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RESEARCH ARTICLE

A CASE SERIES ON MENINGIOMA BASED ON WHO GRADING SYSTEM

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Abstract

Background: The dura mater, arachnoid mater and pia mater are layers of meninges surrounding brain and spinal cord. Meningiomas are tumors arising from them.These are heterogeneous group of tumors and are have 14 distinct histologic types and 03 grades of malignancy.We have studied the variants of meningiomas, as early detection helps in the treatment and improves quality of life.

Objectives:

-Study the histological types as per WHO grading system 2016 for meningiomas.

-Differentiate the benign and malignant meningiomas on histopathology.

Methods: The study is carried out in the department of pathology, D.Y. Patil medical college and hospital kolhapur from June 2020 to June 2021. Total 19 intracranial tumors were received. Sections were stained with H&E and IHC was done wherever necessary.

Results: We had total 19 patients with tumors in different locations of brain. Mainly parasagital followed by intradural . Age range was 32 to 70 years with female predominance. Common histological subtypes were meningothelial (5 cases) and fibrous (5 cases), followed by transitional and angiomatous (2 cases each) and psamomatous (1 case) - WHO grade I tumors. Clear cell and atypical - grade II. Papillary, anaplastic variant - grade III.

Conclusion: Meningiomas are slow growing tumors arising from the meningothelial cells. Commonly they are benign WHO grade I with female predominance. Early detection helps in the treatment and improves quality of life.

Introduction:-

The brain and spinal cord surround by the 3 protective membranes . These are the dura mater, arachnoid mater and pia mater known as the meninges. The most frequent primary intracranial tumours of the central nervous system are meningiomas, which arise from the meninges.[1,2] In 1922, Harvey Cushing invented the term "MENINGIOMA".[3] These are the most prevalent benign intracranial tumours, accounting for up to 34% of all neoplasms in the brain. The incidence is highest in middle-aged patients, with a female-to-male ratio of around 2:1. These are benign tumours

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which is slow-growing and they can cause neurological signs and symptoms because they compress surrounding structures.[4]

Meningiomas are a varied collection of tumours that are classified histologically into 14 subgroups with three Grades of aggressiveness. Small cell alterations, hypercellularity, sheeting, necrosis, mitotic count, and brain invasion are all histological characteristics that are used in the current grading system. Several clinicopathological investigations have found these characteristics to be predictive. The WHO classifies meningiomas into three classes based on histology and clinical behaviour:[3]

Table-1: WHO 2016 grading of meningioma and its variants

Grade	Variants
Grade I Histological subtypes without anaplasia	Meningioma
	Meningothelial meningioma
	Fibrous meningioma
	Transitional (mixed) meningioma
	Microcystic meningioma
	Psammomatous meningioma
	Angiomatous meningioma
	Metaplastic meningioma
	Secretory meningioma
	Lymphoplasmacyte-rich Meningioma
Grade II Histological subtypes with 4-19 Mitotic figures per 10 HPF	Atypical meningioma
	Clear cell meningioma
	Chordoid meningioma
Grade III Histological subtypes with >20Mitotic figures per 10 HPF.	Anaplastic meningioma (malignant)
	Papillary meningioma
	Rhabdoid meningioma

We have studied the histological variants of meningiomas because early detection helps in treatment and improves quality of life.

Case series:
We had a total of 19 patients with tumours in different locations of the brain.

Out of 19 cases, 15 cases were Grade I. In which 5 were **meningothelial meningiomas**. These five cases were found in a wide age range, from 32 to 65 years. The female to male ratio is 4:1. The common presentation of the cases was headache, blurred vision, impaired speech, and personality changes. The locations of the tumour involved parietal, temporal, parasaggital, and intradural. 5 cases were **fibrous meningioma**. These five cases were found in an age range from 36 to 70 years. The female to male ratio is 4:1. The common presentation of the cases were headache, confusion, and altered level of consciousness. The location of the tumour involved is parasagittal and intradural. 2 cases were **transitional meningiomas**. These 2 cases were found in an age range of 35 to 49 years. The female to male ratio is 1:1. Headaches and decreased visual acuity were common symptoms in these cases. The location of the tumour involved cerebralconvexity. We had a single case of **psamomatous meningioma**. This case was found in a 49-year-old female. The common presentation of the case was pain and weakness. It was located in the thoracic spinal cord . Two cases were **angiomatous meningioma**. These 2 cases were found in an age range of 48 to 52 years. The female to male ratio is 1:1. The common presentation of the cases were headaches, dizziness, and temporary loss of consciousness. Location of the tumour was convexity and sphenoidal crest.

Out of 19 cases, 2 cases were grade II .In which one case was **clear cell meningioma**. This case was found in a 60-year-old male. The common presentation of the case was difficulty in speaking. The location of the tumour involved-parietal lobe. Another one case was an **atypical meningioma**. This case was found in a 43-year-old female. The common presentation of the case was blurred vision and diplopia. The paritotemporal region is where the tumour is located.

Out of 19 cases, 2 cases were grade III. In which one case was **a papillary meningioma**. This case was found in a 52-year-old female. The common presentation of the case was difficulty in speaking and understanding. location of the tumour involved in convexity. Another one case was **an anaplastic meningioma**. This case was found in a 52-year-old male. The common presentation of the case was a strong headache and a behavioural disorder. The location of the tumour involved is temporo-occipoital. Details of all the cases are given below.

Surgical resection was done in all the cases and specimen sent for histopathological examination. After tissue processing slides were stained with H&E stain and examined under microscope.

GRADE I:

Meningothelial, fibrous, or a mix of these two kinds (transitional) meningioma is the most prevalent form of grade I meningioma.[5]In our study most common histological types were meningothelial and fibrous meningioma. The clinical presentation of the 5 cases diagnosed as Meningothelial meningiomas are as follows.

Meningothelial meningioma

1. A 32-year-old female presented with a headache and nausea. On CT D10, an intradural tumour was discovered.
2. A 41-year-old female presented with a headache and blurred vision. On CT, a Falx based right high parietal denovo meningioma was noted with the adjacent cerebrum showing vasogenic edema..
3. A 48-year-old female presented with a headache and personality changes. On CT Rt. Parasagital SOL? Meningioma noted.
4. A 54-year-old male presented with impaired speech and aphasia (forgetting words). On CT, 2.5x2.3cms of well defined, lobulated, homogeneously enhanced, extra axial mass along the right posteroinferior temporal convexity with adjacent dural tail was noted.
5. A 65-year-old female presented with blurred vision and a headache. On CT D6:Intradural extramedullary spinal tumour? Meningioma noted.

