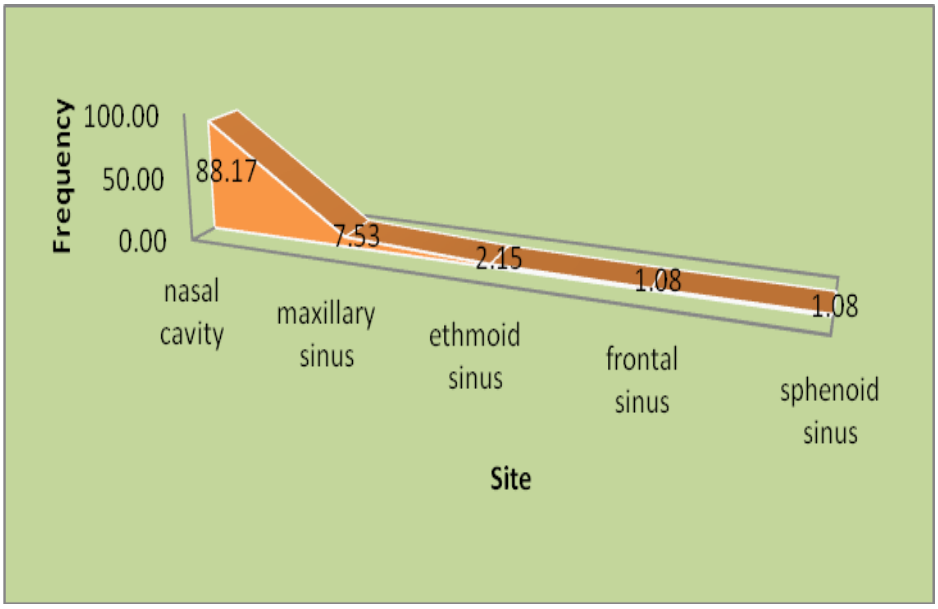


The benign tumors of nasal cavity and paranasal sinuses occurred with variable frequency. Amongst the 93 benign tumors 82 (88.18%) were from the nasal cavity and 11 (11.82%) were from the paranasal sinuses. Maxillary sinus was the commonest site in the paranasal sinuses (Table-4).

TABLE-4: SITE OF BENIGN NEOPLASMS

Site	Number	Percentage
Nasal cavity	**82**	**88.18**
Maxillary sinus	7	7.53
Ethmoid sinus	2	2.15
Frontal sinus	1	1.07
Sphenoid sinus	1	1.07
Total	93	100

GRAPH 3: SITE OF LESION-BENIGN NEOPLASMS



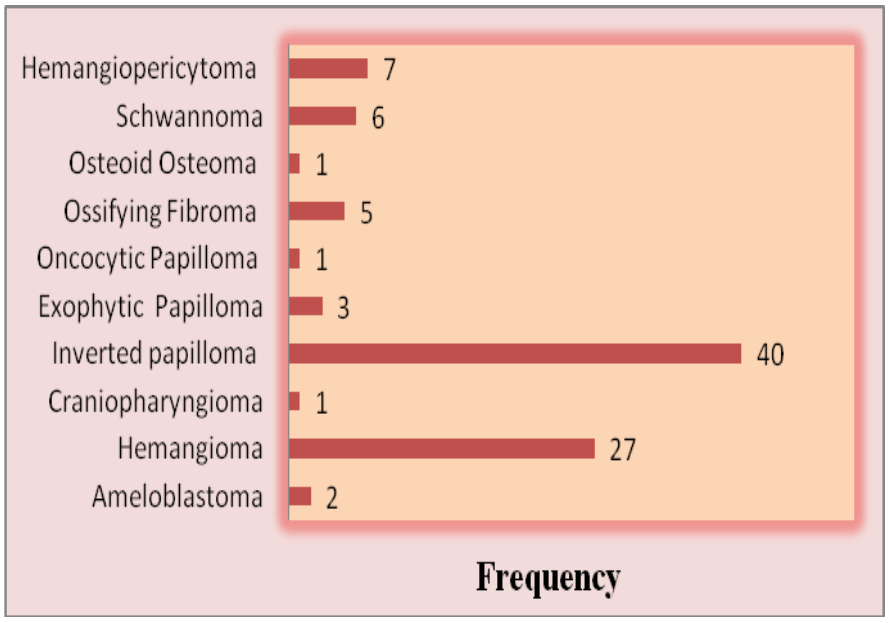
Of 93 benign tumors the most common was inverted papilloma which constituted 43.01% (40); followed by haemangioma 29.03% (27).The other tumors were craniopharyngioma, osteoid osteoma, ameloblastoma, ossifying fibroma,

hemangiopericytoma, exophytic papilloma, oncocytic papilloma and schwannoma (Table-5).

TABLE-5: HISTOLOGICAL DIAGNOSIS OF BENIGN NEOPLASMS

Types	Frequency	Percentage
Ameloblastoma	2	2.15%
Hemangioma	27	29.03%
Craniopharyngioma	1	1.08%
Inverted papilloma	**40**	**43.01%**
Exophytic Papilloma	3	3.23%
Oncocytic Papilloma	1	1.08%
Ossifying Fibroma	5	5.38%
Osteoid Osteoma	1	1.08%
Schwannoma	6	6.45%
Hemangiopericytoma	7	7.53%
Total	**93**	100.00%

GRAPH 4: HISTOLGICAL DIAGNOSIS OF BENIGN NEOPLASMS



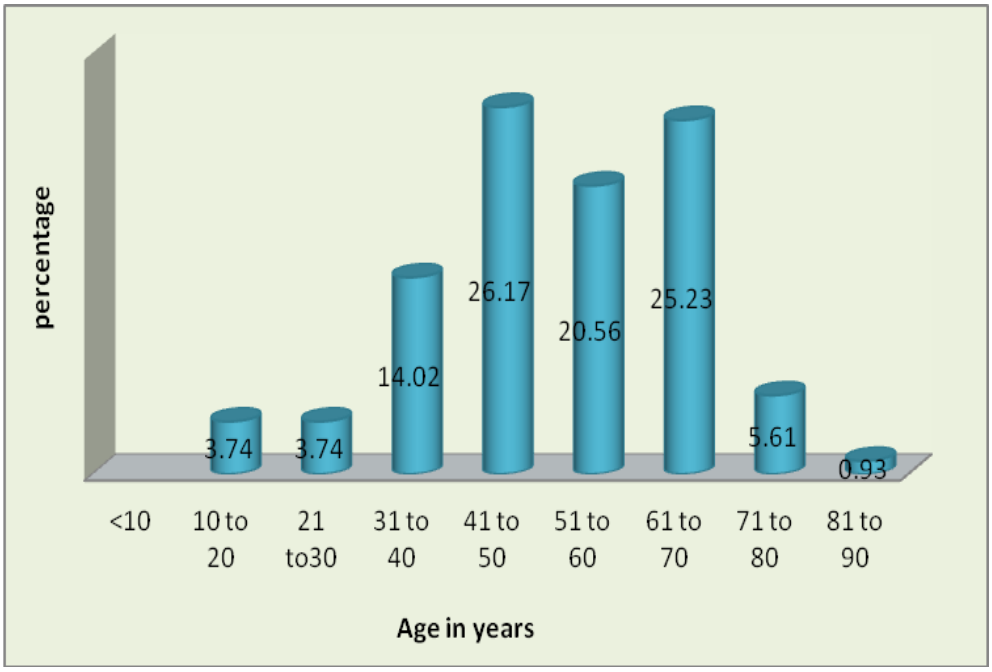
NEOPLASTIC LESIONS - MALIGNANT

Out of 200 samples 107 tumors was malignant constituting 53.5% showing a slight predominance over benign tumors. Malignant tumors occurred in patients one decade later than benign tumors with a mean age of 52.05 years and the male to female ratio was 2.3:1. Among malignant tumors, epithelial tumors (97) constituting 90.65% predominated over non epithelial tumors (10) constituting 9.35% with a ratio of 9.7:1. The age range varied from second to ninth decade of life but the peak age of presentation was 5th decade followed by 7th decade (Table-6).

TABLE-6: AGE DISTRIBUTION OF MALIGNANT NEOPLASMS

Age group(years)	Number	Percentage
<10	0	0
10 to 20	4	3.74
21 to30	4	3.74
31 to 40	15	14.02
41 to 50	**28**	**26.17**
51 to 60	22	20.56
61 to 70	27	25.23
71 to 80	6	5.61
81 to 90	1	0.93
Total	107	100

GRAPH 5: AGE DISTRIBUTION OF MALIGNANT NEOPLASMS

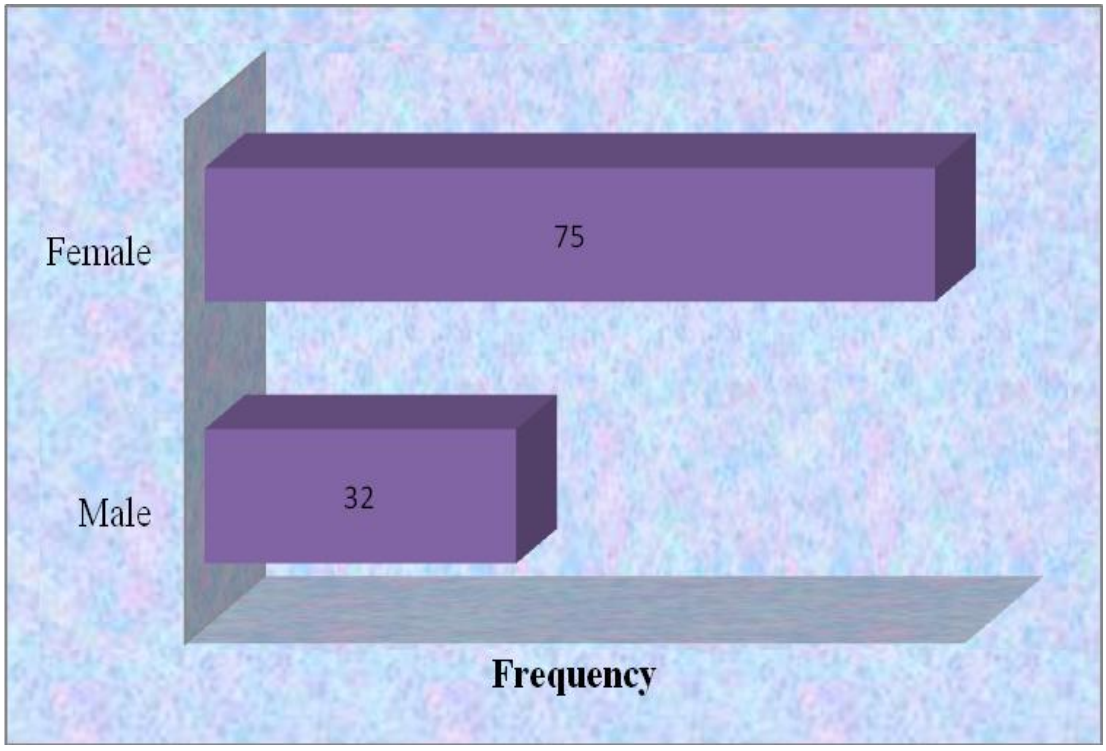


Males showed a higher incidence than females with a male to female ratio of 2.3:1 (Table-7).

TABLE-7: SEX DISTRIBUTION OF MALIGNANT NEOPLASMS

Sex	**Number**	**Percentage**
Male	**75**	**70.09**
Female	32	29.91
Total	107	100

GRAPH 6: SEX DISTRIBUTION OF MALIGNANT NEOPLASMS

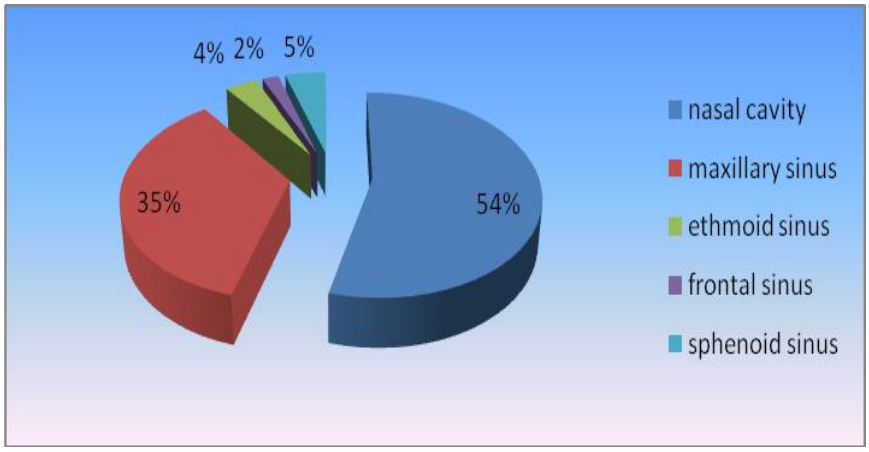


Out of the 107 malignant tumors 58 were from the nasal cavity (54.21%) and 49 were from paranasal sinuses (45.79%). Amongst paranasal sinuses maxillary sinus was the commonest site (Table-8).

TABLE-8: SITE OF MALIGNANT NEOPLASMS

Site	Number	Percentage
Nasal cavity	**58**	**54.21**
Maxillary sinus	**38**	**35.51**
Ethmoid sinus	4	3.74
Frontal sinus	2	1.87
Sphenoid sinus	5	4.67
Total	107	100

GRAPH 7: SITE OF MALIGNANT NEOPLASMS



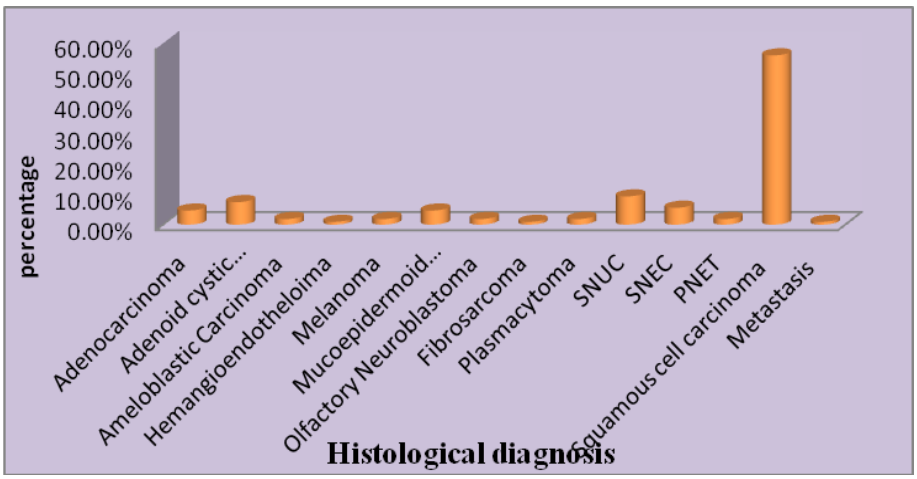
The most common malignant tumor encountered was squamous cell carcinoma 60 cases (56.07%), followed by Sinonasal undifferentiated carcinoma (SNUC) 10 cases (9.35%). The other malignant lesions that involved the region were adenoid cystic carcinoma, adenocarcinoma, mucoepidermoid carcinoma, sinonasal neuroendocrine carcinoma. olfactory neuroblastoma and ameloblastic carcinoma. Rare

tumors included mucosal malignant melanoma, plasmacytoma, PNET, fibrosarcoma and clear cell metastatic deposits. (Table-9)

TABLE-9: HISTOLOGICAL DIAGNOSIS OF MALIGNANT NEOPLASMS

Types	Frequency	Percentage
Adenocarcinoma	5	4.67%
Adenoid cystic carcinoma	8	7.48%
Ameloblastic carcinoma	2	1.87%
Hemangioendothelioma	1	0.93%
Melanoma	2	1.87%
Mucoepidermoid carcinoma	5	4.67%
Olfactory Neuroblastoma	2	1.87%
Fibrosarcoma	1	0.93%
Plasmacytoma	2	1.87%
SNUC	10	9.35%
SNEC	6	5.61%
PNET	2	1.87%
Squamous cell carcinoma	**60**	**56.07%**
Metastasis	1	0.93%
Total	107	100.00%

GRAPH 8: HISTOLOGICAL DIAGNOSIS OF MALIGNANT NEOPLASMS

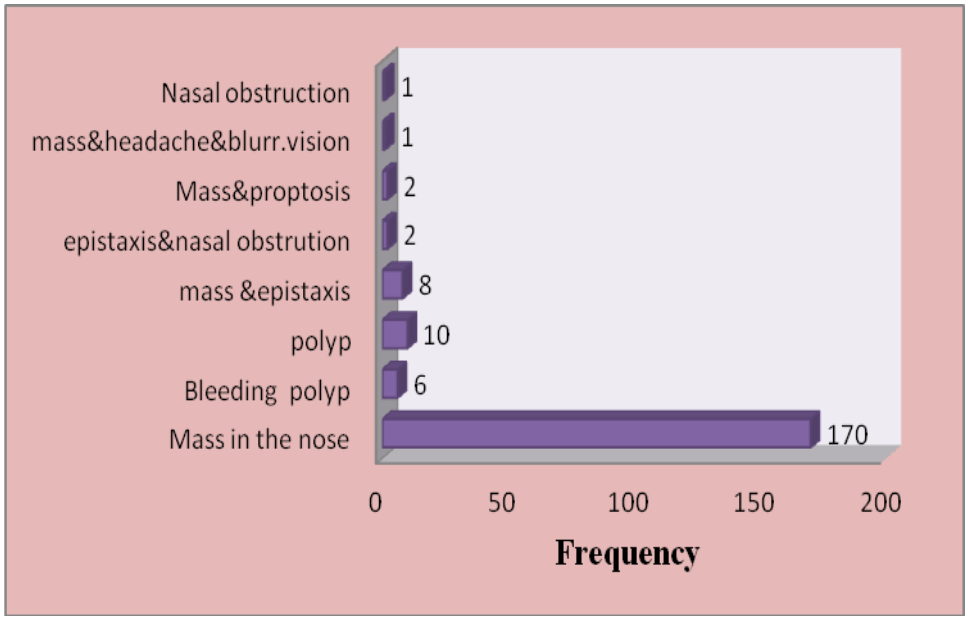


The most common clinical presentation was mass in the nose which constituted 180 cases (90%) (Table-10).

TABLE-10: CLINICAL PRESENTATION

Clinical presentation	Frequency	Percentage
Mass in the nose	**170**	**85**
Bleeding polyp	6	3
Polyp	10	5
Mass &epistaxis	8	4
Epistaxis&nasal obstruction	2	1
Mass&proptosis	2	1
Mass&headache&blurr.vision	1	0.5
Nasal obstruction	1	0.5

GRAPH 9: CLINICAL PRESENTATION

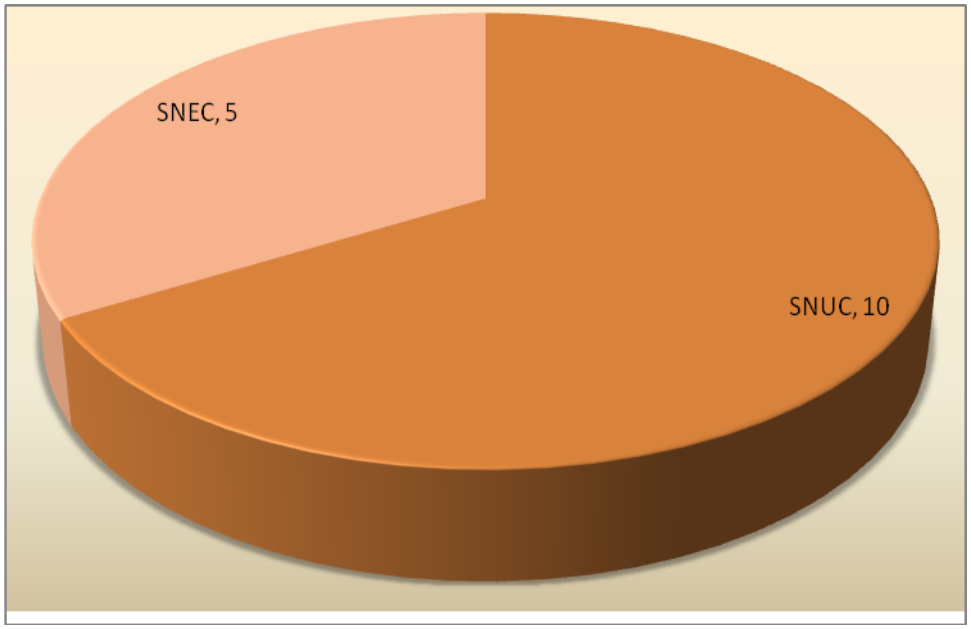


A panel of immunohistochemical markers that included cytokeratin, NSE, synaptophysin, vimentin, desmin, S100, CD99 and CD45 was employed for 15 cases of undifferentiated carcinoma. 10 cases showed diffuse,moderate staining for cytokeratin and no reactivity for other markers except for 2 which in addition to cytokeratin showed focal reactivity for NSE. All the 10 were finally diagnosed as Sinonasal undifferentiated carcinoma (SNUC). 5 showed diffuse moderate staining for cytokeratin, NSE, synaptophysin, and were finally categorized as Sinonasal neuroendocrine carcinoma (SNEC). SNUC was the predominant variant (66.67%) followed by SNEC (33.33%) (Table-11).