No mitotic activity, no necrosis seen in our cases. Out of 5, two cases are showing focal intranulcear pseudoinclusions with psammoma bodies.

Fig 1 & 2 Menigothelial meningioma:

Composed of round to oval cells arranged in whorled pattern. Cells show round uniform nuclei with eosinophilic cytoplasm. Blood vascular proliferations with areas of haemorrhages.

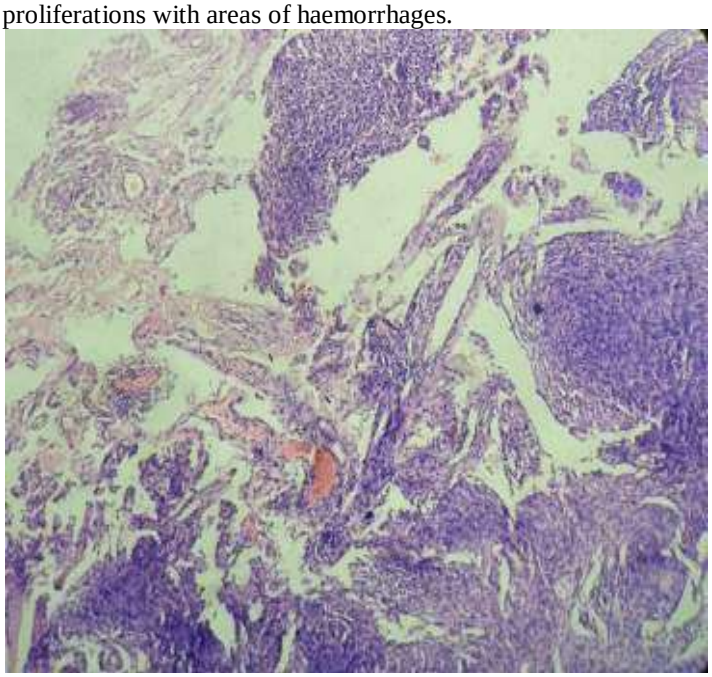


Fig 1:- H&E10x.

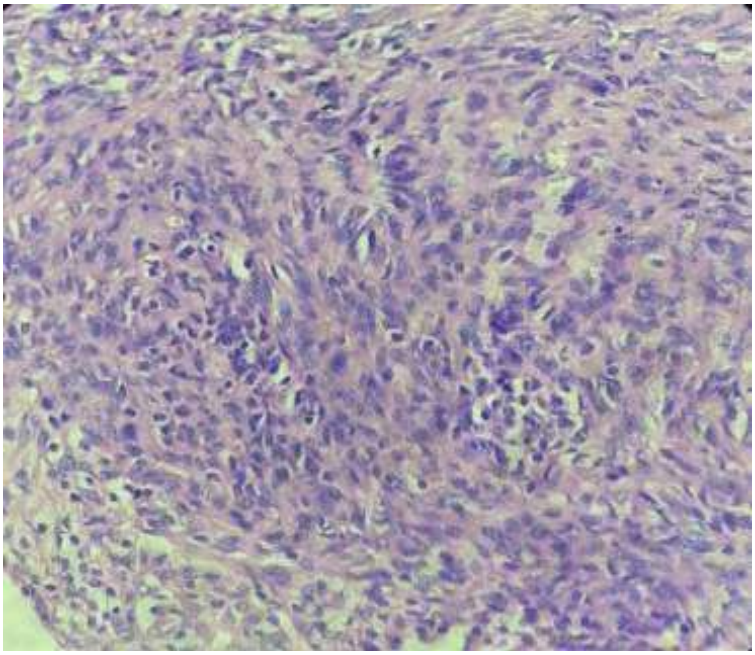


Fig 2:- H&E 40x.

Fibrous meningioma:

The clinical presentation of the 5 cases diagnosed as Fibrous meningiomas are as follows.

1. 36 female presented with difficulty in reading and writing. In CT Is there a well-defined mass on the right parasagital lobe with bone and dura infiltration? Aggressive meningioma? Mets
2. 46-year-old M presented with a global headache and loss of balance. On CT, a well- defined extra axial SOL in the left parasagittal region m. 2.3x2.1x1.9 cm.
3. 58 y female presented with headache and confusion. On CT Left frontal intradural SOL ? Meningioma
4. 59 y male presented with altered level of conscious and confusion. On CT Right parasagittal SOL?Meningioma
5. A 70 female presented with personality changes, confusion, and an altered level of consciousness. On CT, left frontal parasagital. MRI: Meningioma (5 x 5 x 5 cms) is a large, well-defined lesion.

Fibrous meningioma characterised by spindle cells arranged in interlacing pattern. Cells are spindle, fibroblastic. Blood vascular proliferations are noted with areas of haemorrhages in all the cases. Focally transitional areas are seen in two cases while psammoma bodies are noted in three cases out of five. No mitotic activity and necrosis seen, Common presentation in anterior (frontal) or parasagittal meningiomas are Personality changes, disorientation, and a shift in state of awareness and they might be mistaken as dementia or depression atfirst.[6]

In our cases commanly involved location is parasagittal with common symptoms likeheadache, confusion and altered level of counsciousness.

Fig 3 & 4:- Fibrous meningioma: Cellular spindling and a fascicular or storiform architecture.

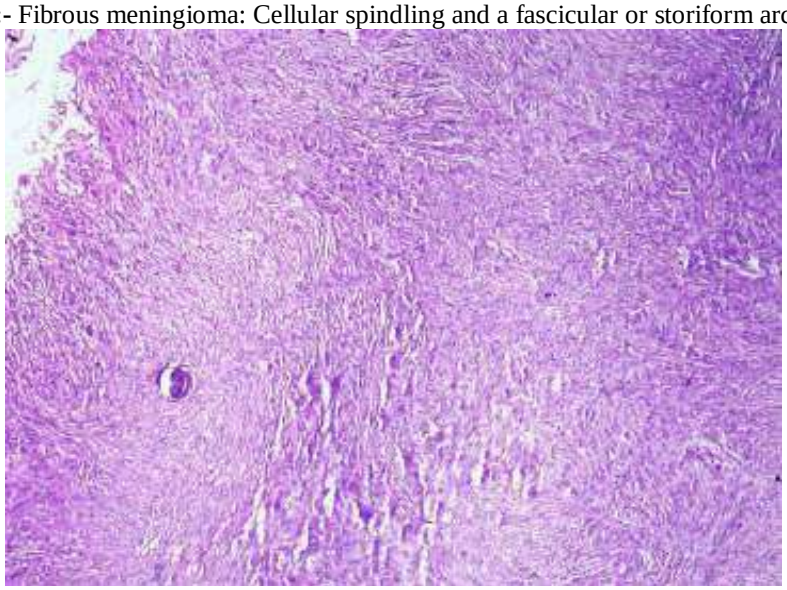


Fig 3:- H&E5x.