TABLE-11: UNDIFFERENTIATED CARCINOMA

Undifferentiated carcinoma	**NO**	**Percentage**
SNUC	10	66.67
SNEC	5	33.33

GRAPH 10: UNDIFFERENTIATED CARCINOMA

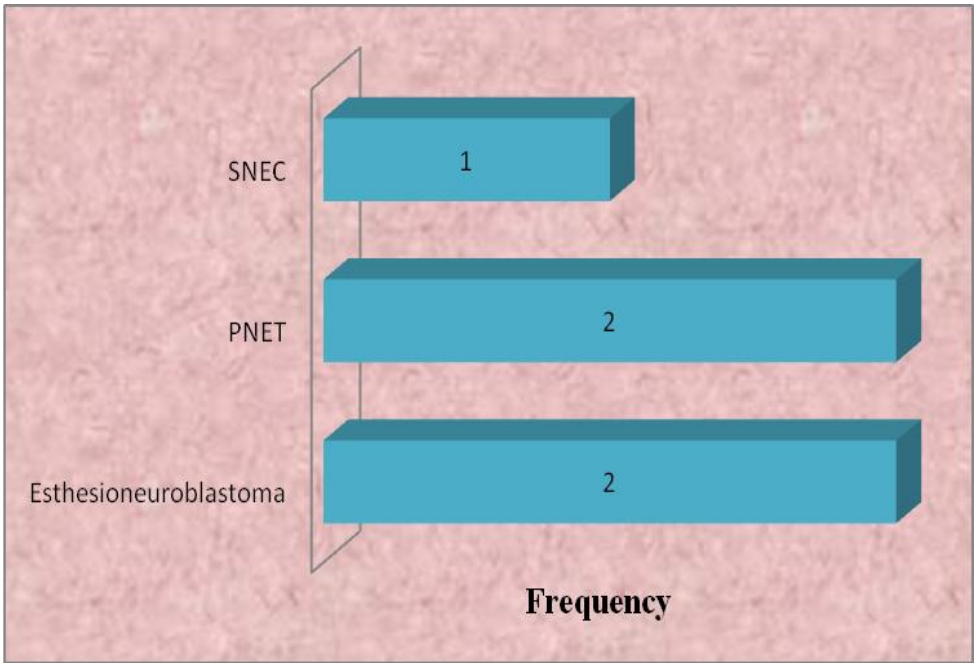


An immunohistochemistry panel was employed for 5 small round cell tumors (SRCT). Among them we observed that 2 showed reactivity for NSE, synaptophysin, S100 and was finally diagnosed as esthesioneuroblastoma(ENB) 40%. Among the other 3 PNET was diagnosed in two cases as they showed reactivity for CD 99 and vimentin.One was diagnosed as SNEC and showed reactivity for cytokeratin, NSE and synaptophysin (Table-12).

TABLE-12: **SMALL ROUND CELL TUMORS**

SRCT	**No**
Esthesioneuroblastoma	2
PNET	2
SNEC	1
Total	5

GRAPH 11: SMALL ROUND CELL TUMORS



INVERTED PAPILLOMA

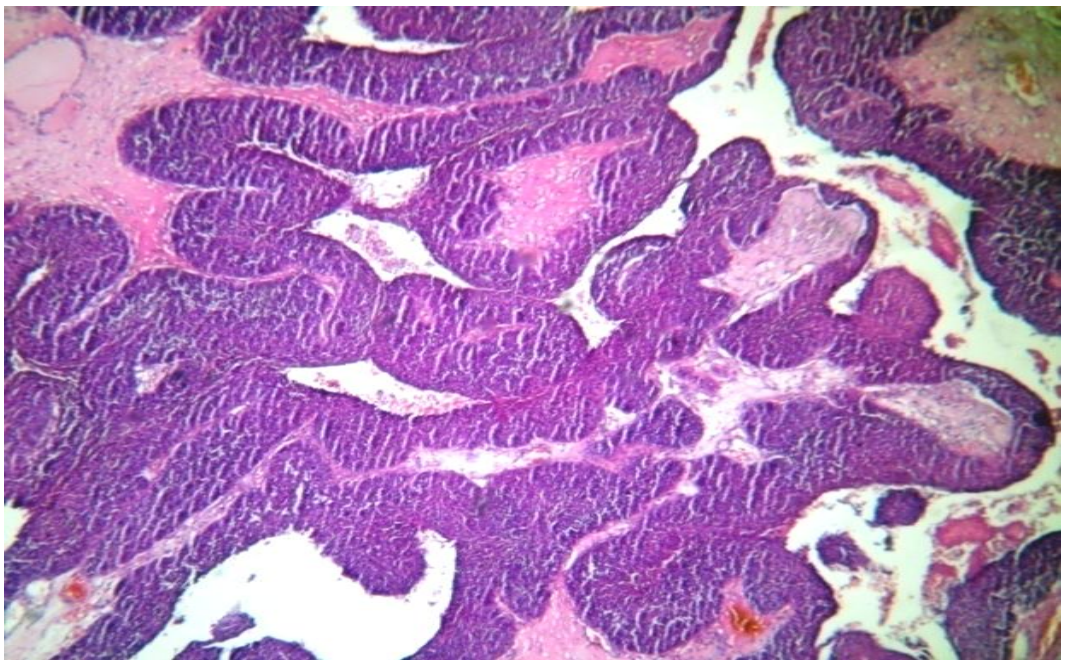


Fig.1: An endophytic growth of thickened squamous epithelium (H&E100x)

INVERTED PAPILLOMA WITH MALIGNANT TRANSFORMATION

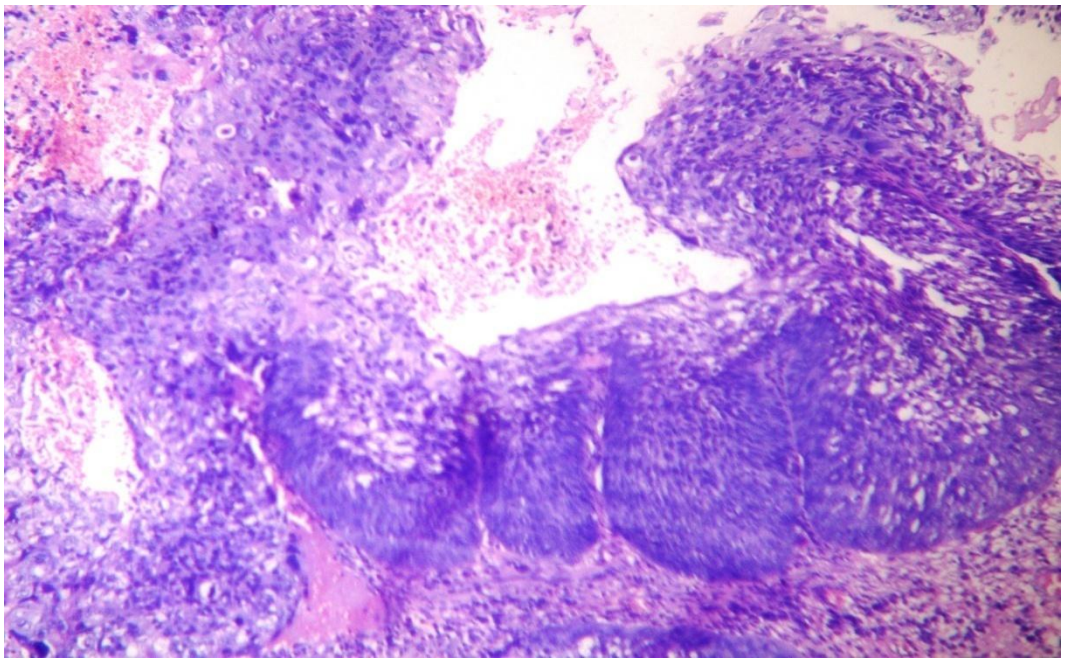


Fig.2: Benign endophytic growth of stratified squamous epithelium with adjacent malignant squamous cell carcinoma (H&E100x)

LOBULAR CAPILLARY HEMANGIOMA

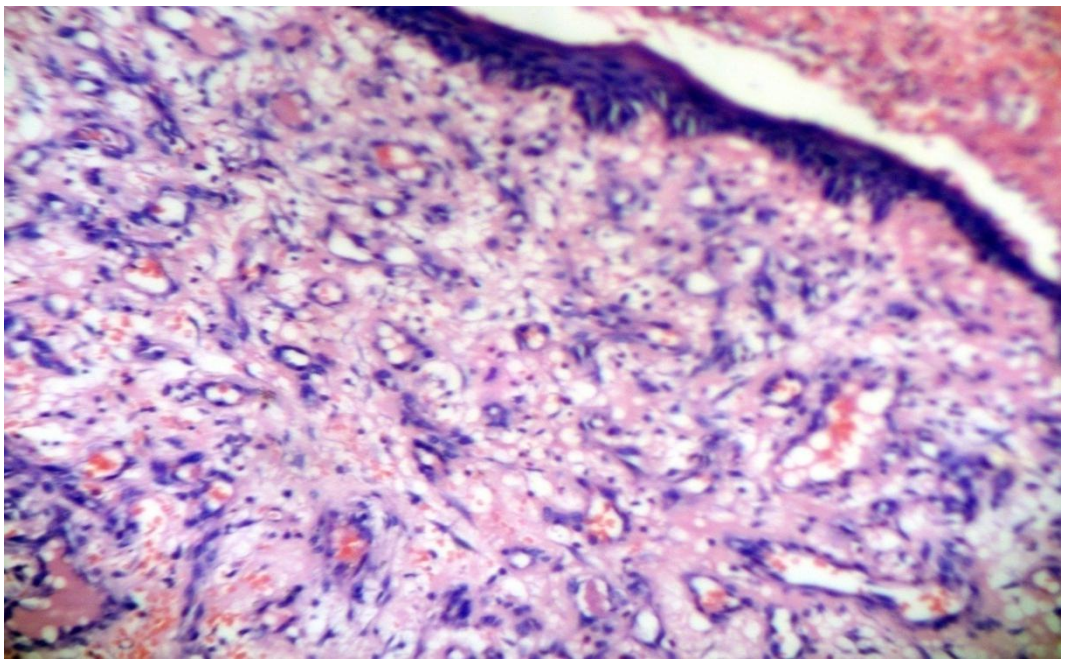


Fig.3: submucosal lobular proliferation of variable sized vascular spaces (H&E100x)

HEMANGIOPERICYTOMA

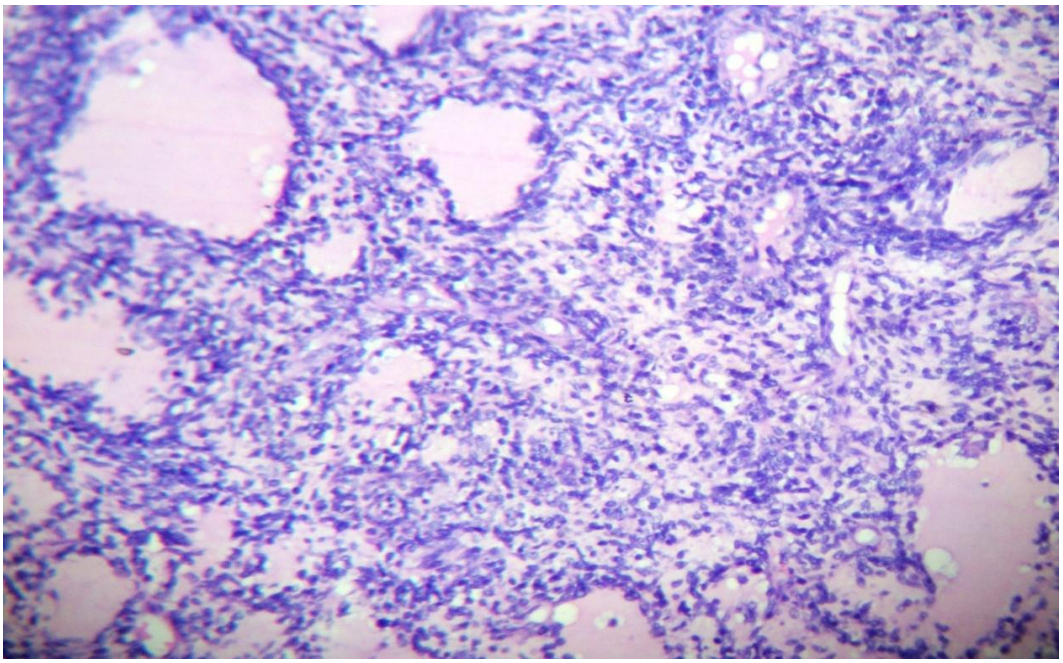


Fig.4: Diffuse growth pattern of closely packed spindle cells and vascular channels of varying sizes (H&E100x)

SCHWANNOMA

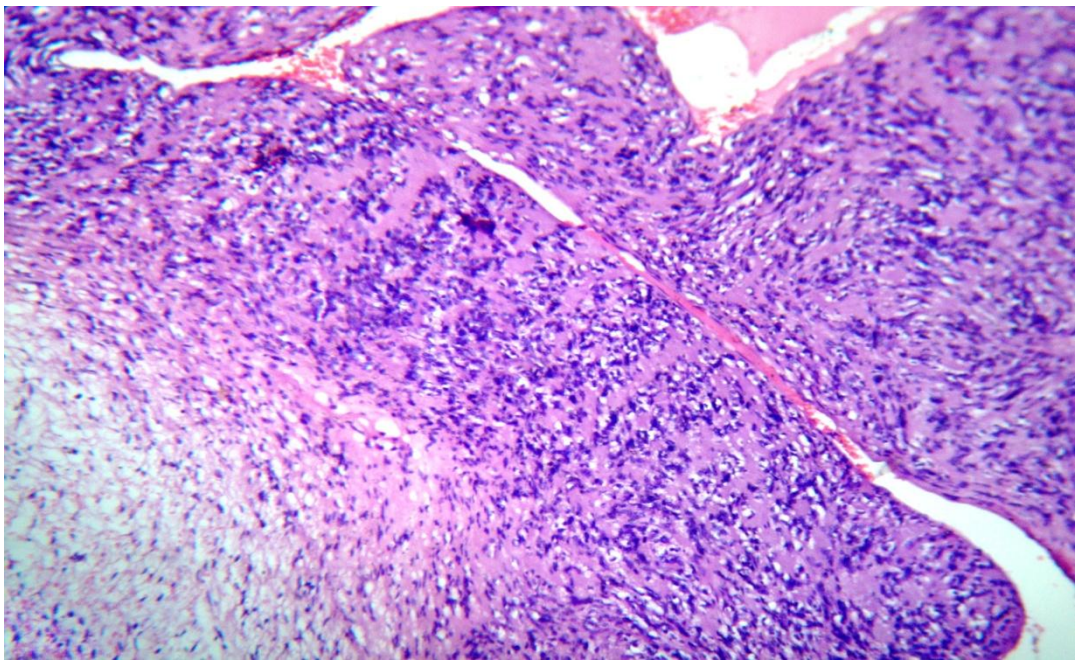


Fig.5: Cellular Antoni A areas arranged in palisades admixed with loose myxoid areas Antoni B areas (H&E100x)

PSAMMOMATOID OSSIFYING FIBROMA

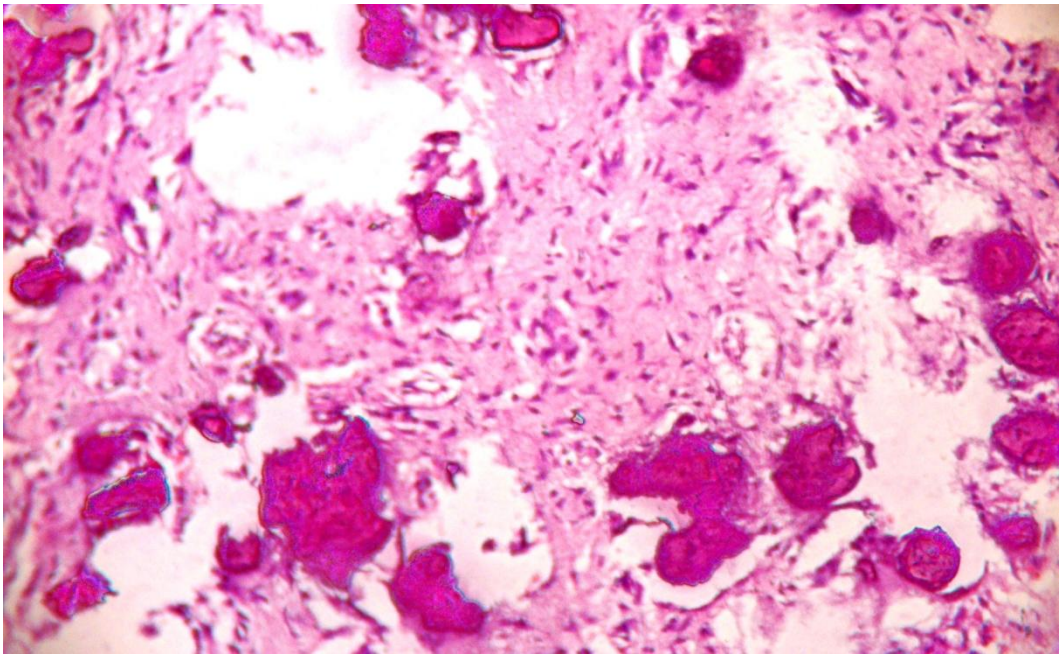


Fig.6: calcified spherules with fibrous stroma(H&E100x)

AMELOBLASTOMA

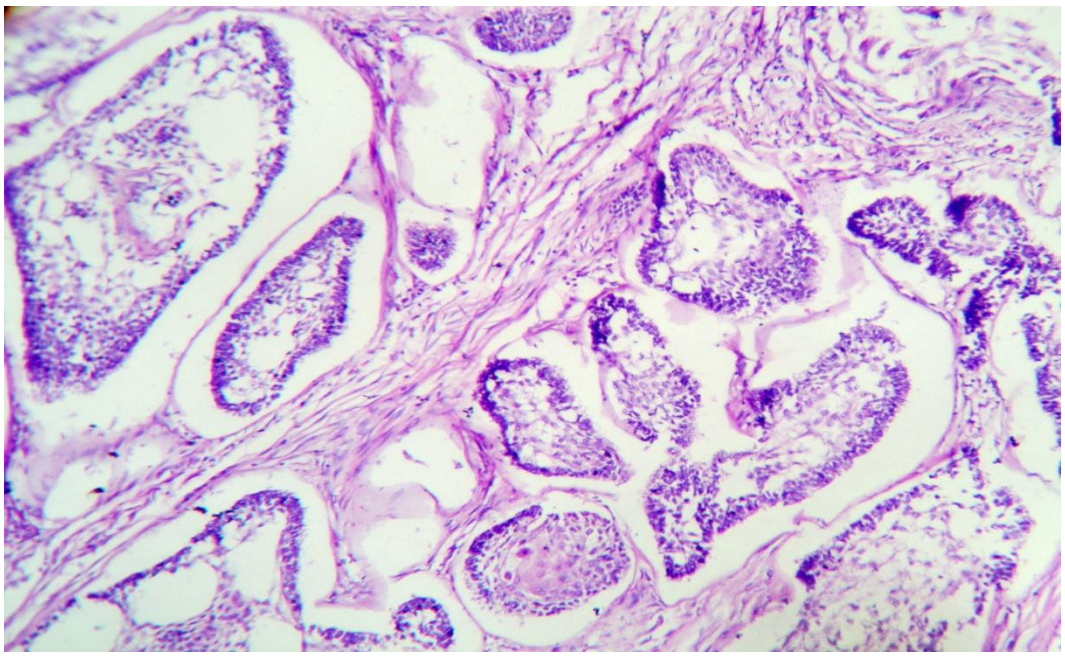


Fig.7: Neoplasm in follicular pattern lined by columnar epithelium showing peripheral palisading with inner stellate reticulam(H&E100x)