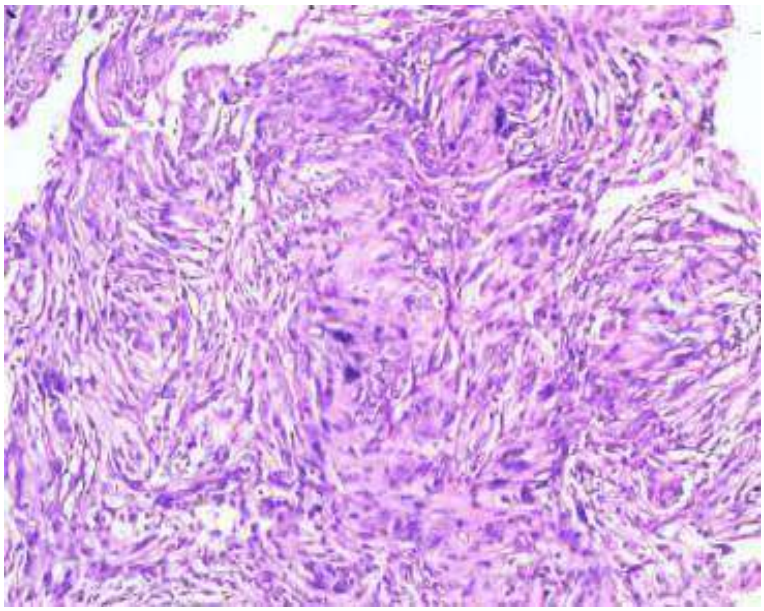


Fig 4:- H&E 10x.

Transitional Meningioma:

The clinical presentation of the 2 cases diagnosed as Transitional meningiomas are as follows:

1. 35Y male presented with throbbing headache, decrease visual acquity. On CT meningioma in convexity area.
2. 49 Y female presented with severe headache. On CT meningioma in convexity area.

Transitional menigioma characterized by cells arranged in lobular and fascicular pattern. Cells are spindle, fibroblastic and are in whorling pattern (transitional areas) with psammoma bodies. Nomitoticactivity,nonecrosisnotedinourcases.Theaverageageofallmeningiomacasesis51.45 years, while the average age of transitional meningioma patients is 50.54 years.[7]

Fig 5 &6 Transitional meningioma: Fig 5 showing Both meningothelial and fibrous pattern with tumor cells arranged in whorls and lobules round to spindle shape cells. Fig 6 showing Intranuclear pseudoinclusions

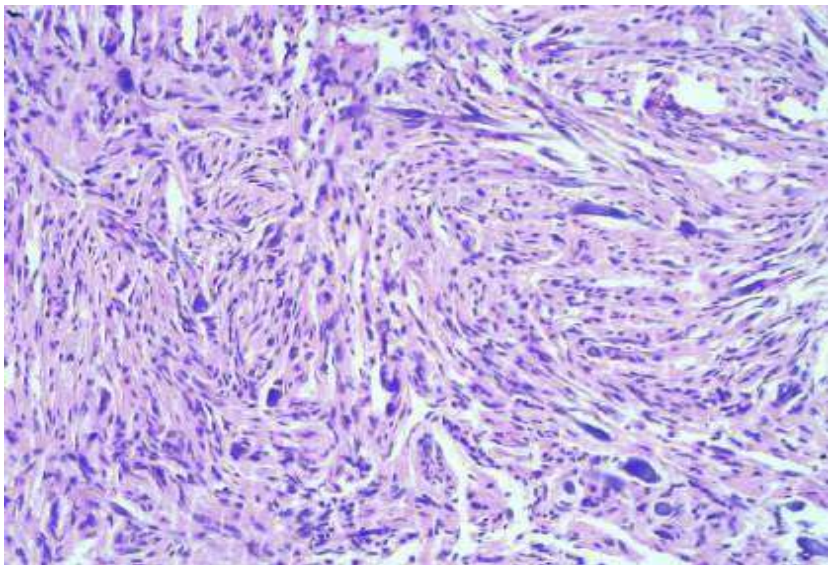


Fig 5:- H&E 10x.

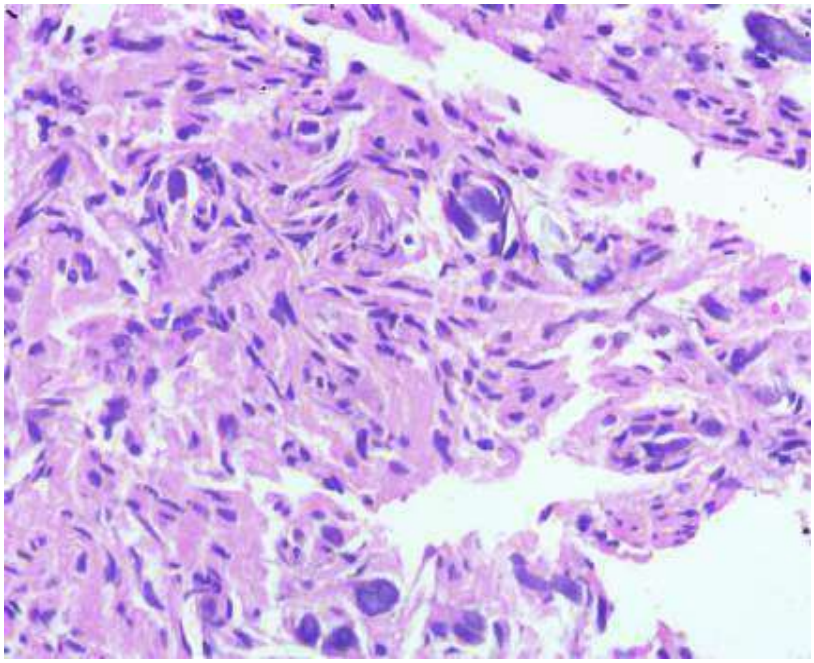


Fig 6:- H&E 40x.