CRANIOPHARYNGIOMA

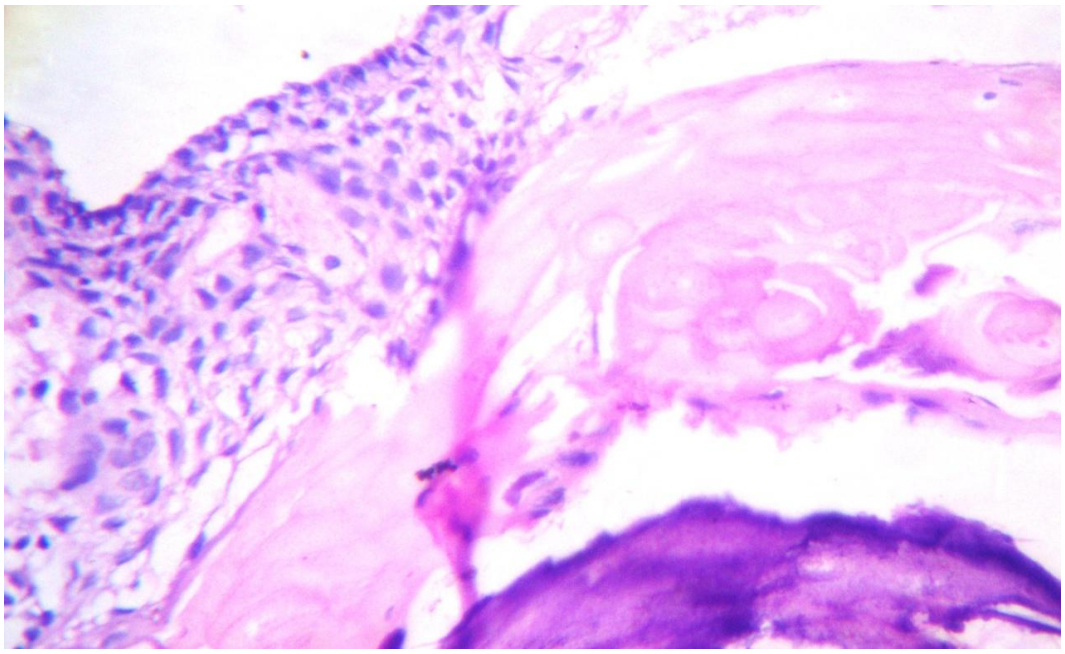


Fig.8: Basaloid appearing columnar cells with peripheral palisading,wet keratin and calcification(H&E400x)

BASALOID SQUAMOUS CELL CARCINOMA

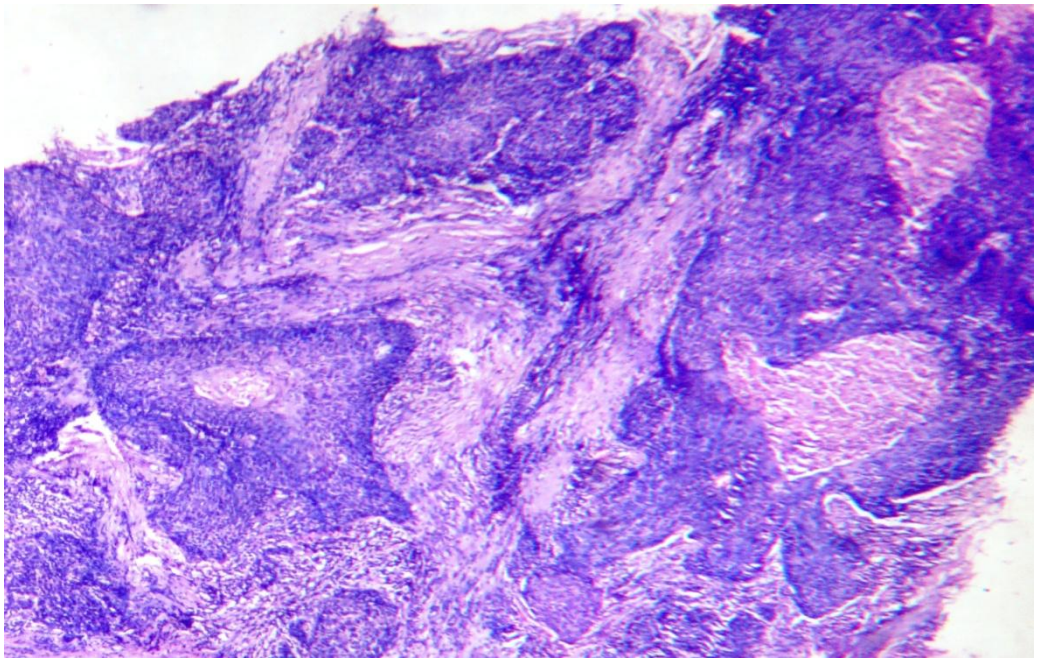


Fig.9: Lobules and nests of basaloid cells with comedo necrosis (H&E100x)

ACANTHOLYTIC SQUAMOUS CELL CARCINOMA

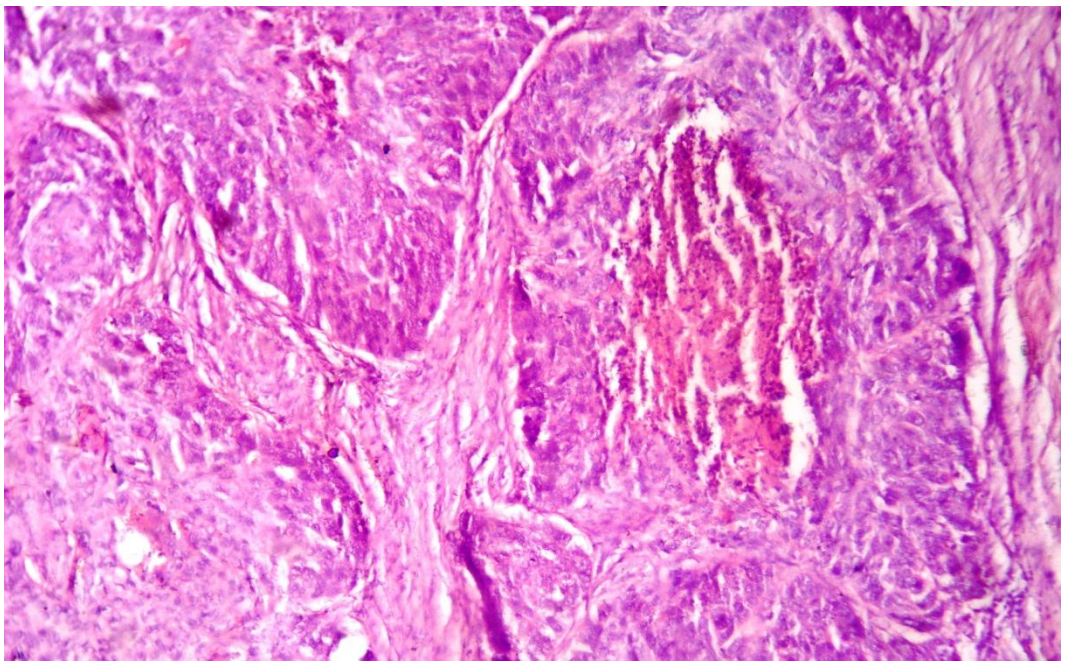


Fig.10: Pseudoglandular pattern of tumour with acantholysis(H&E100x)

ADENOID CYSTIC CARCINOMA

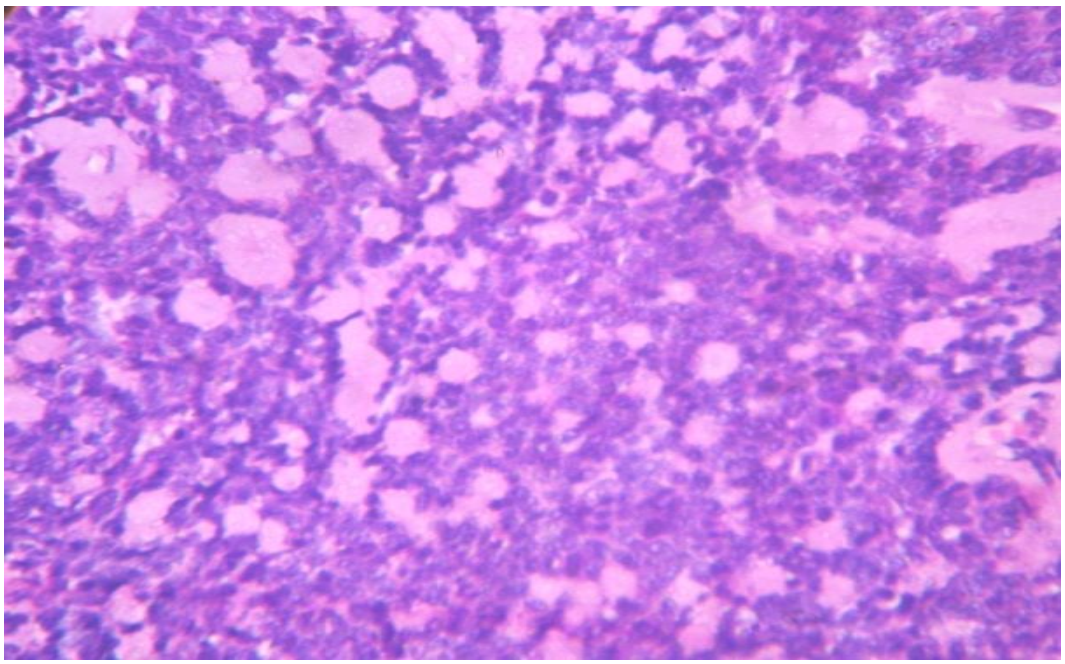


Fig.11: Cribriform configuration of neoplasm composed of basaloid cells with eosinophilic basement membrane material in the lumen (H&E400x)

PAPILLARY ADENOCARCINOMA

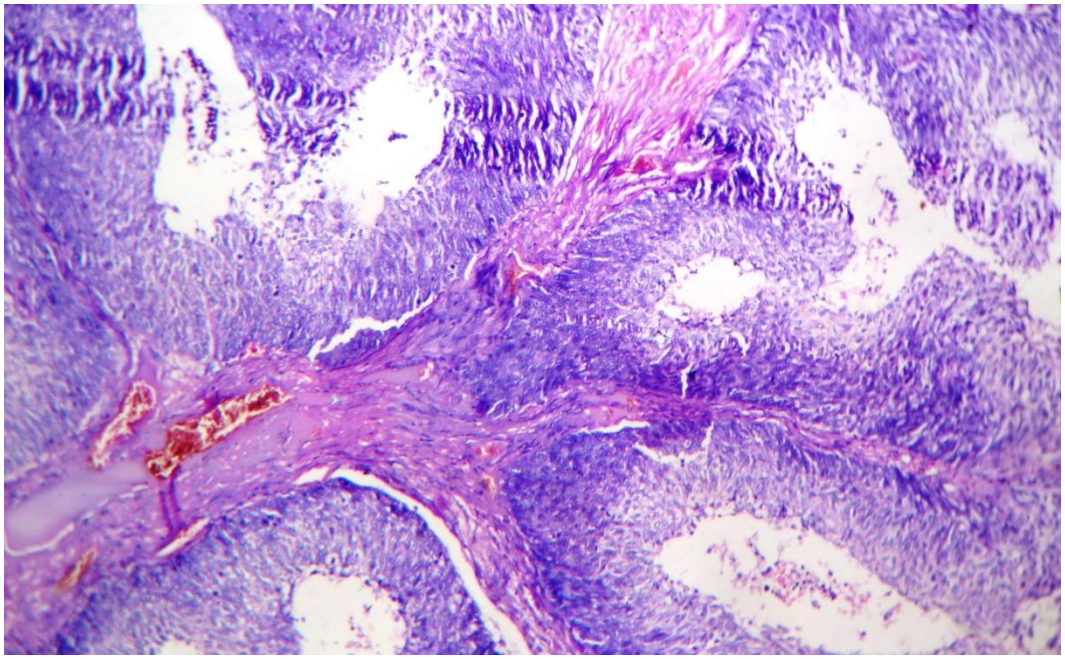


FIG.12: Papillary configuration of tumour lined by malignant columnar epithelial cells with nuclear stratification (H&E100x)

MUCOEPIDERMOID CARCINOMA

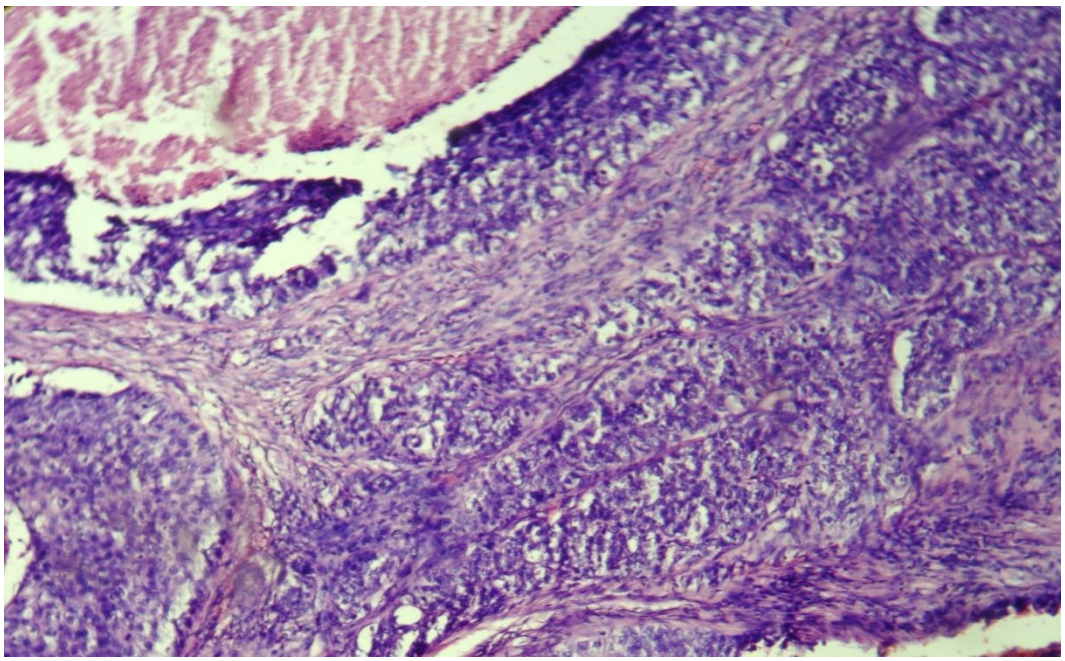


Fig.13: Islands of malignant squamous epithelial cells admixed with mucus secreting cells and necrosis (H&E100x)

PLASMACYTOMA

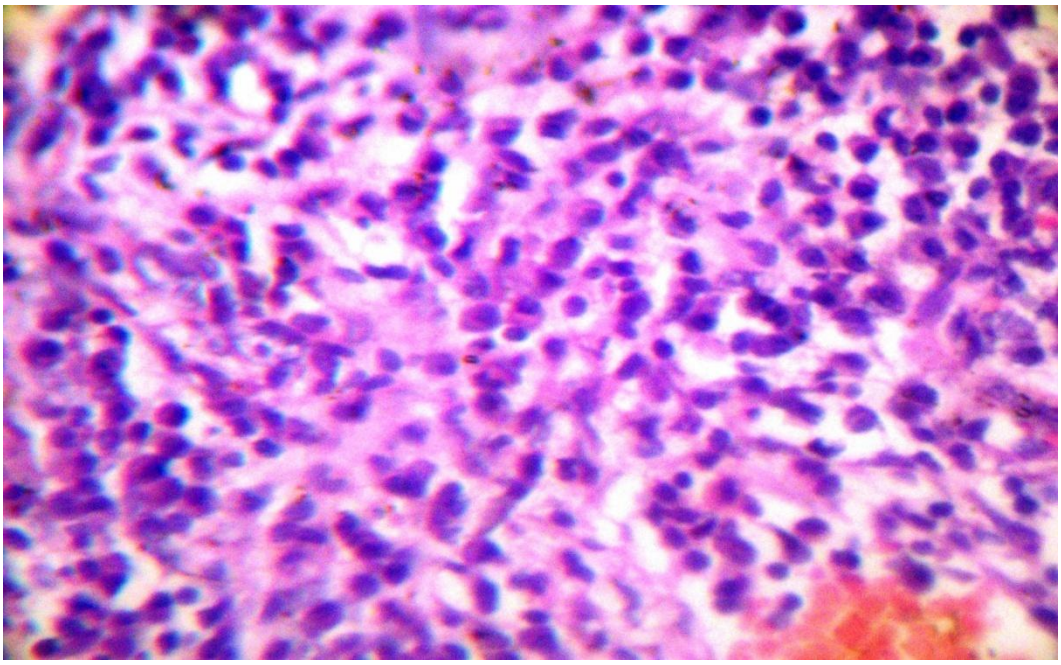


Fig.14: Diffuse sheets of plasma cells with eccentrically placed round nucleus (H&E100X)

FIBROSARCOMA

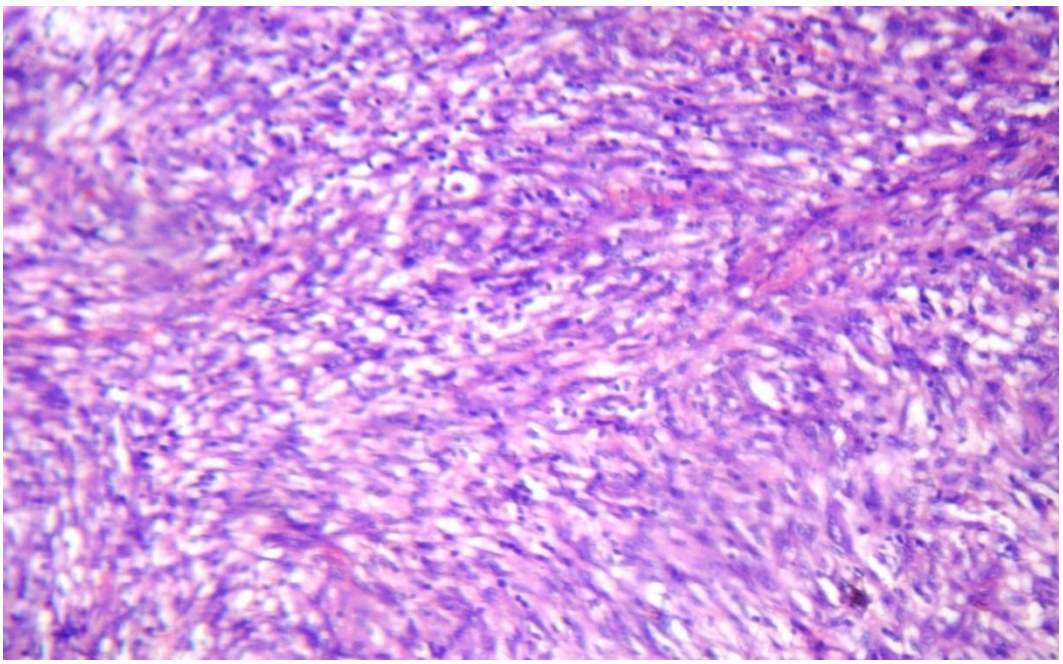


FIG.15: Fascicles and herringbone pattern of spindle shaped cells with mild cellular pleomorphism(H&E100X)

FIBROSARCOMA

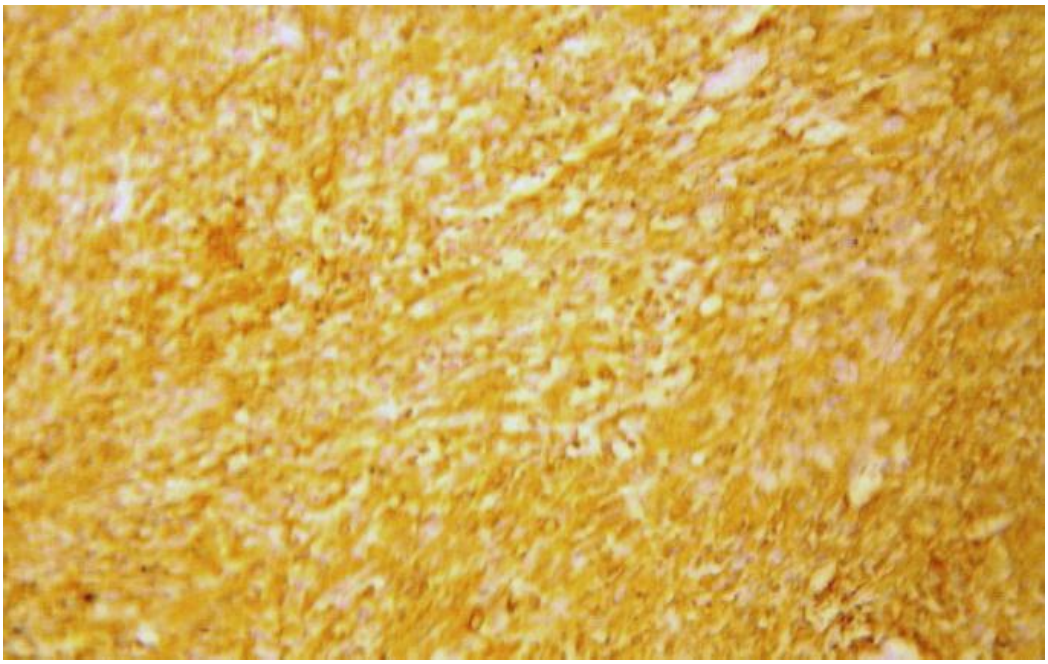


FIG.16: Neoplastic spindle cells showing positivity for vimentin(IHC100X)