Psamomatous Meningioma:

The clinical presentation of the case diagnosed as Psamomatous meningioma is as follows.

A 49 year female presented with pain, weakness. On CT megingioma in thoracic spinal cord.

When compared to ordinary meningothelial meningiomas, psammomatous meningioma is distinguished by the prevalence of psammoma bodies. The location is the same as traditional meningiomas in the skull , but numerous case reports indicates intraspinal mainly in the thoracic spine. It is common in elderly women.[8]

Psammomatous, fibroblastic, meningothelial, transitional are the most prevalent histological types observed in multiple meningiomas.[9]

Fig 7 & 8 Psamomatous meningioma: Tumor cells arranged in whorls with numerous psammomabodies.

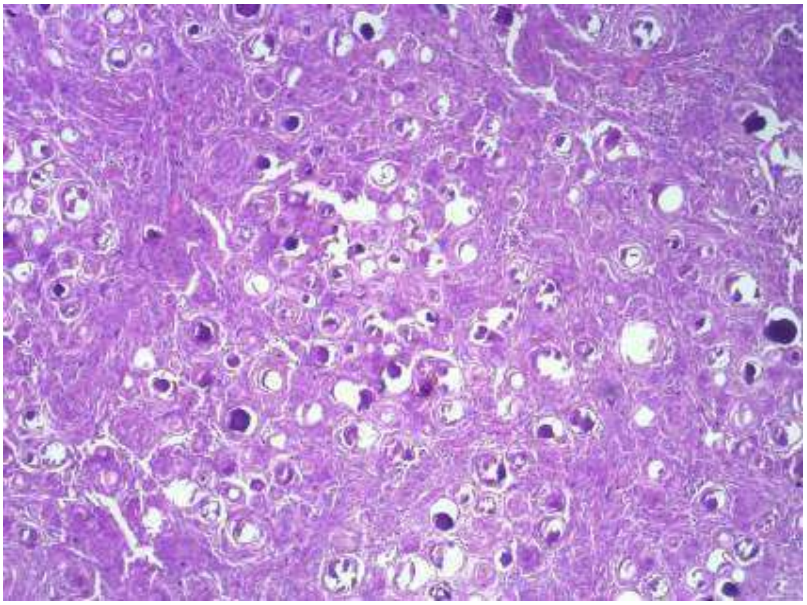


Fig 7:- H&E5X.

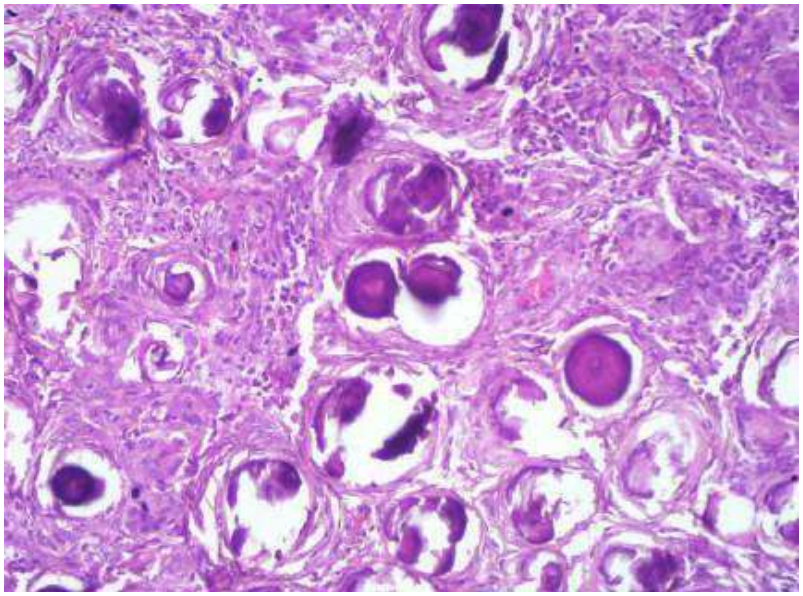


Fig 8:- H&E 10x.

Angiomatous Meningioma:
The clinical presentation of the 2 cases diagnosed as Angiomatous meningiomas are as follows.

A 48-year old male presented with a headache, nausea, vomiting, and temporary loss of conscience.In CT, a solitary mass on the sphenoidalcrest.

A 52-year-old female presented with a headache, dizziness, and visual impairment. Solitary on CTmass on the convexity of thebrain.

It is an uncommon histological subgroup with preponderance of blood vessels. In contrast to the female preponderance of normal meningiomas, a minor male predominance may represent as clinical feature.[8]

Fig 9 & 10 Angiomatous Meningioma: The vascular component accounts more than half of the overall tumour area.

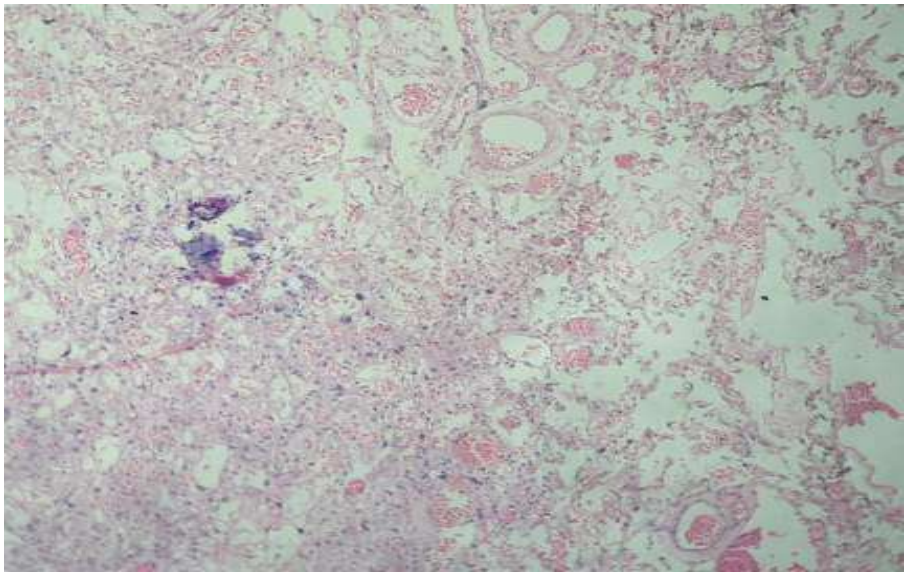


Fig 9:- H&E10x.

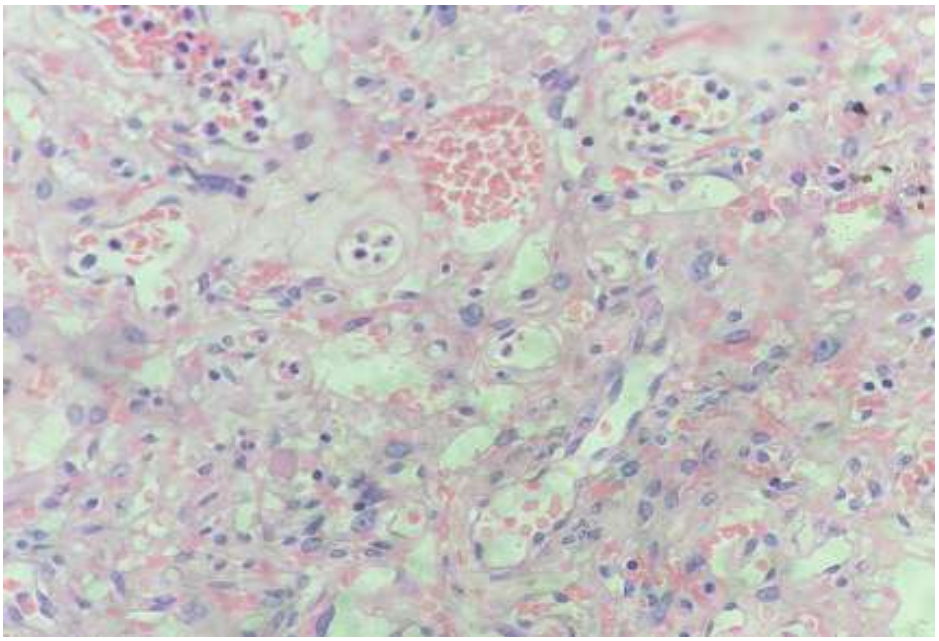


Fig 10:- H&E 40x.

Grade II:

Grade II tumours are defined by a mitotic count of fewer than 19 events per 10 high-power fields and evidence of brain invasion, or by having >4 mitotic events and three of five morphologic criteria, including 1) high cellularity, 2) small cells (clusters of cells with a high nuclear/cytoplasmic ratio), 3) sheeting (loss of whorling or fascicular architecture), 4) spontaneous necrosis, and 5) prominent nucleoli. Grade II meningiomas have distinct cell or chordoid shape.[5]

Clear cell Meningioma:

The clinical presentation of the case diagnosed as Clear cell meningioma is as follows.
A 60 male presented with difficulty in speaking. On CT, left parietal meningioma.

Clear cell meningioma characterized by cells forming lobules which are surrounded by thick collagenous septae. The cells are round to oval mainly monotonous with focally mild variation in size. The cells are having oval nuclei delicate and even chromatin .Cells show clear cytoplasm in areas eosinophilia cytoplasm.. No mitotic activity and necrosis in this case..

A preference for young patients and the cerebellopontine angle as the tumor's site are two clinical criteria. Recurrence and metastasis are both common occurrences.8

Fig 11 & 12 Clear cell meningioma: Cytoplasmic clearing, traversing collagenous bands and absence of meningothelial-type whorls.

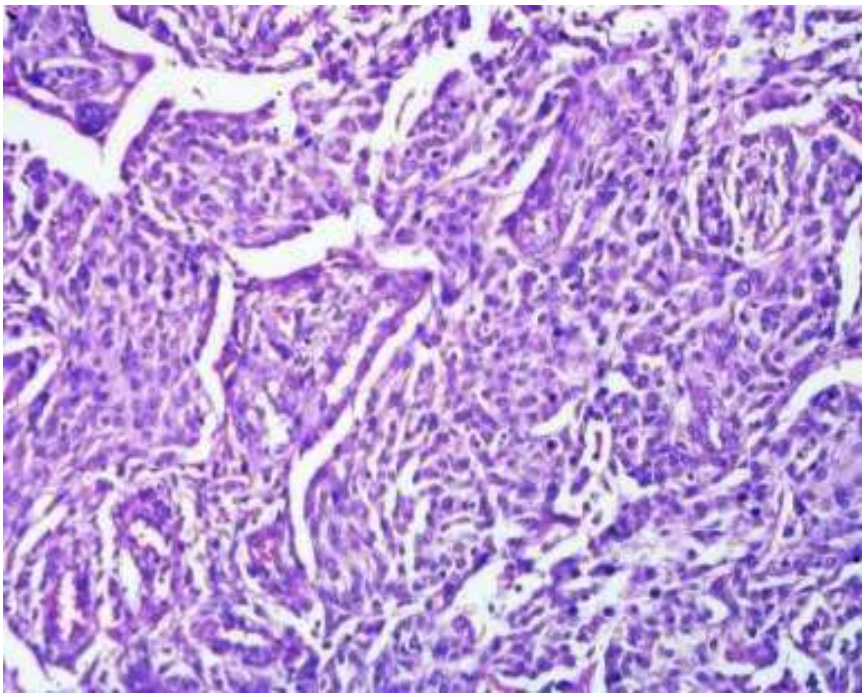


Fig 11:- H&E10X.

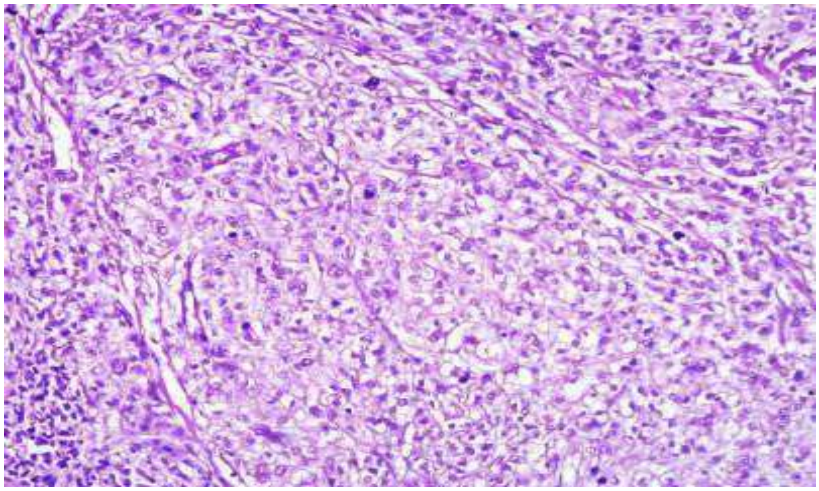


Fig 12:- H&E 40X.