METASTATIC CLEAR CELL CARCINOMA

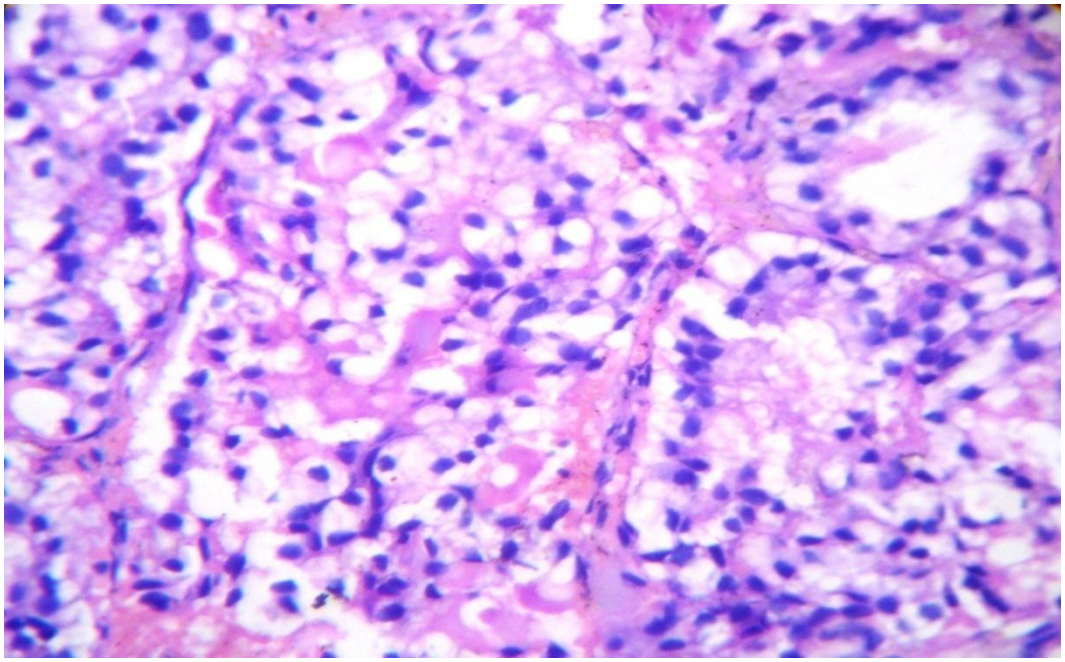


Fig.17: Neoplasm in solid tubuloalveolar pattern composed of clear cells with round nuclei (H&E400X)

MALIGNANT MELANOMA

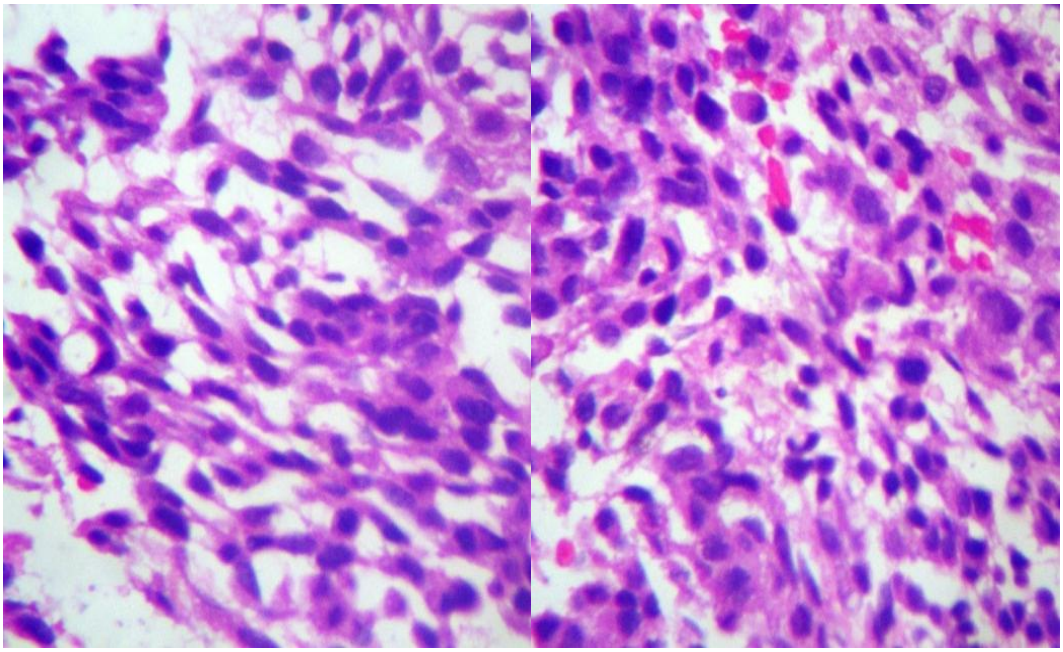


Fig.18: Neoplasm showing spindle cells and epithelioid cells with pleomorphic nuclei (H&E400X)

MALIGNANT MELANOMA

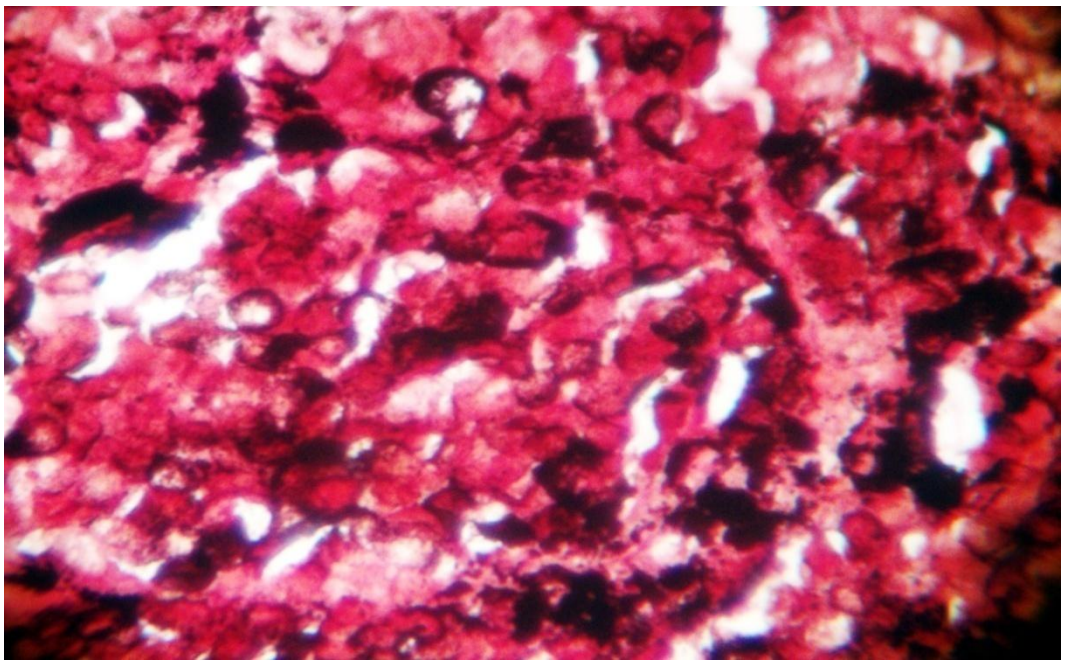


Fig.19: Black pigment (melanin) in the cytoplasm of neoplastic cells (Masson Fontana stain 400x)

MALIGNANT MELANOMA

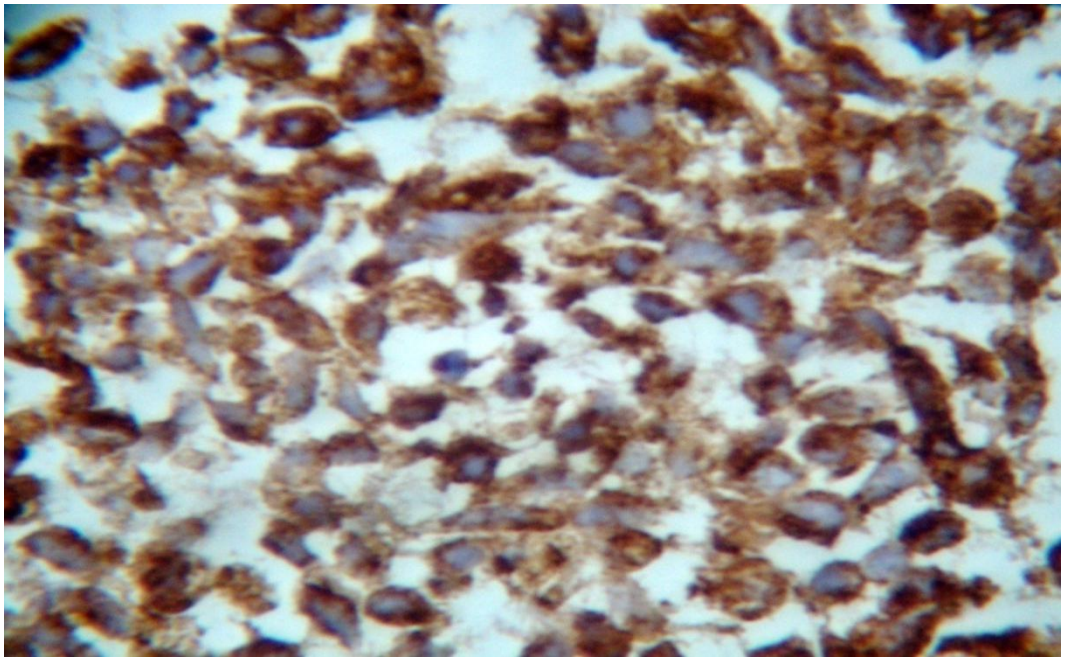


Fig.20: Neoplastic cells showing positivity for HMB 45 (IHC400x)

OLFACTORY NEUROBLASTOMA

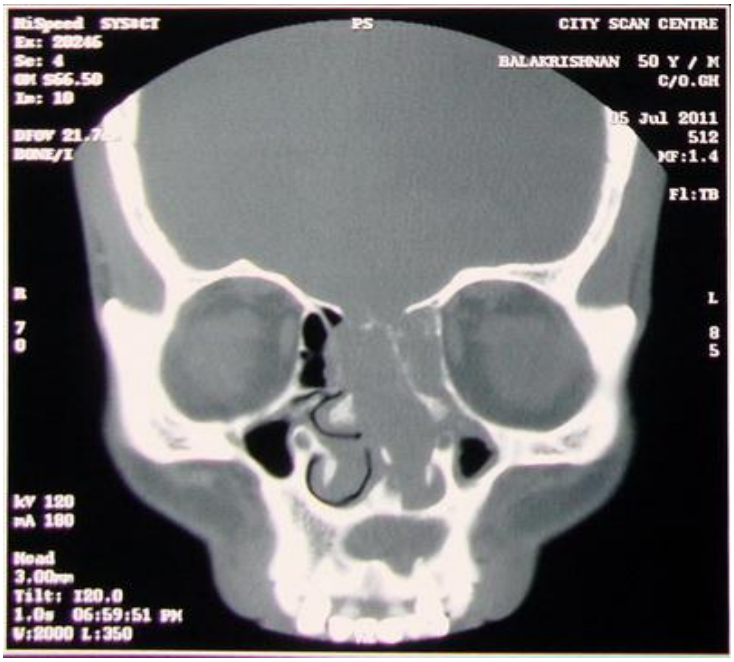


Fig.21: CT paranasal sinuses showing tumor in the left nasal cavity and ethmoid sinus with intracranial extension

OLFACTORY NEUROBLASTOMA

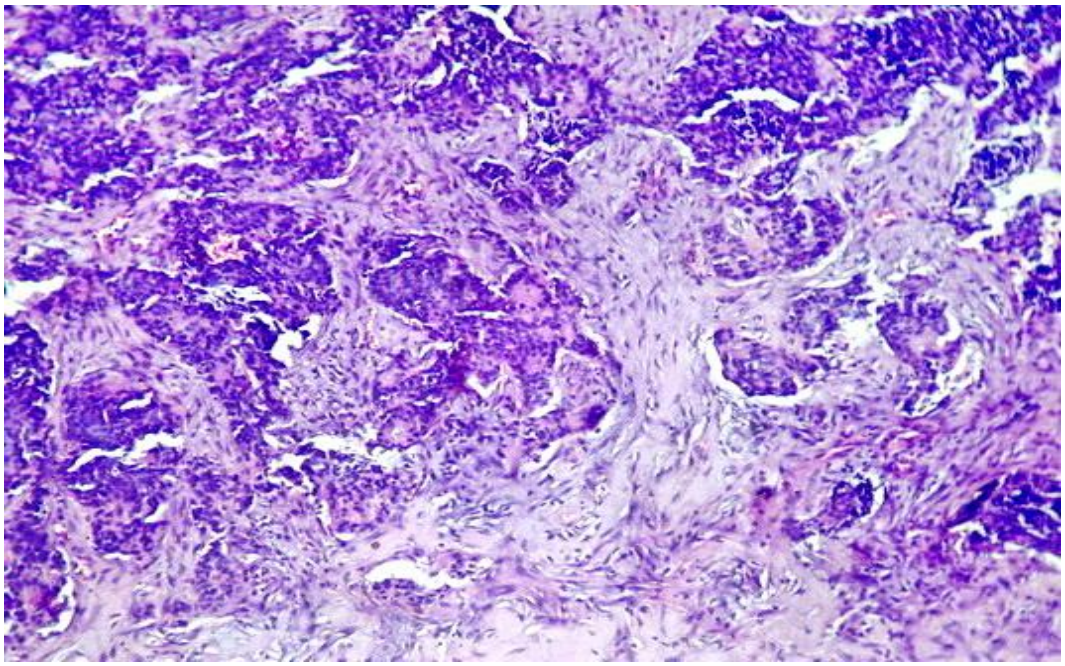


Fig.22: Neoplasm arranged in nests and lobules in a fibrillary background (H&E100X)

OLFACTORY NEUROBLASTOMA

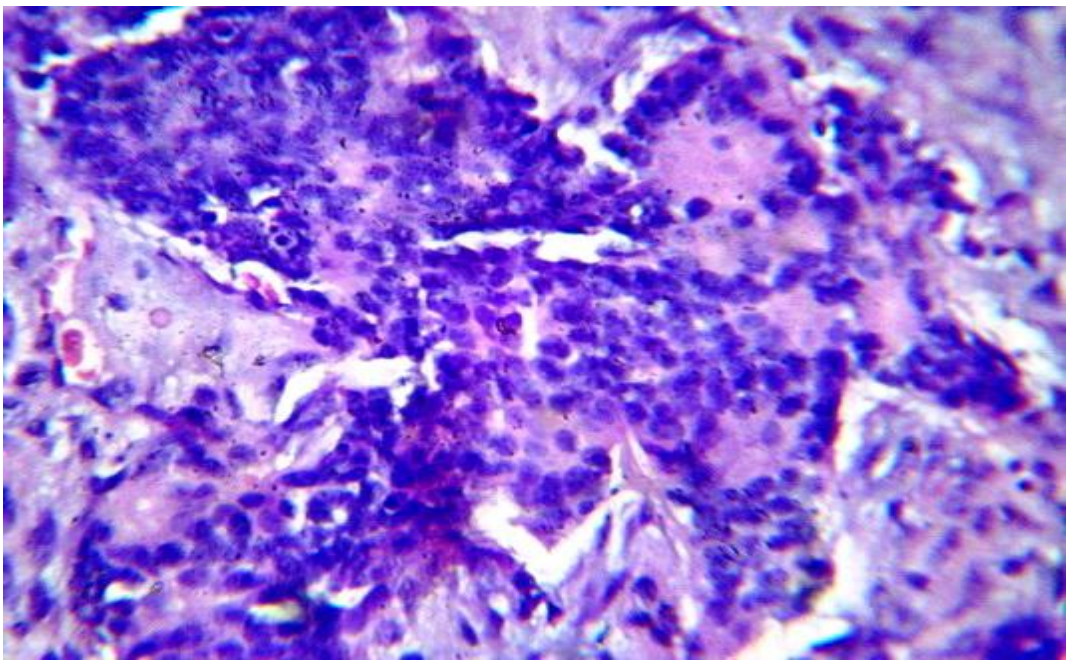


Fig.23: Neoplasm composed of small round cells with Homer-Wright rosettes (H&E400X)

OLFACTORY NEUROBLASTOMA

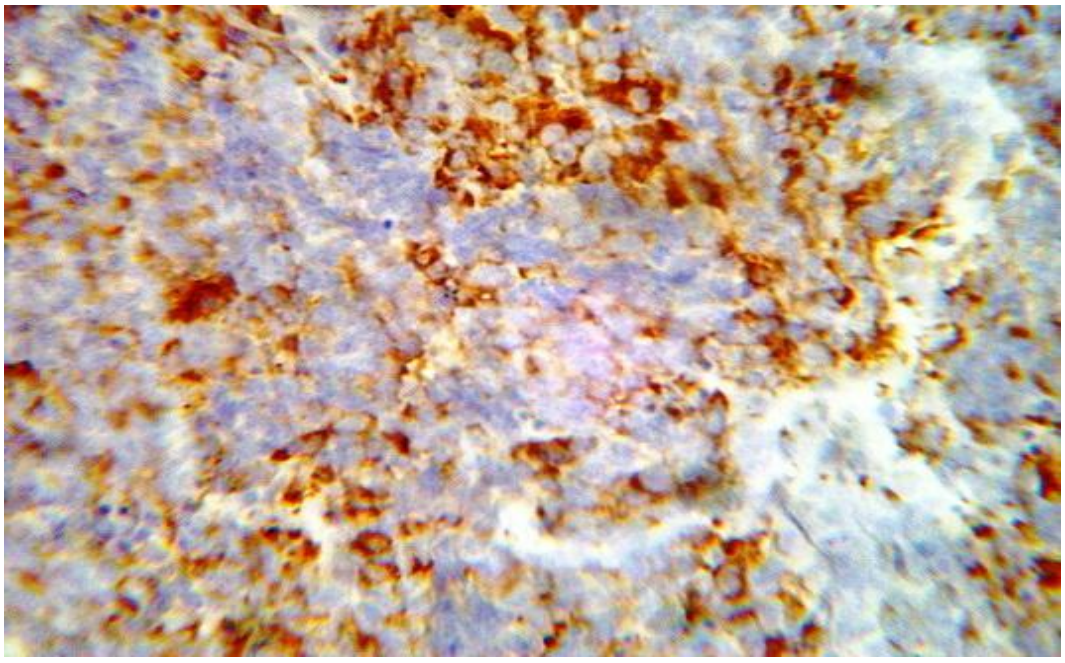


Fig.24: Neoplastic cells showing positivity for neuron specific enolase (NSE) (IHC 400X)

OLFACTORY NEUROBLASTOMA

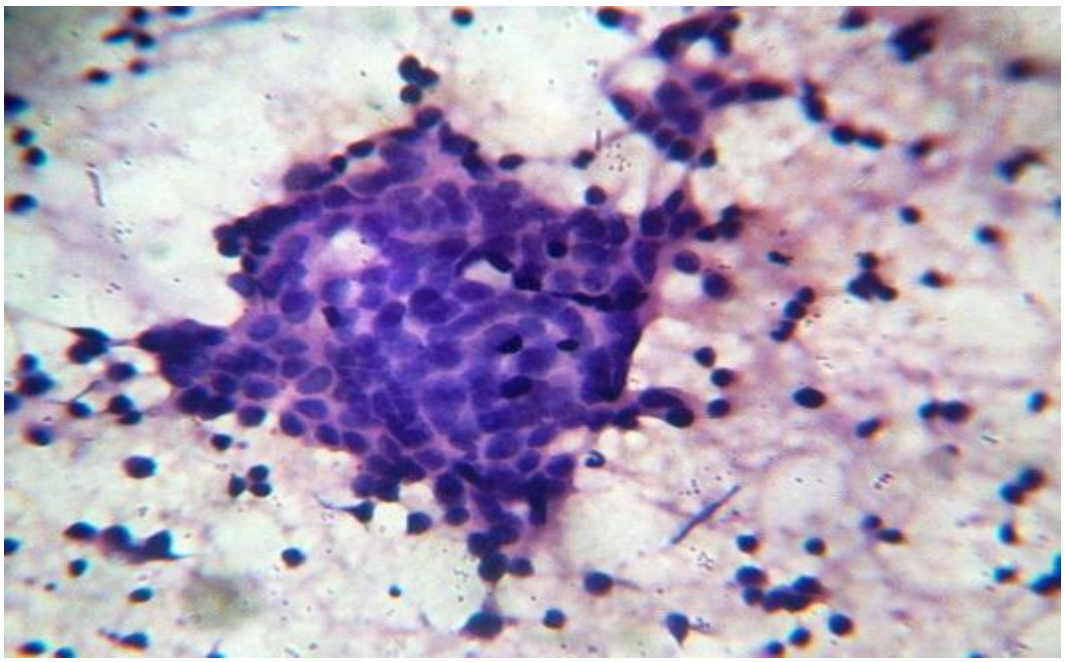


Fig.25: Aspirate from cervical lymph node shows small round cells with occasional rosette formation (FNAC 400X)