Atypical Meningioma:

The clinical presentation of the case diagnosed as Atypical meningioma is as follows.

A 43-year-old female presented with a severe headache, weakness on the left side of her body, blurred vision, pupil edema, and diplopia. On CT, a solid cystic, probably extra- axil lesion in the left paritotemporal region. Most likely

due to meningioma? Pleomorphicxanthoastrocytoma.

Atypical meningioma characterized by spindle cells arranged in interlacing pattern with increased cellularity . Cells are spindle, fibroblastic focally pleomorphic with increased mitotic activity , high NC ratio and prominent nucleoli . Blood vascular proliferations are seen in this case.

Atypical meningioma has malignant characteristics that are halfway between grade I meningioma and anaplastic meningioma. In contrast to conventional benign meningiomas, this subtypes tend to afflict older individuals with a male predominance.[8] The inclusion of brain invasion as a criteria for atypical meningioma is another important modification by WHO 2016.[10] The majority of meningiomas are benign, but some are aggressive, with a high recurrence rate and a higher death rate, and atypical meningiomas are among the aggressive. These are commonly found in the convexity of thebrain.[11]

Fig 12 & 13 Atypical meningioma : Increased cellurity with cells arranged in sheets with cells showing pleomorphism

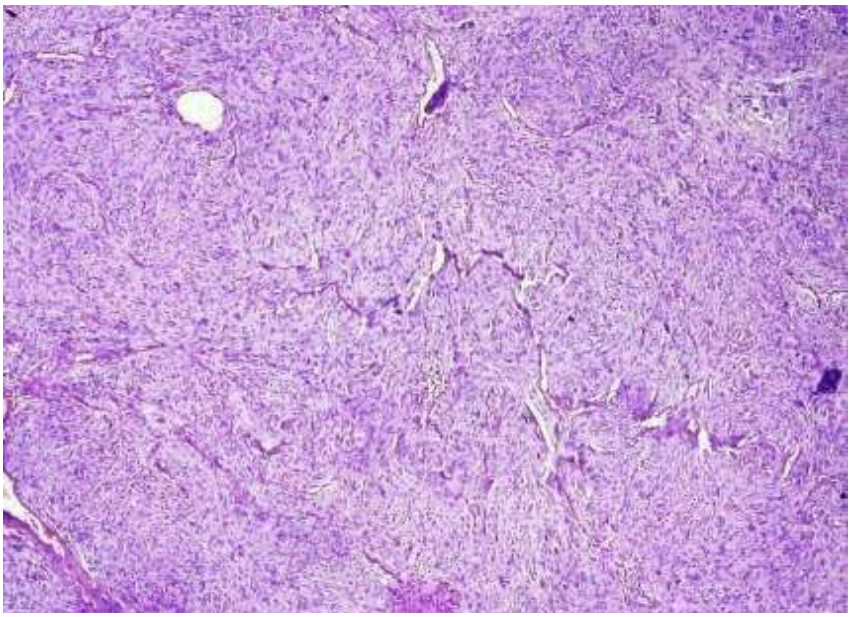


Fig 12:- H&E5x.

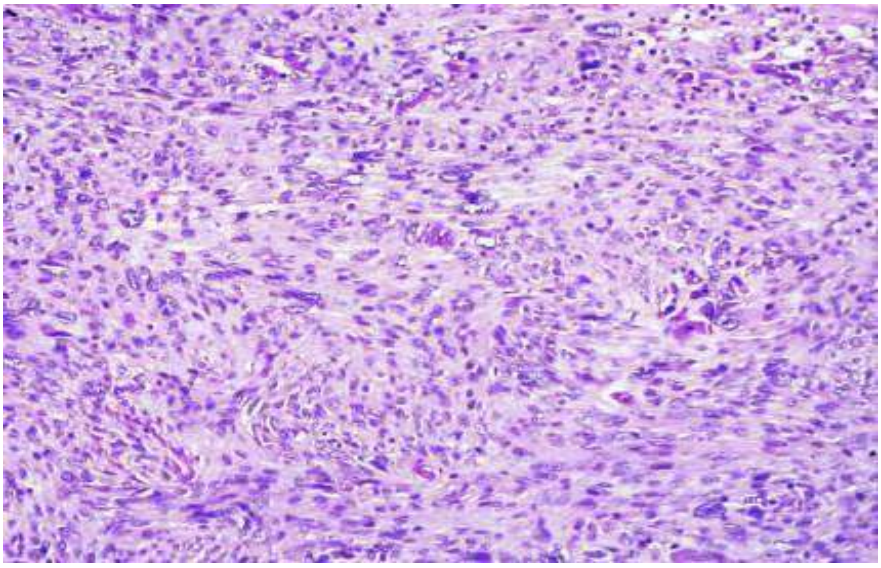


Fig 13:-H&E10x.

Grade III:
Grade III meningioma is defined as a tumour with more than 20 mitotic events per ten high- power fields, loss of cellular architecture resembling meningioma (i.e., sarcomatous or carcinomatous), and brain invasion and necrosis. When rhabdoid cells or papillary characteristics are present, a tumour is classed as Grade III.[5]

Papillary Meningioma:
The clinical presentation of the case diagnosed as Papillary meningioma is as follows.

52 y male presented with difficulty in speaking and understanding. On CT Well defined extraaxial dural based mass lesion in left parital region s/o left parietal convexity Meningioma.

Papillary menigioma characterized by spindle cells arranged in interlacing pattern like meningioma along with papillary structures and cross section of papillae giving ependymoma like histology with perivascular pseudorosettes . No whirling, psammoma bodies and nuclear pseudoinculsions. Hyper cellularity, increased mitosis and prominent nucleoli without necrotic areas.

Tumor recurrence (or advancement) is common, as is death. Recurrence and death were lower after gross complete tumour excision.[12]

Fig 14:- Papillary meningioma :Tumor cells are arranged in papillary structures with thick- thin fibrovascular core.

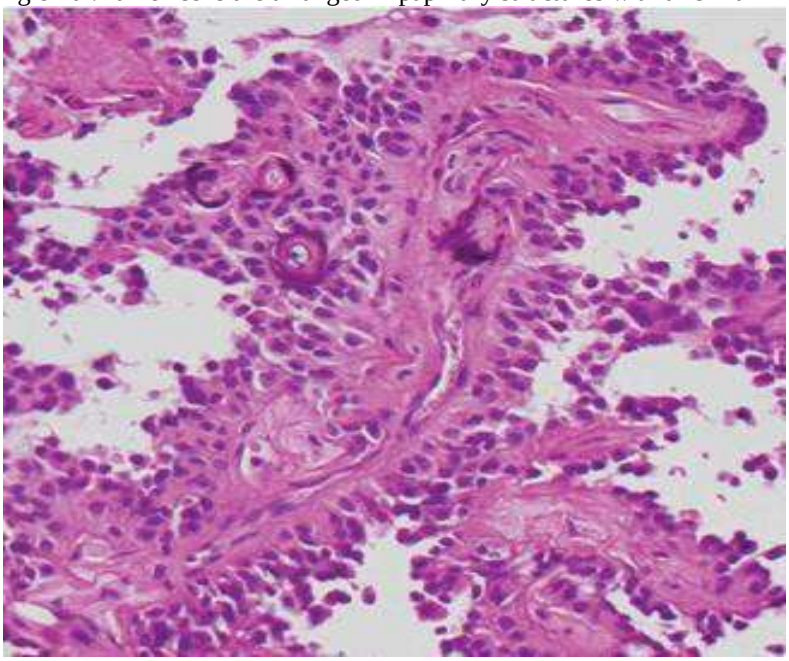


Fig 14:- H&E40x.

AnaplasticMeningioma:
The clinical presentation of the case diagnosed as Anaplastic meningioma is as follows.

A 52 male presented with a strong headache, vomiting, and behavioural disorder. On CT, a large left temporo-occipitalmass.

The cytology of anaplastic meningioma is definitely malignant, resembling carcinoma or high- grade sarcoma.[12] Only 1 to 3 % of anaplastic meningiomas are detected, and they are fast- growing tumours with recurrence rates of 50 % to 75 % following surgical excision. This variant affect patients who are substantially younger than those who have grade I or II tumours, with a slightly higher male gender preponderance. Symptoms are dependent on tumor location.[13]

Fig 15 & 16 Anaplastic meningioma: Densely cellular area with marked pleomorphish and increased mitotic activity in the tumor cells.

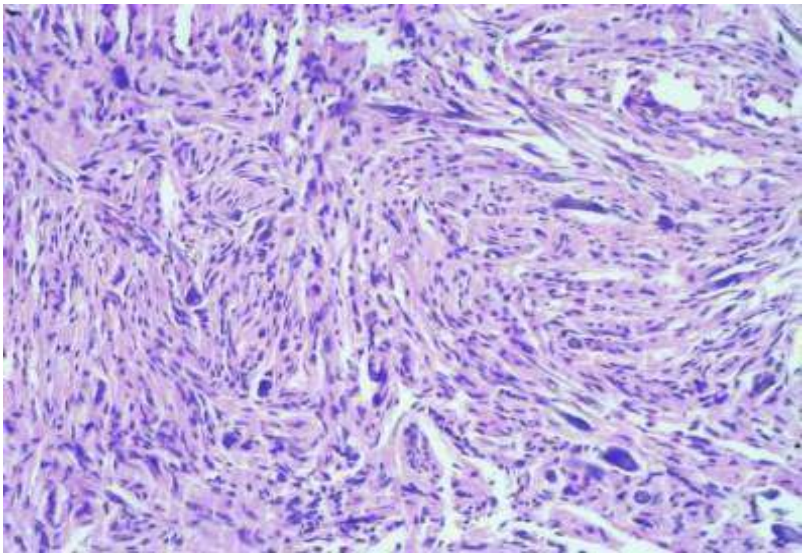


Fig 15:- H&E 10x.

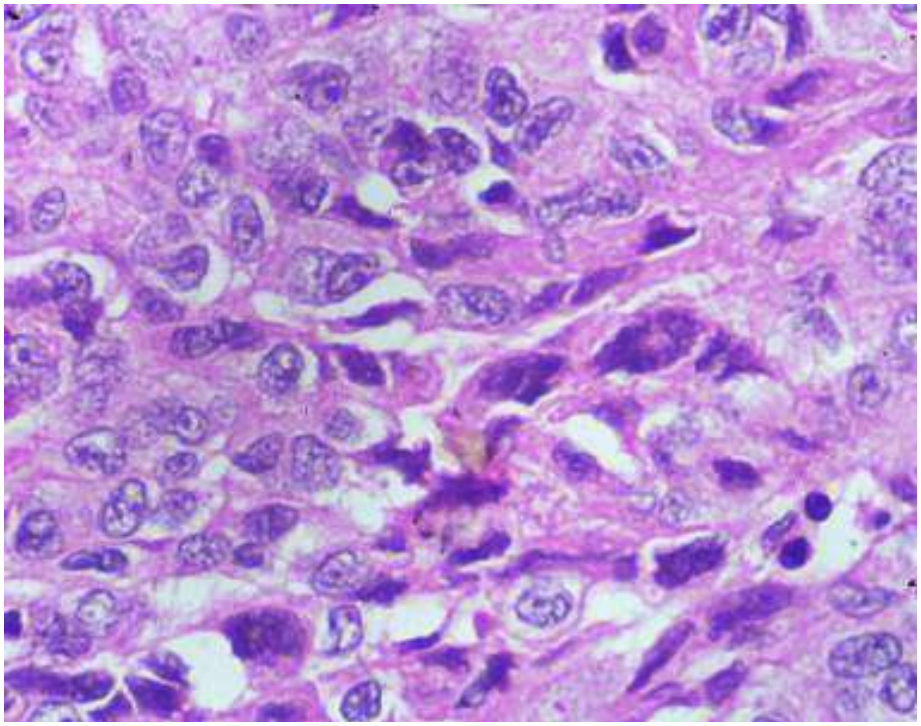


Fig 16:- H&E 40x.

Table 1:- Summary of all the cases:

Histological Type	Grade	Number of case	Age	Sex	Location
1.Meningothelial	I	5	30-70Y	F>M	Mainly intradural, convexity
2.Fibrous	I	5	30-70Y	F>M	Mainly parasaggital
3.Transitional	I	2	30-50Y	F=M	Convexity
4.Psamomatous	I	1	41-50Y	F	Spinal cord
5.Angiomatous	I	2	41-60Y	F=M	Convexity,sphenoidal crest

6.Atypical	II	1	41-50Y	F	Peritemporal
7. Clear cell	II	1	51-60Y	M	Parietal
8.Anaplastic	III	1	51-60Y	F	Temporo-occipital
9.Papillary	III	1	51-60Y	M	Parietal convexity

Fig 17:- Grades distribution based on histological types.