PNET

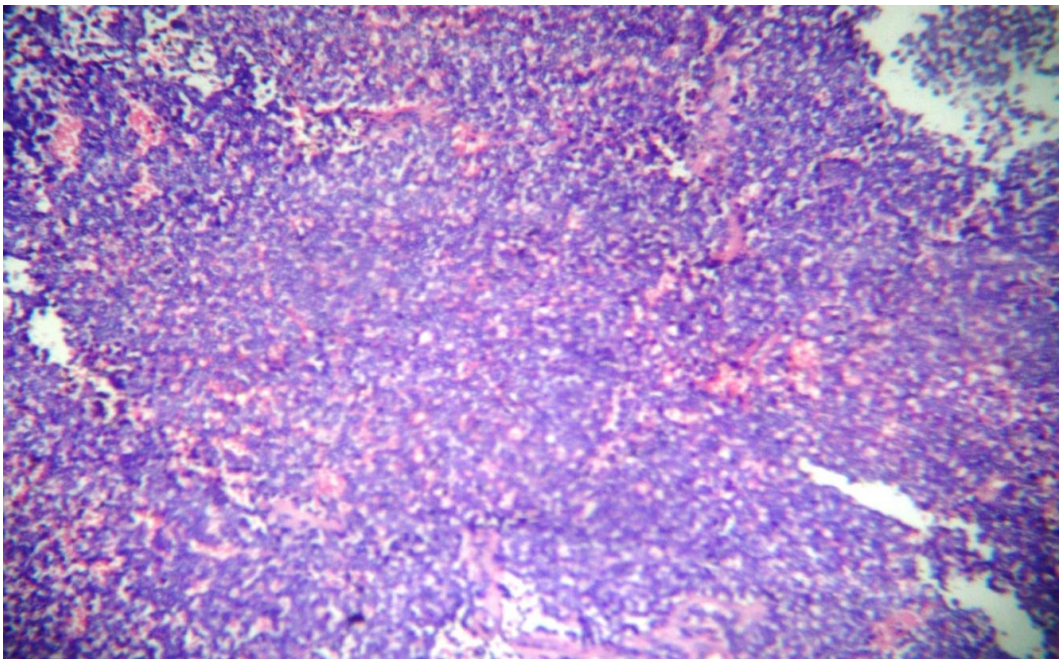


Fig.26: Neoplasm arranged in diffuse dense cellular sheets (H&E100x)

PNET

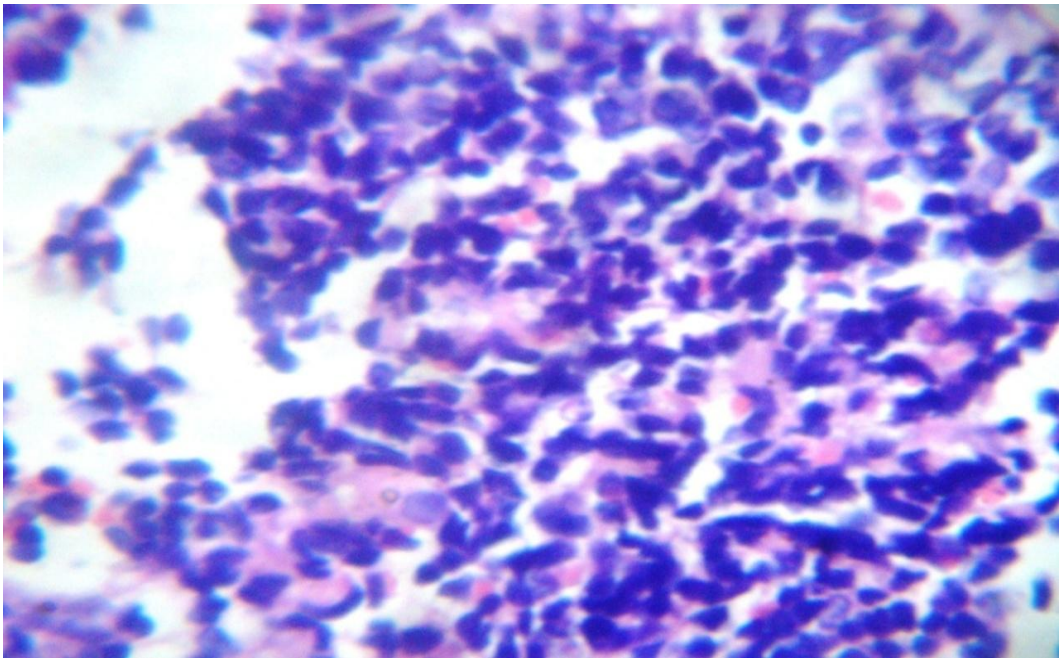


Fig.27: Uniform small to medium sized round cells with scant cytoplasm and rosette formation (H&E400x)

PNET

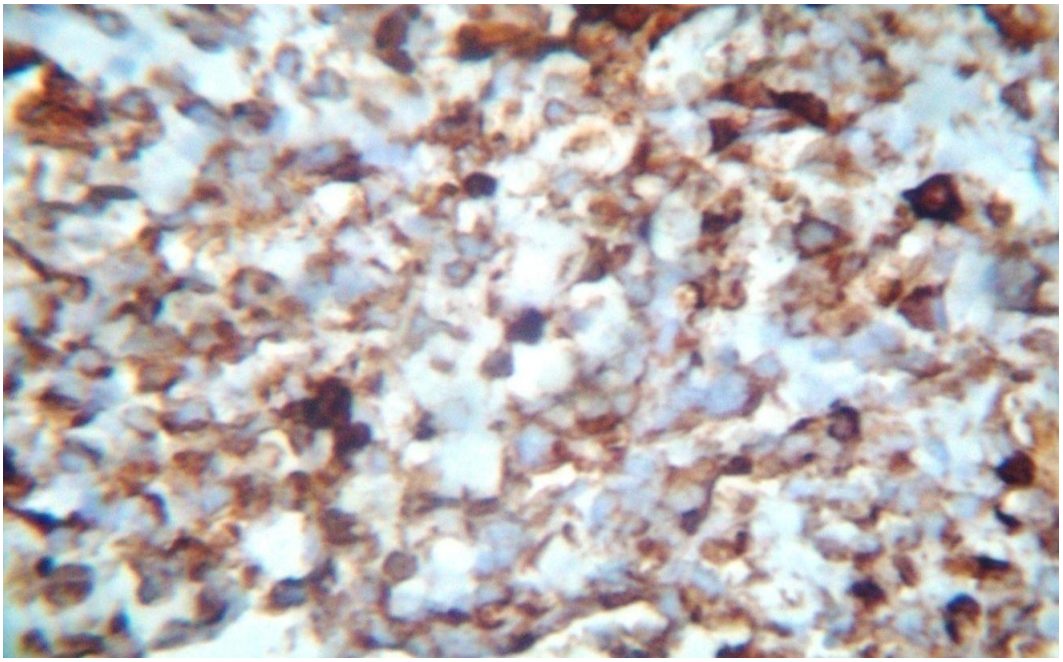


Fig.28: Neoplastic cells showing membranous positivity for CD99 (IHC400X)

PNET

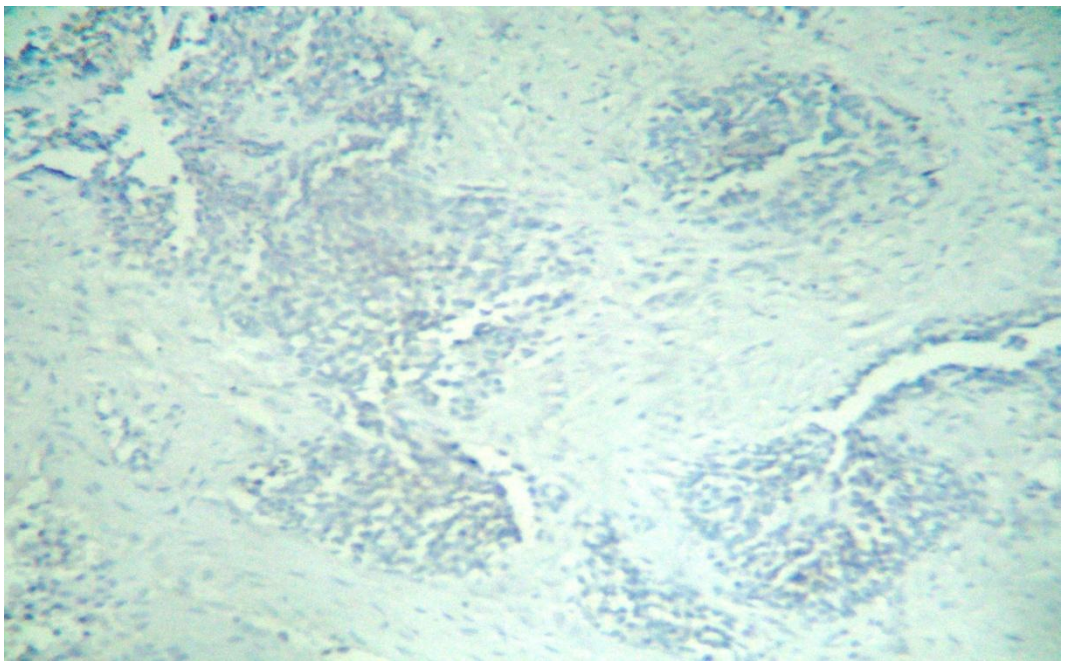


Fig.29: Neoplastic cells showing negativity for cytokeratin (IHC100X)

SINONASAL UNDIFFERENTIATED CARCINOMA

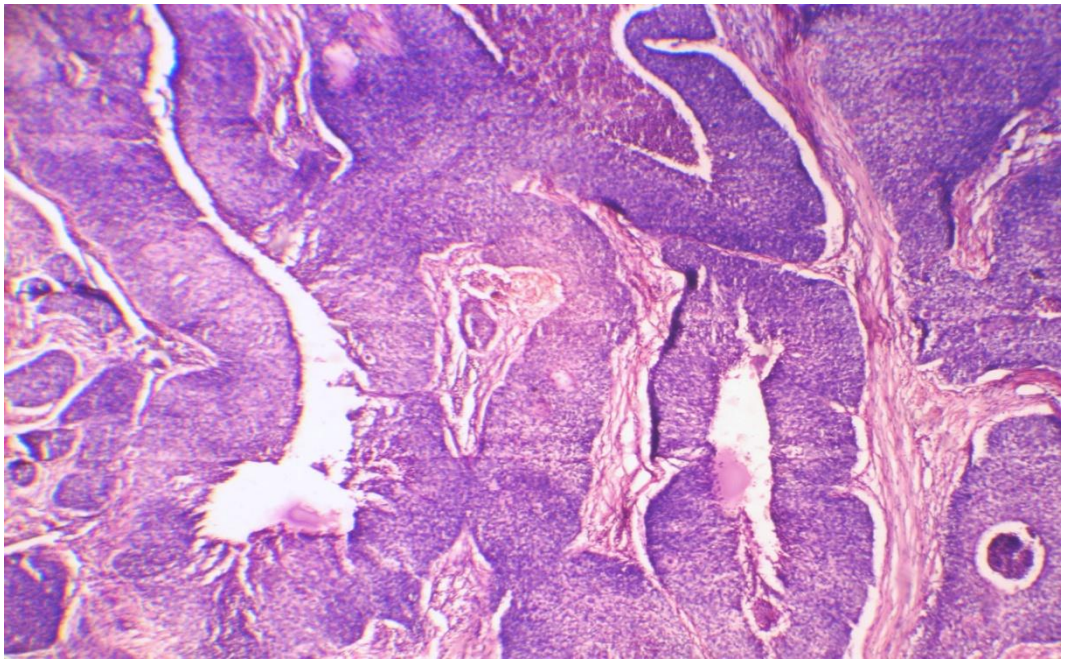


Fig.30: Neoplasm arranged in nests, thick trabeculae with necrosis (H&E100X)

SINONASAL UNDIFFERENTIATED CARCINOMA

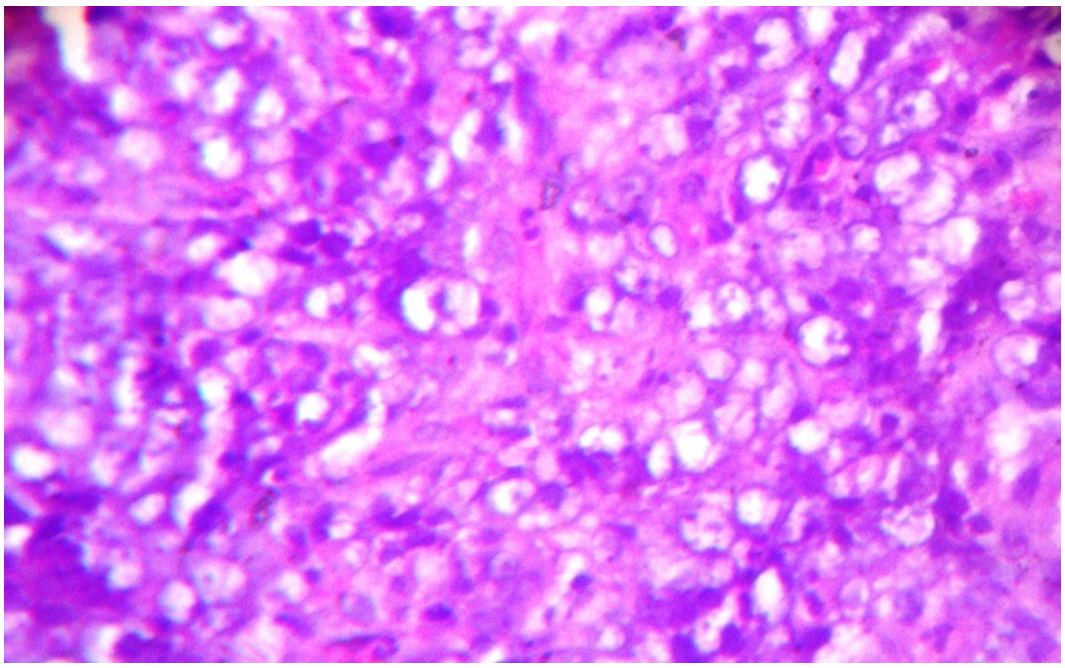


Fig.31: Neoplastic cells have vesicular nuclei and prominent nucleoli (H&E400x)

SINONASAL UNDIFFERENTIATED CARCINOMA

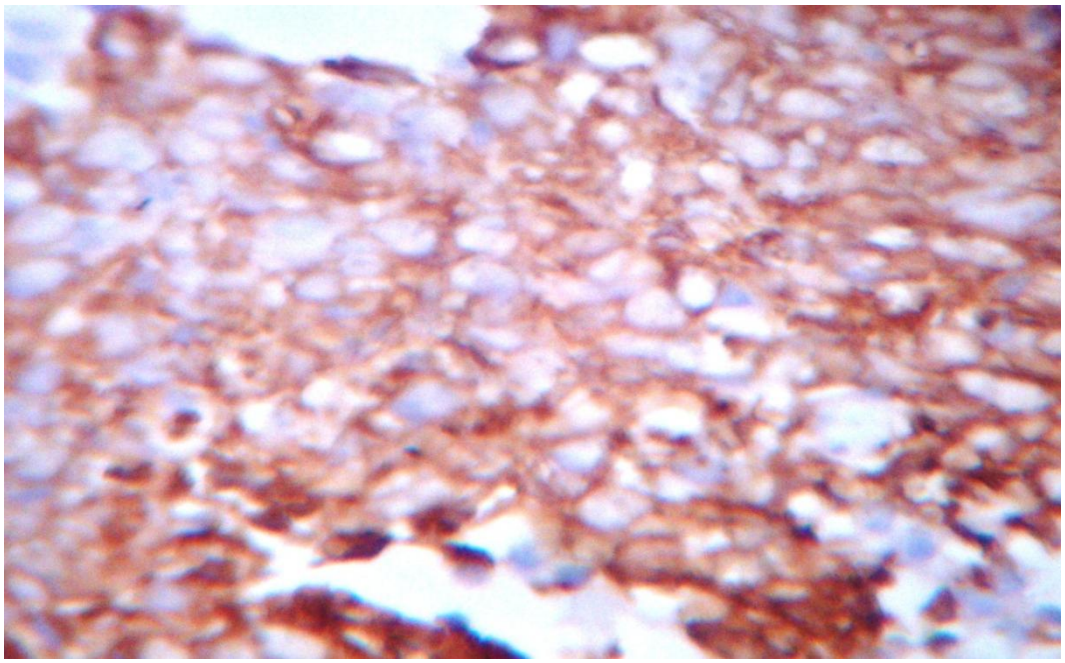


Fig.32: Tumor cells showing positivity for cytokeratin (H&E400x)

SINONASAL NEUROENDOCRINE CARCINOMA

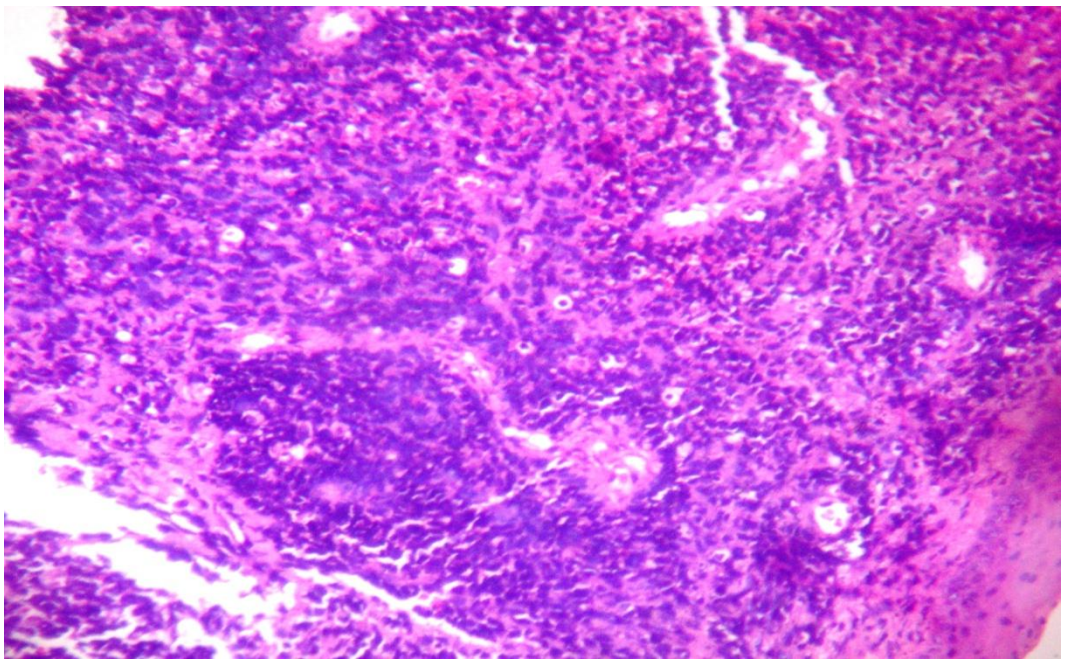


Fig.33: Cellular neoplasm in solid sheets with focal rosette formation lacking neurofibrillary background (H&E 100X)

SINONASAL NEUROENDOCRINE CARCINOMA

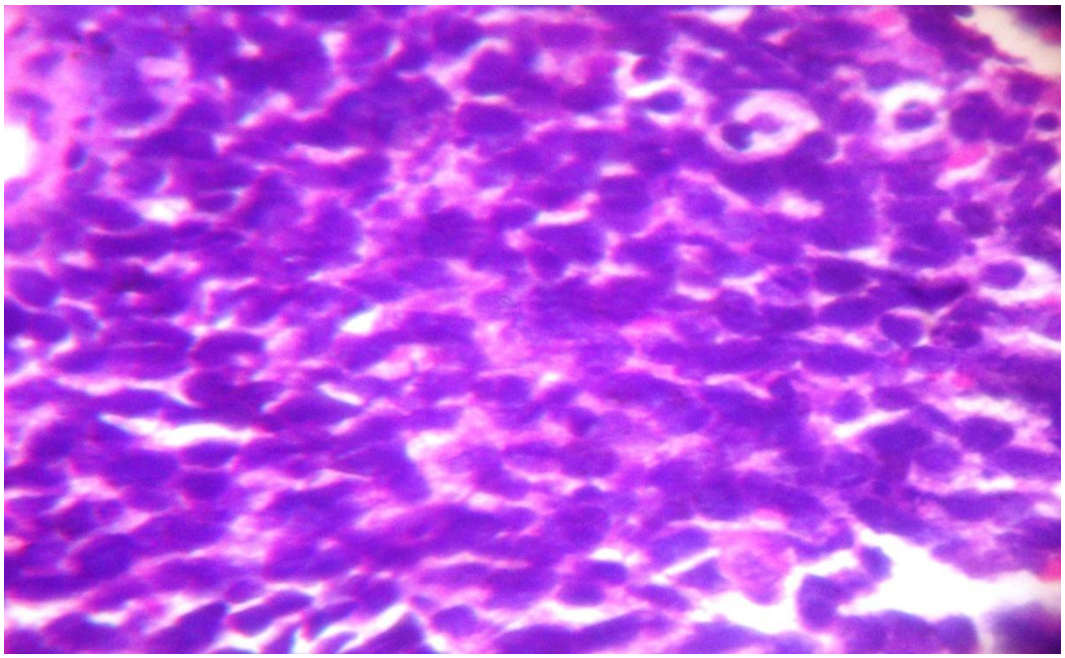


Fig.34: Larger cells with moderate cytoplasm,Inconspicuous nucleoli (H&E 400X)

SINONASAL NEUROENDOCRINE CARCINOMA

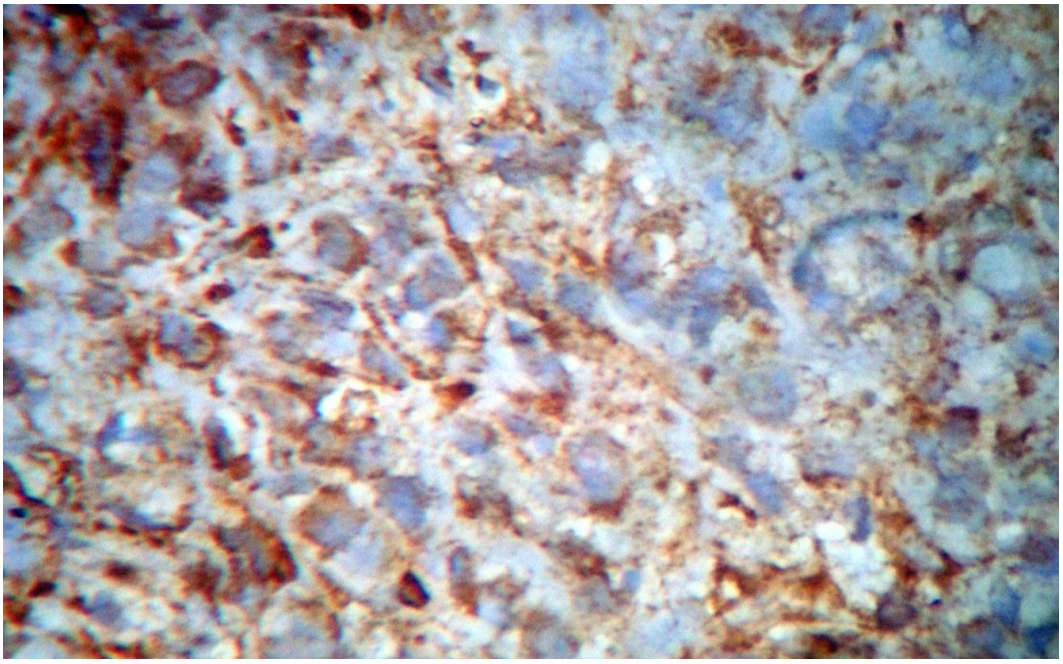


Fig.35: Neoplastic cells showing diffuse positivity for NSE (IHC 400X)

SINONASAL NEUROENDOCRINE CARCINOMA

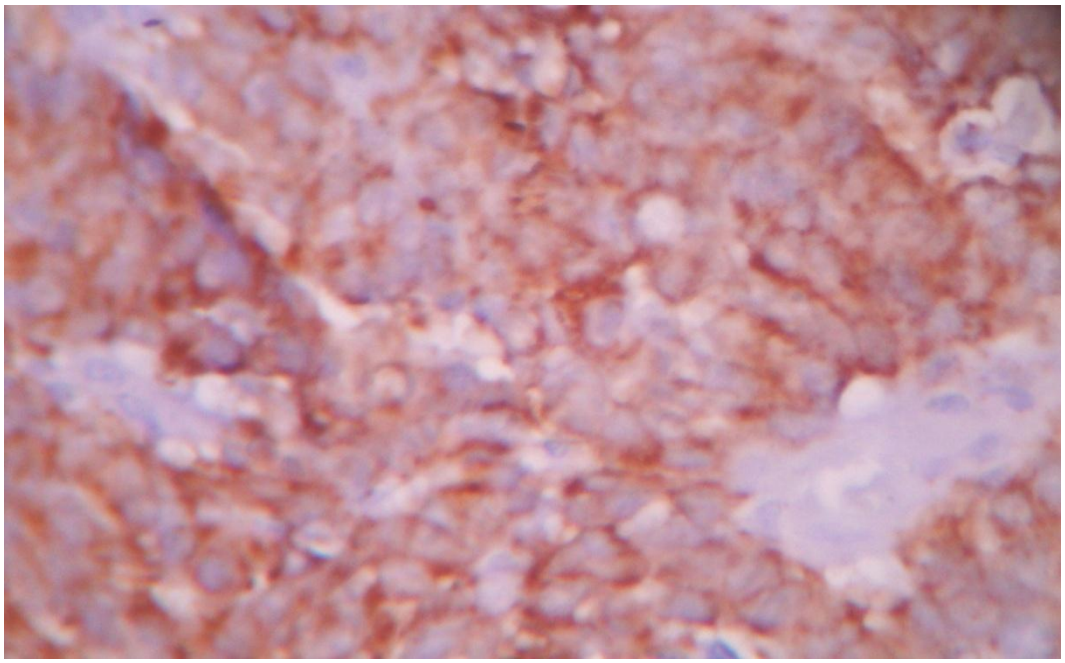


Fig.36: Neoplastic cells showing diffuse positivity for cytokeratin

(H&E 400x)

SQUAMOUS CELL CARCINOMA

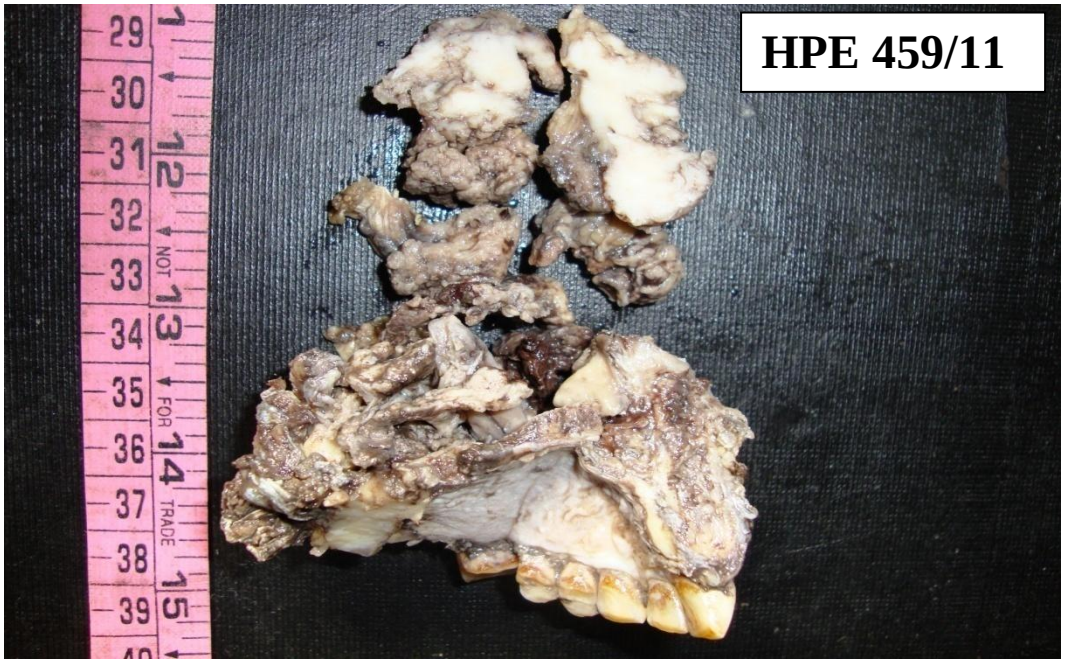


Fig.37: Maxillectomy specimen with an irregular infiltrating grey white growth

DISCUSSION

DISCUSSION

The present clinicopathological study of sinonasal tumors includes 200 tumors of nasal cavity and paranasal sinuses from January 2007 to October 2011.During the above period 44730 specimens were received at the general surgical pathology laboratory with an incidence of 0.45%. The rare nature of the tumors is almost a universal finding (Okafor, 1983; Harison, 1971; Lilly-Tariah da, 1999).[99] Of the 200 cases, 107 were malignant, 93 were benign. Malignant tumors predominated with an incidence of 53.5% over benign tumors with an incidence of 46.5%.The ratio of malignant to benign tumors was 1.15:1.144 epithelial tumors(72%) predominated over 56 nonepithelial tumors (28%). The ratio of epithelial to nonepithelial tumors was 2.57:1. Male to female ratio was 2.03:1 similar to other studies (Lilly-Tariah da, 1999; Mundy et al., 1985;).[99]Age range was 2 to 85 years with an average of 47.6 years.The maximum number of cases were present in nasal cavity (70%) followed by paranasal sinuses (30%).Among the paranasal sinuses maxillary sinus(75%) was the commonest site of presentation. Mass in the nose (85%) was the most common clinical presentation. Both sides (Right & Left) involved with equal frequency (50%).

While reviewing literature of tumors of nasal cavity and paranasal sinuses, it was found that various authors have studied these tumors in different aspects, such as epithelial tumors, non epithelial tumors and malignant neoplasms. Some have studied specific tumor entities like fibro osseus tumors and minor salivary gland tumors. Some others have included tumors of nasopharynx while studying tumors of nasal cavity and paranasal sinuses. All this lead to some difficulty in finding out the exact incidence of various tumors in these studies and comparing with the present study.

On analysing the 93 benign tumors it was noted that the commonest in incidence was sino-nasal type (schneiderian papillomas).Several authors have reported the relative incidence of papillomas (Table-13).

TABLE-13: COMPARISON OF INCIDENCE OF SINONASAL PAPILLOMAS

Authors	Incidence
Ghosh and Bhattacharya (1966)[100]	13.46%
Tondon et al (1971)[101]	23.53%
Butchanan& Slavin (1972)[102]	20.00%
Sagar et al (1976)[103]	1.00%
Bjerregaard et al (1992)[104]	16.67%
Panchal et al (2005)[96]	34.80%
Present study (2011)	**47.32%**

40 cases of inverted papillomas constituted the most common morphologic type with an incidence of 43.01% and the predominant age group was seen in 7th followed by 5th decade. There were 25 males and 15 females forming a ratio of 1.6:1.One was a recurrent tumor involving the nasal cavity in a male. Osborn (1971),Butchanan& Slavain (1972),[102] Christenson and Smith (1986),[105] Judd & Zaki 50(1991)[106] and Bielamowicz et al (1993)[107] observed a male preponderance.

37 inverted papillomas involved the nasal cavity and 3 involved the paranasal sinuses.Nasal cavity was observed as the commonest site of involvement by Hyames et al(1971)[108]**,** Lasser et al(1976)[109], Mujumdar & Beck (1984)[110] and Panchal et al (2005).[96] However Butchanan & Slavin (1972)[102], Robin et al (1979), Barnes & Bedett

et al (1984),[111] Judd & Zaki (1991)[106] observed paranasal sinuses as the common site of involvement by papilloma.

The commonest histological type encountered was inverted papilloma. Microscopy showed an endophytic growth of thickened squamous epithelium composed of squamous, transitional, and columnar cells with admixed mucocytes and inflammatory cell infiltrate (Fig.1). 9 inverted papillomas showed malignant transformation. The histological features revealed predominantly a carcinoma with a small proportion of residual papilloma which occurred synchronously (Fig.2).The tumors were well to moderately differentiated squamous cell carcinoma with an incidence of 18.37% of which 3 were recurrent tumors and remaining 6 showed both benign inverted papilloma and malignant component. Lesperance et al (1995) had reported 27% malignant transformation in inverted papilloma. Panchal et al (2005)[96] reported inverted papilloma with squamous cell carcinoma in 8.16%.

One oncocytic papilloma presented in the left nasal cavity in a 25 year old male and 3 exophytic squamous papillomas presented in the nasal cavity.All the 3 tumors were seen in males and presented in the 3rd &6th decade.

Second in order of frequency included hemangiomas with an incidence of 29.03%. The peak age incidence was equally found in 2nd and 4th decade in comparison with studies of Sayed et al (1997) who found a peak age incidence in 3rd and 4th decade. The most common location of hemangioma was nasal cavity.Capillary hemangioma was the predominant variant as also noted by Fu & Perzin et al(1974).[112] Microscopy showed lobular proliferation of variably sized vascular spaces composed

of central capillaries and smaller ramifying tributaries (Fig.3). Males predominated over females. There were 3 cases of cavernous hemangioma of which one presented in a 2 year old child in the right nasal cavity.

7 cases of hemangiopericytoma were encountered with an incidence of 7.53%. The mean age of presentation was 45 years. There were 5 females and 2 males forming a ratio of 2.5:1. Among the 7, five presented in the nasal cavity and two in the maxilla. Microscopy showed an unencapsulated cellular neoplasm in diffuse growth pattern, in short fascicles of closely packed spindle cells with blunt nuclei, coarse chromatin, eosinophilic cytoplasm and vascular channels ranging from capillary size to staghorn vasculature (Fig.4). Immunostaining revealed tumor cells which showed diffuse positivity for Vimentin and negative for CD 34.There were no recurrent tumors.

Intranasal schwannomas are very rare and less than 100 cases have been described in the literature (Buob D et al.2003).[123] The present study included six cases of schwannoma with an incidence of 6.45%.This was slightly higher than the incidence of 4% reported by various authors(Hasewaga SL et al .1997).[126]

All the 6 cases presented in the age range of 30-67 years with a mean age of 41.7 years and an equal sex ratio. None of the tumors were encapsulated as described by Hasewaga SL et al.(1997)[126] which is a distinctive feature of schwannoma in the sinonasal region. Microscopically tumors were composed of cellular areas (Antoni type A) with spindle cells arranged in palisades (Verocay bodies), together with more

loosely structured areas with myxoid stroma(Fig.5). 5 cases presented in the nasal cavity and one in the maxilla.

5 cases of ossifying fibroma were reported with an incidence of 5.38% and male to female ratio of 1.5:1 in the age group of 13 to 32 years. The predominant site was the nasal cavity. Four tumors were psammomatous ossifying fibroma and microscopy showed fibro-osseous proliferation composed of calcified spherules admixed with fibrous stroma (Fig.6).

Primary ameloblastoma of the sinonasal tract (extragnathic ameloblastoms) is unusual and extraordinarily uncommon (Schafer et al .1998).[64] 2 rare cases of ameloblastoma were reported with an incidence of 2.15%.The mean age of presentation was 39 years. Both cases were male with one presenting in the nasal cavity and the other in the maxillary sinus. Microscopy showed follicular pattern composed of epithelial islands bounded at the periphery by a layer of columnar cells exhibiting hyperchromatic, palisaded and reverse polarized nuclei with inner stellate reticulum (Fig.7).

Osteoma was reported in one case with an incidence of 1.08% in an 18 year old male.This was similar to studies by Eggston et al and others.The tumor involved the frontal sinus.The paranasal sinus was the commonest site in studies by Sooknundan et al(1986)[63]&others.

One case of craniopharyngioma was reported in an 18 year old male who presented as right nasal cavity mass attached to septum in contrast to Bryne MN et al (1999)[129] who found that the peak age incidence was 1st decade. The tumor was

composed of centrally situated stellate cells with small nuclei and clear cytoplasm surrounded by a palisade of basaloid appearing columnar cells with polarized nuclei (Fig.8).

Among the 107 malignant tumors it was found that the majority were squamous cell carcinomas. Studies on the incidence of squamous cell carcinoma by various authors also reveal similar findings. Ghosh et al (1966)[100]noted the incidence of 72.70%. The incidence of squamous cell carcinoma in the present study was 56.07%.Several authors have analysed the age incidence of squamous cell carcinoma and the average peak was noted between 50-70 yrs of age (Table-14).

TABLE-14: COMPARISON OF AGE INCIDENCE OF SQUAMOUS CELL CARCINOMA

Authors	**Age in years**							
	1 to 10	**11 to 20**	**21 to 30**	**31 to 40**	**41 to 50**	**51 to 60**	**61 to 70**	**> 70**
Ghosh and Bhattacharya (1966)[100]					18.80%	54.50%	18.18%	9.09%
Ascheson et al (1970)[115]		4.50%			13.64%	22.73%	45.45%	13.64%
Butchanan& Slavin (1972)[102]					14.20%	14.20%	28.50%	42.80%
Sagar et al (1976)	1.60%	3.30%	1.60%	6.67%	60.60%	8.33%	8.33%	3.33%
Bosch et al (1976)[113]				5%	7.50%	12.50%	32.50%	42.50%
Das Gupta (1976)[114]			5.60%	29.50%	28.17%	23.01%	12.60%	
Present study			**1.66%**	**10.00%**	**18.34%**	**35.00%**	**23.33%**	**11.67%**

The present study revealed that the predominant age range was 51 to 60 years.Males predominated over females in studies by several authors. The present study also revealed a male preponderance with a ratio of 2.69:1.The nasal cavity was a

slightly preponderant site of involvement over paranasal sinuses. Among the paranasal sinuses the maxillary sinus was the predominant site of occurrence. Sagar et al (1976)[116] and other authors have noted a predilection for paranasal sinus over nasal cavity.

Das Gupta (1976),[114] Gupta et al (1986)[117] and Panchal et al (2005)[96] observed that moderately differentiated squamous cell carcinoma was most commonly encountered. It was also observed that moderately differentiated squamous cell carcinoma predominated in this study similar to other authors.10 cases of poorly differentiated squamous cell carcinoma were included and all the cases showed immunoreactivity for cytokeratin. Uncommon and high grade variants of squamous cell carcinoma including two basaloid variant and one each of acantholytic, adenosquamous,spindle cell variants were reported. Microscopy of basaloid variant showed lobular arrangement of basaloid cells with areas of comedo necrosis admixed with focal areas of squamous differentiation (Fig.9).The acantholytic variant showed the neoplasm in pseudoglandular pattern (Fig.10).Spindle cell squamous carcinoma was confirmed by showing positive immunoreactivity for cytokeratin and negativity for mesenchymal markers.The present study did not include any metastatic squamous cell carcinoma. One recurrent tumor involved the maxilla of a 46 year old male.

10 cases of sinonasal undifferentiated carcinomas were included with an incidence of 9.35%.Studies by other authors revealed the incidence of sinonasal undifferentiated carcinoma had a varied range of incidence from 1.7 to 17%.The peak incidence was the 5^{th} decade and males dominated over females in the present study.

In a study done in Taiwan by Jeng YM and Sung MT, 36 cases of sinonasal undifferentiated carcinoma was reviewed .They found that median age of presentation was 53 years with a male female ratio of 2:1. The most common locations were nasal cavity and ethmoidal sinus. The commonest site in the present study was the nasal cavity. Histopathology showed either small or large tumor cells and was predominantly arranged in nests, ribbons, thick trabeculae or sheet like pattern and had coarse chromatin, prominent nucleoli and necrosis (Fig.30, Fig.31).

8 cases of adenoid cystic carcinoma were reported with an incidence of 7.48% and slight preponderance in females,in the age range of 40 to 70 yrs with the peak in 7^{th} decade similar to other studies. Five cases involved the nasal cavity and three cases involved the maxilla. Histopathology showed basaloid cells with scant cytoplasm and round to oval hyperchromatic nuclei arranged in tubular and cribriform pattern (Fig.11). Four were categorized as grade II and four as grade I..

Adenocarcinoma of the sinonasal tract was observed in 5 out of 107 malignant tumors with an incidence of 4.67%.Several authors have analysed the incidence of adenocarcinoma and found it was widely variable ranging from 4%[Lopez et al(1990)][118] to 42.86%[Tandon and Bahadur et al(1992)].[120]The mean age of presentation was 57.6 years. All the five tumors affected males similar to studies by Lopez et al (1990).[118]The nasal cavity was the predominant site. Barbeiri et al (2003)[119] noted a preponderance of paranasal sinus involvement,while Tandon et al (1992)[120] noted an increased incidence in the nasal cavity.

Lopez et al (1990)[118] observed tubulopapillary variant of intestinal type adenocarcinoma as the most common variant (83.33%). Urso et al (1993)[121] observed

that moderately differentiated intestinal type adenocarcinoma was the most common histologic type (27.78%). Abecasis et al (2004)[122]observed that 10 out of 14 cases were high grade intestinal type adenocarcinoma and 2 out 14 cases were low grade Intestinal type adenocarcinoma. The papillary variant of adenocarcinoma predominated in the present study. Two tumors were moderately differentiated and 2 tumors were well differentiated. Microscopy showed a papillary architecture lined by malignant epithelial cells with nuclear stratification and mild atypia(Fig.12). One was a recurrent tumor which involved the nasal cavities of a male in the 5th decade.The present study did not include any metastatic adenocarcinoma.

5 cases of mucoepidermoid carcinoma were reported with an incidence of 4.67%.The peak incidence was in 5th decade with a male to female ratio of 1.5:1. Paranasal sinus was the commonest site.Histopathology revealed islands of malignant squamous cells admixed with mucus secreting cells (Fig.13).Four were high grade tumors and one case was low grade.

2 cases of plasmacytoma were reported with a incidence of 1.87%.Both presented in the nasal cavity with an equal sex incidence and occurred in 5&7th decade respectively similar to Roberta De Paula Araujo et al(2008)[130] except that they found male preponderance in their study. Histopathology showed plasma cells in diffuse sheets with varying degrees of maturation, round eccentrically placed nucleus with paranuclear clear zone and clock face chromatin (Fig.14).There was no evidence of multiple myeloma elsewhere.

Two cases of ameloblastic carcinoma were included which presented in the maxilla of two males in the 5th decade and 7th decade respectively with an incidence of 1.87%.

One rare case of spindle cell sarcoma involved the maxilla of a 38 year old male with an incidence of 0.93%.Histopathology showed spindle shaped cells in fascicles and herring bone pattern with mild cellular pleomorphism provisionally diagnosed as fibrosarcoma - low grade (Fig.15).This was supported by immunohistochemistry by vimentin reactivity (Fig.16) and cytokeratin negativity similar to G.plaza et al. (2006).[125]

One case of hemangioendothelioma was encountered which presented in the nasal cavity of a 65 year old male with an incidence of 0.93%.Histopathology showed rounded epithelioid tumor cells with intracytoplasmic lumina arranged in nests and strands with angiocentric growth pattern similar to study by Chih –Chieh Tseng et al (2005).[124]

One case of metastatic clear cell carcinomatous deposits was included involving the sphenoid sinus of a 45 year old female with an incidence of 0.93%. Histopathology showed solid tubuloalveolar pattern of clear cells with round nuclei (Fig.17). PAS stain showed positivity in the cytoplasm of tumor cells.

Two cases of malignant melanoma were reported with an incidence of 1.87% similar to other studies (Shaw et al.1977, Snow et al 1978).[127, 128] Both presented in the nasal cavities of males aged 40 and 54 years respectively similar to Zafer et al (2008).[95] Histopathology showed features similar to other undifferentiated neoplasms of sinonasal tract showing malignant epithelioid and spindle cells with pleomorphic

nuclei and eosinophilic nucleoli with evidence of melanin deposition (Fig.18). Masson Fontana stain showed positivity in the cytoplasm of tumor cells (Fig.19). Immunostaining revealed tumor cells which were positive for markers HMB45, S100 confirming the diagnosis of melanoma (Fig.20).

The present study included 5 small round cell tumors (SRCT) and 15 undifferentiated carcinomas. For confirmation and further subcategorization a panel of immunohistochemical markers that include cytokeratin, NSE, synaptophysin, CD99, vimentin, CD45, desmin, S100 and HMB 45 were employed. Among the Five cases of SRCT,two showed positivity for NSE, synaptophysin, and S100 confirming the diagnosis of olfactory neuroblastoma (Fig.24). Two showed positivity for CD99 and vimentin and were negative for other markers thus confiming PNET (Fig.28, Fig.29). One tumor showed positivity for cytokeratin, NSE, synaptophysin and a final diagnosis of SNEC was made.

The incidence of olfactory neuroblastoma in the present study was 1.87%. Of the two olfactory neuroblastomas,one presented in a 20 year old female involving the ethmoid sinus and the other in a 48 year old male involving the nasal cavity.A bimodal peak in age was observed similar to Maran et al.1993.[131] The tumor was disposed in lobules and nests and composed of small round cells with high N/C ratio, small uniform hyperchromatic nuclei with salt and pepper type of chromatin, Homer-Wright rosettes in a fibrillary background with a Hyams grade I (Fig.22, Fig.23). One showed intracranial extension and cervical lymph node metastasis with a Kadish stage C. FNAC of cervical node revealed small round cells with occasional rosette formation confirming metastasis to cervical node (Fig.25).

Two cases of PNET presented in 15 and 17 year old males respectively with an incidence of 1.87%. One presented in the nasal cavity and the other in the maxilla. Histopathology showed diffuse densely cellular sheets of uniform small to medium sized round cells with scant cytoplasm and round nuclei with delicate chromatin (Fig.26, Fig.27).

One small round cell tumor diagnosed as SNEC presented in the nasal cavity of a 48 year old female.

Of the undiferentiated neoplasms 10 cases showed diffuse positivity for cytokeratin alone with focal positivity for NSE only in 2 cases with a final diagnosis of SNUC (Fig.32).

5 tumors showed diffuse positivity for both cytokeratin and neuroendocrine markers namely NSE, synaptophysin confirming the diagnosis of SNEC (Fig.35, Fig.36). The incidence of SNEC in the present study was 5.61%.There was a slight preponderance in males. Nasal cavity was the commonest site and peak age was found in 5^{th} decade similar to Silva et al (1982).[132] Histopathology showed sheets of large round cells having moderate amount of cytoplasm,fine chromatin with inconspicuous nucleoli and focal rosette formation without fibrillary background (Fig.33, Fig.34).

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

Clinicopathological analysis of 200 neoplastic lesions of nasal cavity and paranasal sinuses was conducted. All the cases were classified according to WHO Head and neck tumors-2005.

Out of 200 cases, 93 were benign and 107 were malignant. Thus the incidence of malignant tumors outnumbered the benign tumors. Among all neoplastic lesions,squamous cell carcinoma (60 out of 200 cases) was the most frequent representing 30%.

144 were epithelial tumors and 56 were non epithelial tumors. Thus the incidence of epithelial tumors outnumbered the non epithelial tumors.

Among benign tumors, inverted papilloma (40 out of 93 cases) was the common histological entity (43.01%). There was a slight higher incidence in males (62.5%).These tumors were seen mostly in the 5^{th} and 6^{th} decade.

Hemangioma was the next common benign neoplastic lesion (27 out of 93) with an incidence of 29.03%.There was a male preponderance (66.66%). A higher incidence was noted in the 2^{nd} and 4^{th} decade.

Among the malignant tumors, squamous cell carcinoma (60 out of 107 cases) was the most common (56.07%), the commonest site being nasal cavity. Mostly they presented as a mass lesion in the nose. The age incidence ranged from 3^{rd} to 9^{th} decade. There was a male preponderance (73.33%).

Primary sinonasal tumors with neuroendocrine differentiation are an uncommon heterogenous group with overlapping histomorphological features. Based on their behaviour and natural history they can diverge in to two main groups namely esthesioneuroblastoma (ENB) and NonENB. They can be distinguished based on immunohistochemical characteristics. Pathological subcategorization is imperative for management and prognostication of these highly aggressive tumors. This categorization is based on the fact that excellent loco regional and distant control of ENB can be achieved with local therapy alone (surgery with or without postoperative local RT) where as SNUC and SNEC have higher rates of local and systemic failure and hence require aggressive multimodality approach including upfront chemotherapy. This study highlights the characteristics of the rare 6 cases of sinonasal neuroendocrine malignancies encountered and emphasizes the importance of IHC in distinguishing ENB from non ENB which has a bearing on prognosis and therapeutic intervention.

Tumors of the nasal cavity and paranasal sinuses are rare pathologies with extremely varied etiopathology,clinical behaviour,treatment and prognosis. The symptoms of the neoplastic processes are essentially similar to inflammatory pathology of the sinonasal tract with resultant delay of diagnosis. The clinical and radiological features of masses of nasal cavity and paranasal sinuses are overlapping and often only a provisional diagnosis is possible. Definite diagnosis requires histopathological examination as most of the lesions are inaccessible for fine needle aspiration or FNAC is not recommended because of fear of haemorrhage.

In our attempt at a comprehensive analysis of 200 sinonasal tumors a heterogenous and a wide variety of benign and malignant neoplasms were encountered. Rare entities like craniopharyngioma,schwannoma and osteoid osteoma among benign tumors and malignant melanoma,fibrosarcoma, metastatic clear cell carcinoma among malignant tumors were reported.

To conclude, categorizing the sinonasal tumors according to histopathological features into various types helps us to understand the clinical presentation, treatment, clinical outcome and prognosis. The key in the diagnosis and treatment of sinonasal tumors remains a high index of suspicion and early diagnosis, as late presentation and delay in early diagnosis are major constraints to favourable outcome of treatment.

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MASTER CHART

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S. No	Biopsy No	IP/OP No	Age	sex	Side	Site	Complaints	Specimen	Histologic Diagnosis	Nature	Grade
1	47/07	857322	48	M	L	Maxilla	Mass	Maxillectomy	Ameloblastic Carcinoma	Mg	
2	90/07	600	48	M	L	Nasal cavity	Mass	Biopsy	Hemangiopericytoma	Bn	LMP
3	146/07	717	24	F	R	Nasal cavity	Mass	Biopsy	Psammomatoid Ossifying Fibroma	Bn	
4	231/07	1735	45	F	R	Maxilla	Mass	Maxillectomy	Mucoepidermoid Carcinoma	Mg	Low grade
5	477/07	3196	47	M	R	Maxilla	Mass	Maxillectomy	Mucoepidermoid Carcinoma	Mg	High grade
6	523/07	4553	71	M	L	Maxilla	Mass	Biopsy	Squamous cell carcinoma	Mg	Moderately Differentiated
7	591/07	7821	72	F	L	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma with Malig Trans	Mg	
8	703/07	4645	50	M	R	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	
9	708/07	4758	30	M	L	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	
10	844/07	7827	32	F	L	Nasal cavity	Mass	Biopsy	Schwannoma	Bn	
11	929/07	43718	52	M	R	Maxilla	Mass	Biopsy	Squamous cell carcinoma	Mg	Poorly Differentiated
12	956/07	10772	58	F	R	Nasal cavity	Mass	Biopsy	Squamous cell carcinoma	Mg	Moderately Differentiated
13	1047/07	7387	71	F	L	Nasal cavity	Mass	Biopsy	Squamous cell carcinoma	Mg	well Differentiated
14	1198/07	31143	57	F	L	Nasal cavity	Mass	Biopsy	Squamous cell carcinoma	Mg	Moderately Differentiated
15	1204/07	10772	58	F	L	Maxilla	Mass	Biopsy	Inverted Papilloma with Malig Trans	Mg	
16	1264/07	13673	42	M	R	Nasal cavity	Mass	Biopsy	Undifferentiated Carcinoma	Mg	
17	1367/07	5849	18	M	L	Nasal cavity	Mass	Excision Biopsy	Capillary Hemangioma	Bn	
18	1428/07	13619	30	F	R	Nasal cavity	Mass	Excision Biopsy	Capillary Hemangioma	Bn	
19	1547/07	819629	46	M	L	Maxilla	Mass	Maxillectomy	Squamous cell carcinoma	Mg	Moderately Differentiated
20	1579/07	14740	55	M	L	Nasal cavity	Mass	Biopsy	Basaloid Squamous cell carcinoma	Mg	High grade
21	1655/07	14636	60	M	R	Maxilla	Mass	Excision Biopsy	Inverted Papilloma	Bn	
22	1763/07	19072	65	M	R	Nasal cavity	Mass	Biopsy	Squamous cell Carcinoma	Mg	Well Diffentiated
23	1782/07	170813	65	F	L	Maxilla	Mass	Maxillectomy	Adenoid cystic Carcinoma	Mg	Grade II
24	1887/07	171550	45	F	L	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	
25	1918/07	141723	45	F	L	Maxilla	Mass	Biopsy	Undifferentiated Carcinoma	Mg	

S. No	Biopsy No	IP/OP No	Age	sex	Side	Site	Complaints	Specimen	Histologic Diagnosis	Nature	Grade
26	2035/07	26090	40	M	R	Maxilla	Mass	Biopsy	Squamous cell Carcinoma	Mg	Poorly Differentiated
27	2278/07	19072	65	M	L	Ethmoid	Mass	Biopsy	Basaloid Squamous cell Carcinoma	Mg	
28	2393/07	26517	63	M	R	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	
29	2484/07	22967	40	M	R	Maxilla	Mass	Biopsy	Squamous cell Carcinoma	Mg	Moderately Differentiated
30	2596/07	26972	72	F	L	Nasal cavity	Mass	Biopsy	Squamous cell carcinomna	Mg	Well Differentiated
31	2597/07	28589	49	M	R	Nasal cavity	Mass	Biopsy	Inverted Papilloma	Bn	
32	3446/07	36213	58	M	L	Nasal cavity	Mass	Biopsy	Squamous Papilloma	Bn	
33	3632/07	19194	30	M	L	Nasal cavity	Mass	Biopsy	Squamous Papilloma	Bn	
34	3664/07	37971	54	M	R	Nasal cavity	Mass	Biopsy	Melanoma	Mg	
35	3771/07	35651	25	F	R	Ethmoid	Mass	Biopsy	Mucoepidermoid Carcinoma	Mg	High grade
36	3874/07	18450	30	M	R	Nasal cavity	Mass	Biopsy	Inverted Papilloma	Bn	
37	4506/07	18675	25	M	L	Nasal cavity	Mass	Biopsy	Inverted Papilloma	Bn	
38	4531/07	43843	36	F	R	Nasal cavity	Mass	Biopsy	Capillary Hemangioma	Bn	
39	5038/07	57608	16	M	R	Nasal cavity	Mass	Excision Biopsy	Capillary Hemangioma	Bn	
40	5920/07	58888	46	M	L	Nasal cavity	Mass	Biopsy	Adenocarcinoma	Mg	Well Differentiated
41	6059/07	61214	65	M	R	Nasal cavity	Mass	Excision Biopsy	Hemangioendothelioma	Mg	Low grade
42	6898/07	65588	56	M	L	Maxilla	Mass	Maxillectomy	Squamous cell Carcinoma	Mg	Moderately Differentiated
43	6927/07	49894	50	M	L	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	
44	7576/07	44889	66	M	R	Nasal cavity	Mass	Biopsy	Plasmacytoma	Mg	
45	7587/07	75652	29	M	L	Nasal cavity	Mass	Excision Biopsy	Cavernous Hemangioma	Bn	
46	7665/07	41361	50	M	R	Nasal cavity	Mass	Biopsy	Inverted Papilloma	Bn	
47	7668/07	73472	17	M	L	Frontal	Mass	Excision Biopsy	Osteoid Osteoma	Bn	
48	7856/07	64034	46	M	L	Maxilla	Mass	Biopsy	Ameloblastoma- Follicular type	Bn	
49	8064/07	76447	49	F	R	Sphenoid	Mass	Biopsy	Mucoepidermoid Carcinoma	Mg	High grade
50	8086/07	76652	50	M	R	Nasal cavity	Mass	Biopsy	Inverted Papilloma with Malig Trans	Mg	
51	8269/07	82014	65	M	L	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	
52	8339/07	21896	60	F	R	Nasal cavity	Mass	Excision Biopsy	Capillary Hemangioma	Bn	
53	12/08.	85949	35	M	R	Sphenoid	Mass, Headache, Blurring vision	Biopsy	AdenoSquamous Carcinoma	Mg	High grade

S. No	Biopsy No	IP/OP No	Age	sex	Side	Site	Complaints	Specimen	Histologic Diagnosis	Nature	Grade
54	455/08	2094	67	M	L	Nasal cavity	Mass	Biopsy	Squamous cell carcinoma	Mg	Moderately Differentiated
55	497/08	4531	66	M	R	Nasal cavity	Bleeding , Nasal obstruction	Biopsy	Adenocarcinoma - Papillary type	Mg	Moderately Differentiated
56	584/08	4941	32	F	R	Nasal cavity	Mass	Biopsy	Adenoid cystic Carcinoma	Mg	Grade II
57	1301/08	5278	67	M	L	Maxilla	Mass	Maxillectomy	Ameloblastic Carcinoma	Mg	
58	1492/08	11959	34	F	R	Nasal cavity	Mass	Excision Biopsy	Capillary Hemangioma	Bn	
59	1541/08	13964	60	M	R	Nasal cavity	Mass	Biopsy	Squamous cell carcinoma	Mg	Moderately Differentiated
60	2142/08	18958	45	F	R	Sphenoid	Mass	Biopsy	Metastasis from Clear cell carcinoma	Mg	
61	2877/08	27990	33	M	L	Nasal cavity	Mass	Excision Biopsy	Capillary Hemangioma	Bn	
62	3003/08	27998	40	M	L	Nasal cavity	Mass	Excision Biopsy	Capillary Hemangioma	Bn	
63	3173/08	27408	60	M	R	Maxilla	Mass	Maxillectomy	Acantholytic Squamous cell carcinoma	Mg	Moderately Differentiated
64	3394/08	32712	78	F	L	Nasal cavity	Mass	Biopsy	Squamous cell carcinoma	Mg	Well Differentiated
65	3760/08	18686	65	F	L	Maxilla	Mass	Biopsy	Spindle cell Squamous cell carcinoma	Mg	High grade
66	3869/08	33631	36	M	L	Nasal cavity	Mass	Biopsy	Squamous cell carcinoma	Mg	Poorly Differentiated
67	3922/08	39259	29	F	L	Nasal cavity	Bleeding , Polyp	Excision Biopsy	Inverted Papilloma	Bn	
68	4076/08	40398	48	F	R	Maxilla	Bleeding ,Nasal obstruction,Proptosis	Maxillectomy	Hemangiopericytoma	Bn	LMP
69	4515/08	41604	39	M	L	Nasal cavity	Mass	Biopsy	Squamous cell carcinoma	Mg	Well Differentiated
70	4163/08	42593	13	F	R	Nasal cavity	Bleeding , Polyp	Excision Biopsy	Capillary Hemangioma	Bn	
71	4290/08	41581	45	M	L	Nasal cavity	Bleeding , Polyp	Excision Biopsy	Capillary Hemangioma	Bn	
72	4433/08	40398	48	F	R	Maxilla	Mass	Maxillectomy	Hemangiopericytoma	Bn	LMP
73	4557/08	44340	85	M	R	Nasal cavity	Mass	Biopsy	Squamous cell carcinoma	Mg	Moderately Differentiated
74	4866/08	25108	65	M	L	Nasal cavity	Mass	Biopsy	Squamous cell carcinoma	Mg	Well Differentiated
75	5166/08	50349	65	M	L	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	
76	5332/08	53712	52	F	R	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	
77	5499/08	50349	65	M	R	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	
78	5975/08	60694	57	M	R	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	

S. No	Biopsy No	IP/OP No	Age	sex	Side	Site	Complaints	Specimen	Histologic Diagnosis	Nature	Grade
79	6041/08	62294	65	M	L	Nasal cavity	Mass	Biopsy	Adenoid cystic Carcinoma	Mg	Grade I
80	6130/08	63600	20	M	R	Nasal cavity	Bleeding Polyp	Excision Biopsy	Capillary Hemangioma	Bn	
81	6185/08	892218	42	M	R	Nasal cavity	Mass	Biopsy	Squamous cell carcinoma	Mg	Moderately Differentiated
82	6333/08	56374	60	F	R	Maxilla	Mass	Maxillectomy	Squamous cell carcinoma	Mg	Poorly Differentiated
83	6707/08	849781	65	F	L	Nasal cavity	Mass	Biopsy	Squamous cell carcinoma	Mg	Poorly Differentiated
84	7063/08	70905	45	M	L	Maxilla	Mass	Biopsy	Squamous cell carcinoma	Mg	Well Differentiated
85	7065/08	75643	61	M	R	Maxilla	Mass	Biopsy	Squamous cell carcinoma	Mg	Moderately Differentiated
86	7285/08	71292	65	M	L	Maxilla	Mass	Maxillectomy	Squamous cell carcinoma	Mg	Moderately Differentiated
87	7354/08	71218	22	M	L	Ethmoid	Mass	Biopsy	Ossifying Fibroma	Bn	
88	7414/08	37333	60	M	R	Nasal cavity	Mass, Epistaxis	Excision Biopsy	Capillary Hemangioma	Bn	
89	7578/08	25834	32	F	L	Nasal cavity	Mass	Biopsy	Inverted Papilloma	Bn	
90	7677/08	20943	67	M	L	Maxilla	Mass	Maxillectomy	Squamous cell carcinoma	Mg	Moderately Differentiated
91	7707/08	35494	30	F	R	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	
92	8105/08	86008	25	M	L	Ethmoid	Polyp	Excision Biopsy	Inverted Papilloma	Bn	
93	8134/08	84574	52	M	L	Maxilla	Mass	Biopsy	Squamous cell carcinoma	Mg	Moderately Differentiated
94	8166/08	86053	58	M	R	Maxilla	Mass	Biopsy	Squamous cell carcinoma	Mg	Poorly Differentiated
95	8322/08	88190	61	M	R	Maxilla	Polyp	Excision Biopsy	Inverted Papilloma	Bn	
96	8395/08	88848	30	F	L	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	
97	8412/08	217441	70	F	R	Maxilla	Mass	Biopsy	Squamous cell carcinoma	Mg	Moderately Differentiated
98	8585/08	221196	60	F	R	Nasal cavity	Mass	Biopsy	Inverted Papilloma with Malig Trans	Mg	Well Differentiated
99	8731/08	91998	48	M	L	Frontal	Mass	Biopsy	Squamous cell carcinoma	Mg	Moderately Differentiated
100	8805/08	89594	70	F	R	Maxilla	Mass	Maxillectomy	Squamous cell carcinoma	Mg	Poorly Differentiated
101	8844/08	93680	22	M	L	Nasal cavity	Mass	Biopsy	Squamous Papilloma- Exophytic	Bn	
102	118/09	36	26	M	R	Frontal	Mass	Biopsy	Inverted Papilloma with Malig Trans	Mg	Well Differentiated
103	217/09	2388	60	M	L	Maxilla	Mass	Biopsy	Squamous cell carcinoma	Mg	Well Differentiated

S. No	Biopsy No	IP/OP No	Age	sex	Side	Site	Complaints	Specimen	Histologic Diagnosis	Nature	Grade
104	225/09	1858	65	M	R	Nasal cavity	Mass	Biopsy	Mucoepidermoid Carcinoma	Mg	High grade
105	497/09	2658	50	F	L	Nasal cavity	Mass	Excision Biopsy	Capillary Hemangioma	Bn	
106	598/09	5831	40	F	L	Maxilla	Mass	Maxillectomy	Adenoid cystic Carcinoma	Mg	Low grade
107	892/09	11234	68	M	L	Nasal cavity	Mass	Excision Biopsy	Papillary Adenocarcinoma	Mg	Moderately Differentiated
108	1030/09	7141	38	M	L	Maxilla	Mass	Maxillectomy	spindle cell sarcoma (Fibrosarcoma)	Mg	
109	1294/09	14277	64	M	R	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	
110	1357/09	15029	67	M	L	Maxilla	Mass	Biopsy	Squamous cell carcinoma	Mg	Moderately Differentiated
111	2891/09	25773	30	F	R	Nasal cavity	Mass	Excision Biopsy	Schwannoma	Bn	
112	2944/09	34580	33	F	L	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	
113	3520/09	36425	45	M	L	Nasal cavity	Mass	Excision Biopsy	Inverted papilloma	Bn	
114	3745/09	16665	50	F	R	Nasal cavity	Polyp	Excision Biopsy	Cavernous Hemangioma	Bn	
115	3797/09	39235	2	F	R	Nasal cavity	Polyp	Excision Biopsy	Cavernous Hemangioma	Bn	
116	4073/09	45583	45	M	L	Maxilla	Mass	Maxillectomy	Squamous cell Carcinoma	Mg	Moderately Differentiated
117	4230/09	45312	66	M	L	Sphenoid	Mass	Biopsy	Adenocarcinoma - Papillary type	Mg	Moderately Differentiated
118	4490/09	50310	16	M	R	Nasal cavity	Mass	Biopsy	Capillary Hemangioma	Bn	
119	4792/09	56127	79	M	L	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	
120	5069/09	26555	82	M	L	Nasal cavity	Polyp	Excision Biopsy	Capillary Hemangioma	Bn	
121	5085/09	23085	56	M	R	Nasal cavity	Polyp	Excision Biopsy	Inverted Papilloma	Bn	
122	5188/09	60337	32	M	L	Nasal cavity	Mass	Excision Biopsy	Capillary Hemangioma	Bn	
123	5306/09	61708	24	M	L	Nasal cavity	mass	Biopsy	Undifferentiated Carcinoma	Mg	
124	5618/09	65537	28	M	L	Nasal cavity	Mass	Biopsy	Undifferentiated Carcinoma	Mg	
125	5800/09	60687	39	M	R	Nasal cavity	Polyp	Excision Biopsy	Schwannoma	Bn	
126	5873/09	68223	80	F	R	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	
127	6322/09	68072	50	F	R	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma with Malig Trans	Mg	Well Differentiated
128	7732/09	87197	41	F	L	Nasal cavity	Mass	Biopsy	Inverted Papilloma	Bn	
129	8102/09	90939	17	F	L	Nasal cavity	Mass	Biopsy	Undifferentiated Carcinoma	Mg	
130	8117/09	40753	41	F	L	Nasal cavity	Mass	Biopsy	Adenoid cystic Carcinoma	Mg	Low grade

S. No	Biopsy No	IP/OP No	Age	sex	Side	Site	Complaints	Specimen	Histologic Diagnosis	Nature	Grade
131	8292/09	88714	62	M	R	Nasal cavity	Mass	Biopsy	Adenoid cystic Carcinoma	Mg	Low grade
132	8501/09	87218	41	F	R	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	
133	8634/09	51188	67	M	L	Maxilla	Mass, Proptosis	Biopsy	Schwannoma	Bn	
134	8784/09	57598	60	M	L	Nasal cavity	mass	Excision Biopsy	Inverted Papilloma	Bn	
135	8827/09	42865	50	F	R	Maxilla	Mass	Biopsy	Undifferentiated Carcinoma	Mg	
136	159/10	102667	52	M	R	Nasal cavity	Polyp	Excision Biopsy	Inverted Papilloma with Malig Trans	Mg	Well Differentiated
137	188/10	102882	50	M	R	Nasal cavity	Mass	Excision Biopsy	Squamous cell Carcinoma	Mg	Well Differentiated
138	247/10	607125	60	M	L	Nasal cavity	Mass	Biopsy	Squamous cell carcinoma	Mg	Moderately Differentiated
139	419/10	5178	62	M	R	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	
140	474/10	2605	42	F	R	Nasal cavity	Mass	Biopsy	Small round cell tumour	Mg	
141	482/10	6519	60	M	R	Nasal cavity	Mass	Biopsy	Squamous cell carcinoma	Mg	Moderately Differentiated
142	520/10	6849	25	M	L	Nasal cavity	Polyp	Excision Biopsy	Papilloma- Oncocytic	Bn	
143	682/10	9141	42	M	L	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	
144	725/10	9242	65	M	L	Nasal cavity	Mass	Excision Biopsy	Inverted Papilloma	Bn	
145	993/10	51854	19	M	L	Nasal cavity	Bleeding Polyp	Excision Biopsy	Hemangiopericytoma	Bn	LMP
146	1094/10	11194	70	M	L	Maxilla	Mass	Biopsy	Undifferentiated Carcinoma	Mg	
147	1371/10	16005	29	M	R	Nasal cavity	Polyp	Excision Biopsy	Capillary Hemangioma	Bn	
148	1478/10	10345	17	M	L	Maxilla	Mass	Biopsy	Small round cell tumour	Mg	
149	1647/10	19044	60	M	R	Nasal cavity	Mass	Biopsy	Inverted Papilloma with Malig Trans	Mg	Well Differentiated
150	1666/10	17011	42	M	R	Nasal cavity	Mass	Excision Biopsy	Schwannoma	Bn	
151	1683/10	17210	15	M	L	Nasal cavity	Mass	Biopsy	Small round cell tumour	Mg	
152	3078/10	34363	65	M	L	Nasal cavity	Mass	Excision Biopsy	Capillary Hemangioma	Bn	
153	3430/10	27506	40	F	L	Maxilla	Mass	Biopsy	Adenoid cystic Carcinoma	Mg	Grade II
154	3562/10	448800	45	M	L	Nasal cavity	Mass	Biopsy	Undifferentiated Carcinoma	Mg	
155	4303/10	22634	50	F	R	Nasal cavity	Mass, Epistaxis	Biopsy	Hemangiopericytoma	Bn	LMP
156	4494/10	48199	51	F	L	Nasal cavity	Mass, Epistaxis	Biopsy	Hemangiopericytoma	Bn	LMP
157	4728/10	50542	70	M	L	Nasal cavity	Mass	Biopsy	Adenoid cystic Carcinoma	Mg	Grade II
158	4790/10	51080	34	M	R	Maxilla	Mass	Biopsy	Undifferentiated Carcinoma	Mg	

S. No	Biopsy No	IP/OP No	Age	sex	Side	Site	Complaints	Specimen	Histologic Diagnosis	Nature	Grade
159	4810/10	57131	65	M	R	Nasal cavity	Mass	Biopsy	Squamous cell carcinoma	Mg	Poorly Differentiated
160	5201/10	48199	51	F	R	Nasal cavity	Mass	Biopsy	Hemangiopericytoma	Bn	LMP
161	5224/10	57097	31	M	L	Nasal cavity	Mass, epistaxis, Obstruction	Biopsy	Undifferentiated Carcinoma	Mg	
162	5761/10	62461	41	F	R	Nasal cavity	Mass	Biopsy	Inverted Papilloma	Bn	
163	5849/10	61401	60	M	R	Nasal cavity	Mass	Excision Biopsy	Squamous cell carcinoma	Mg	Moderately Differentiated
164	5976/10	64935	40	F	R	Nasal cavity	Mass, epistaxis	Biopsy	Undifferentiated Carcinoma	Mg	
165	6225/10	67414	18	M	R	Nasal cavity	Mass	Biopsy	Craniopharyngioma	Bn	
166	7304/10	48795	51	M	R	Maxilla	Mass	Biopsy	Squamous cell carcinoma	Mg	Moderately Differentiated
167	8138/10	41204	20	F	R	Ethmoid	Mass, Proptosis	Biopsy	Olfactory neuroblastoma	Mg	
168	8516/10	94816	63	M	R	Nasal cavity	Mass	Biopsy	Inverted Papilloma with Malig Trans	Mg	Moderately Differentiated
169	8632/10	95464	60	M	R	Nasal cavity	Mass	Excision Biopsy	Capillary Hemangioma	Bn	
170	8633/10	94802	30	F	L	Nasal cavity	Mass, epistaxis	Excision Biopsy	Capillary Hemangioma	Bn	
171	423/11	327	31	M	R	Nasal cavity	Mass	Biopsy	Undifferentiated Carcinoma	Mg	
172	440/11	6054	71	M	L	Nasal cavity	Mass	Biopsy	Squamous cell carcinoma	Mg	Poorly Differentiated
173	459/11	1975	40	M	R	Maxilla	Mass	Maxillectomy	Squamous cell carcinoma	Mg	Moderately Differentiated
174	951/11	9875	32	M	R	Nasal cavity	Mass	Biopsy	Psammomatoid Ossifying Fibroma	Bn	
175	1643/11	19679	32	M	R	Nasal cavity	Mass, epistaxis	Excision Biopsy	Psammomatoid Ossifying Fibroma	Bn	
176	1908/11	32711	40	F	L	Nasal cavity	Mass	Excision Biopsy	Schwannoma	Bn	
177	2323/11	27409	17	M	R	Nasal cavity	Mass	Excision Biopsy	Capillary Hemangioma	Bn	
178	3370/11	36489	65	M	R	Nasal cavity	Mass	Biopsy	Inverted Papilloma	Bn	
179	3373/11	35681	13	F	R	Nasal cavity	Mass	Biopsy	Inverted Papilloma	Bn	
180	3540/11	39969	48	M	R	Nasal cavity	Mass	Excision Biopsy	Undifferentiated Carcinoma	Mg	
181	3697/11	35240	60	M	R	Nasal cavity	Mass	Biopsy	Squamous cell carcinoma	Mg	Moderately Differentiated
182	3792/11	40313	45	F	L	Sphenoid	Mass	Biopsy	Squamous cell carcinoma	Mg	Poorly Differentiated
183	3863/11	39489	65	F	L	Nasal cavity	Mass	Biopsy	Inverted Papilloma	Bn	
184	5282/11	57629	42	M	L	Ethmoid	Mass	Biopsy	Adenocarcinoma-(colonic type)	Mg	Well Differentiated
185	5407/11	61485	48	M	L	Nasal cavity	mass	Biopsy	Olfactory neuroblastoma	Mg	

S. No	Biopsy No	IP/OP No	Age	sex	Side	Site	Complaints	Specimen	Histologic Diagnosis	Nature	Grade
186	5561/11	62893	62	M	R	Nasal cavity	Mass	Biopsy	Undifferentiated Carcinoma	Mg	
187	5563/11	61370	72	M	L	Nasal cavity	Bleeding Polyp	Excision Biopsy	Capillary Hemangioma	Bn	
188	6046/11	66195	45	M	R	Maxilla	Mass	Biopsy	Squamous cell carcinoma	Mg	Well Differentiated
189	6199/11	57999	38	M	L	Sphenoid	Mass	Excision Biopsy	Capillary Hemangioma	Bn	
190	6303/11	70491	32	M	R	Nasal cavity	mass	Excision Biopsy	Ameloblastoma	Bn	
191	6512/11	73167	13	F	R	Maxilla	Nasal Obstruction	Biopsy	Cemento ossifying Fibroma	Bn	
192	7379/11	83747	65	F	L	Nasal cavity	Mass	Biopsy	Inverted Papilloma	Bn	
193	7736/11	86561	50	M	L	Nasal cavity	Mass	Biopsy	Inverted Papilloma	Bn	
194	7791/11	89344	46	M	R	Nasal cavity	Mass	Biopsy	Squamous cell carcinoma	Mg	Moderately Differentiated
195	7793/11	82882	63	F	L	Nasal cavity	Mass, epistaxis	Excision Biopsy	Inverted Papilloma	Bn	
196	8113/11	85344	48	M	R	Nasal cavity	Mass	Biopsy	Undifferentiated Carcinoma	Mg	
197	8155/11	86851	50	M	L	Nasal cavity	Mass	Excision Biopsy	Capillary hemangioma	Bn	
198	8161/11	88571	53	F	L	Maxilla	Mass	Maxillectomy	Squamous cell carcinoma	Mg	Moderately Differentiated
199	8367/11	90440	40	M	L	Nasal cavity	Mass	Biopsy	Melanoma	Mg	
200	8507/11	94626	50	F	R	Nasal cavity	Mass	Biopsy	Plasmacytoma	Mg	

KEY TO MASTER CHART

Bn- Benign

Mg-Malignant

M - Male

F - Female

R- Right

L- Left

LMP- Low Malignant Potential

Inverted papilloma with Malig Trans- Inverted papilloma with malignant transformation

ANNEXURES

ANNEXURE - I

IMMUNOHISTOCHEMISTRY PANEL												
S. No	**Biopsy No**	**HPE Diagnosis**	**IHC Markers**									**Final Diagnosis**
			CK	Synapto physin	NSE	Vimentin	CD45	Desmin	HMB 45	S100	CD99	
1	1264/07	UDC	Focal +	+	+	-	-	-	-	-	-	SNEC
2	1918/07	UDC	Focal +	+	+	-	-	-	-	-	-	SNEC
3	3667/07	Melanoma	-	-	-	+	-	-	+	+	-	Melanoma
4	5306/09	UDC	+	-	-	-	-	-	-	-	-	SNUC
5	8102/09	UDC	+	-	-	-	-	-	-	-	-	SNUC
6	8827/09	UDC	+	-	Focal +	-	-	-	-	-	-	SNUC with focal NE
7	1030/09	Spindle cell sarcoma	-	-	-	+	-	-	-	-	-	Fibrosarco ma
8	474/10	SRCT	Focal +	+	+	-	-	-	-	-	-	SNEC
9	1094/10	UDC	+	-	-	-	-	-	-	-	-	SNUC
10	1478/10	SRCT	-	-	-	+	-	-	-	-	+	PNET
11	1683/10	SRCT	-	-	-	-	-	-	-	-	+	PNET
12	3562/10	UDC	Focal +	-	-	-	-	-	-	-	-	SNUC
13	4790/10	UDC	Focal +	-	-	-	-	-	-	-	-	SNUC
14	5224/10	UDC	Focal +	-	-	-	-	-	-	-	-	SNUC
15	5976/10	UDC	+	+	Focal+	-	-	-	-	-	-	SNEC
16	8138/10	ONB	Focal +	+	+	-	-	-	-	+	-	ONB
17	423/11	UDC	+	Focal +	+	-	-	-	-	-	-	SNEC
18	3540/11	UDC	+	-	-	-	-	-	-	-	-	SNUC
19	5407/11	ONB	Focal +	+	+	-	-	-	-	+	-	ONB
20	5561/11	UDC	+	-	Focal +	-	-	-	-	-	-	SNUC with Focal NE
21	5618/11	UDC	+	-	-	-	-	-	-	-	-	SNUC
22	8113/11	UDC	Focal +	Focal +	+	-	-	-	-	-	-	SNEC
23	8367/11	Melanoma	-	-	-	+	-	-	+	+	-	Melanoma

ANNEXURE - II

PATIENT PROFORMA

NAME:

AGE:

OP/IP NO:

CLINICAL PRESENTATION:

PATHOLOGY ID NO:

LOCATION OF TUMOUR

Nasal cavity

Maxillary sinus

Ethmoid sinus

Frontal sinus

Sphenoid sinus

LATERALITY OF PRESENTATION: RIGHT/LEFT

HISTOLOGIC DIAGNOSIS: BENIGN/MALIGNANT

GRADE

INSTITUTIONAL ETHICAL COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI -3

Telephone No: 04425305301
Fax : 044 25363970

CERTIFICATE OF APPROVAL

To
Dr. S. Ashok Kumar
PG in MD Pathology
Madras Medical College, Chennai -3

Dear Dr. S. Ashok Kumar

The Institutional Ethical Committee of Madras Medical College reviewed and discussed your application for approval of the project / proposal / clinical trail entitled " Clinicopathological profile of Sinonasal tumors – A five year study" No 83082010.

The following members of Ethical committee were present in the meeting held on 24.08.2010 conducted at Madras Medical College, Chennai -3.

1. Prof. S.K. Rajan, MD	-- Chairperson
2. Prof. J. Mohanasundaram, MD,Ph.D,DNB Dean, Madras Medical College, Chennai -3	-- Deputy Chairman
3. Prof. A. Sundaram, MD Vice Principal , MMC, Chennai -3	-- Member Secretary
4. Prof R. Nandhini, MD Director, Institute of Pharmacology, MMC, Ch-3	-- Member
5. Prof. C. Rajendiran , MD Director, Institute of Internal Medicine, MMC, Ch-3	-- Member -- Member
6. Prof. Md. Ali, MD, DM Professor & Head ,,Dept. of MGE, MMC, Ch-3	-- Member -- Member
7 Prof. Shantha Ravishankar, MD Professor of Neuro Pathology, MMC, Ch-3	-- Member
8. Tmt. Arnold Soulina	-- Social Scientist

We approve the trail to be conducted in its presented form.

Sd /. Chairman & Other Members

The Institutional Ethics Committee expects to be informed about the progress of the study, any SAE occurring in the course of the study, any changes in the protocol and patient information / informed consent and asks to be provided a copy of the final report

Member Secretary, Ethics Committee

ABSTRACT

CLINICO PATHOLOGICAL PROFILE OF SINO NASAL TUMORS – A FIVE YEAR STUDY

BACKGROUND: The nasal cavity and the paranasal sinuses form a single functional unit. Sinonasal tumours are characterized by low incidence, non specific symptoms, and late presentation. The sinonasal tumours encompass an entire range of both epithelial and non-epithelial tumours. Undifferentiated malignant neoplasms of the sinonasal tract are clinically aggressive and share clinical and light microscopic features. Immunohistochemistry might be of immense help for pathological subcategorization of these highly aggressive tumors which is imperative for management and prognostication.

AIMS & OBJECTIVES: The present study aims to determine incidence, age, sex, site, mode of presentation and histological types of various sinonasal tumours over a 5 year period and the importance of immunohistochemistry in undifferentiated malignant neoplasms of the sinonasal tract.

METHODS: 200 sinonasal tumors biopsied or surgically excised over a period from Janauary 2007 to October 2011 were studied. The tumors were classified as benign or malignant according to WHO classification. A panel of immunohistochemical markers including Cytokeratin, Synaptophysin, Neuron specific enolase, CD99, vimentin, CD45, Desmin, S100, HMB45 were employed for the undifferentiated malignant neoplasms and small round cell tumors.

RESULTS: The incidence of sinonasal tumors was 0.45%. Among the 200 tumors studied, 107 (53.5%) were malignant lesions and 93 (46.5%) were benign lesions. All age groups were involved with a mean age of 42.5 years for benign tumors and 52.05 years for malignant tumors. The male to female ratio was 1.7:1 for benign tumors and 2.3:1 for malignant tumors. The maximum number of cases were present in the nasal cavity (70%). Inverted papilloma was the commonest benign tumor and Squamous cell carcinoma was the commonest malignant tumor. Epithelial tumors (72%) outnumbered nonepithelial tumors (28%). The most common mode of presentation was nasal mass.

CONCLUSION: The clinical and radiological features of masses of nasal cavity and paranasal sinuses are overlapping and often only a provisional diagnosis is possible. Definite diagnosis requires histopathological examination. Immunohistochemistry is mandatory for Pathological subcategorization of undifferentiated malignant neoplasms of the sinonasal tract.

KEY WORDS: Nasal cavity, paranasal sinuses, Tumors, Immunohistochemistry