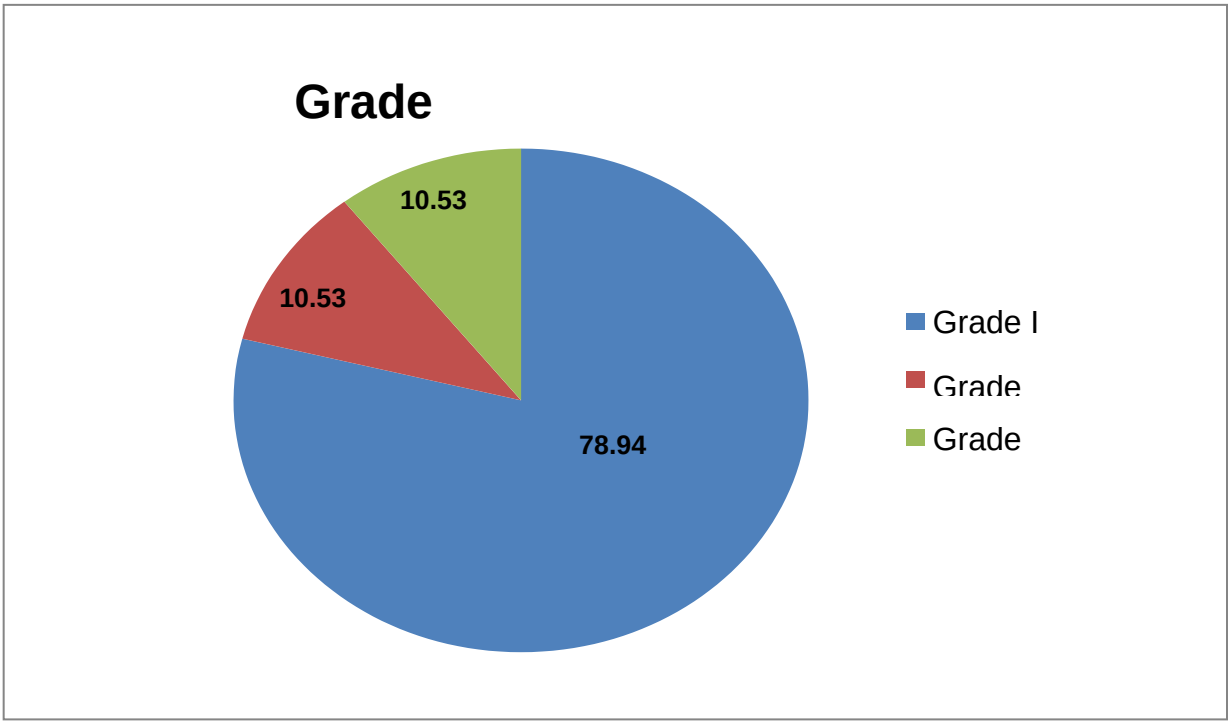
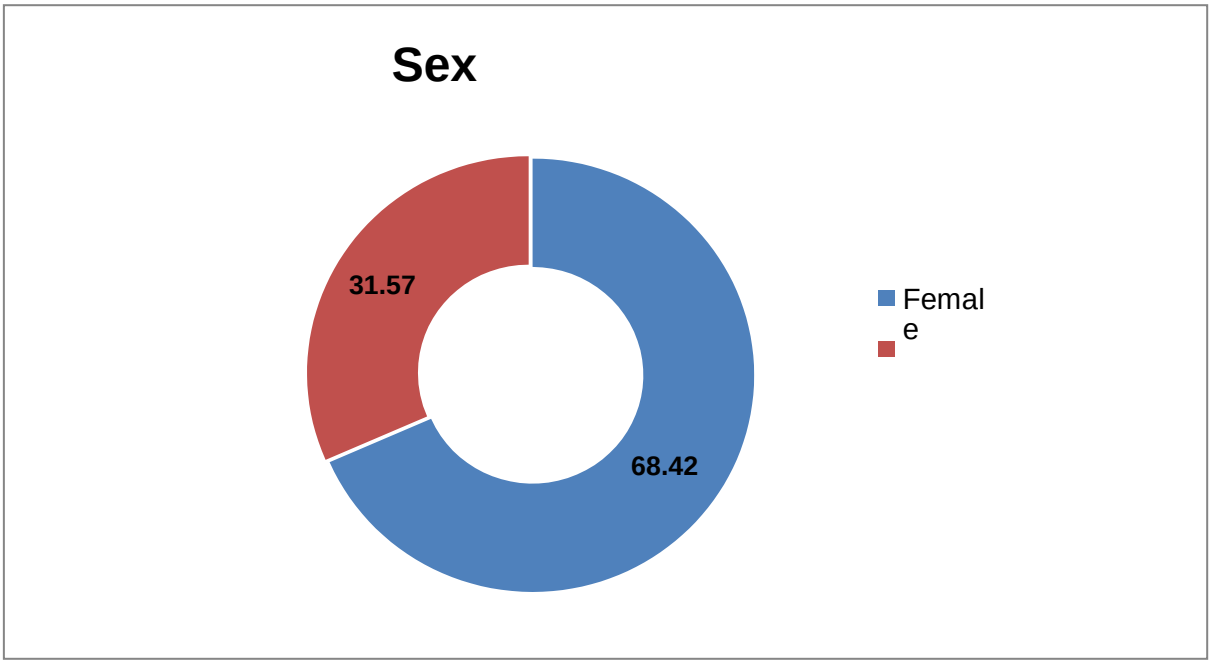


Fig 18:- Sex distribution.



Discussion:-

Meningiomas are the most common primary intracranial neoplasm. They are more prevalent in women, and their frequency increases as one gets older. In our study females were 68.42% while males were 31.57%. The WHO divides meningiomas into three histopathological classes, with WHO grade I accounting for 70 percent to 95 percent of cases. Meningiomas of WHO grades II and III are more aggressive, with greater rates of mitosis, and are more likely to return following surgery, necessitating adjuvant radiation.[14] We had total 19 patients (13 Females and 6 Males) with tumors in different locations of brain. Mainly parasagital followed by intradural . Age range was 32 to 70 years with female predominance. Common histological subtype was meningothelial (5 cases) and fibrous (5 cases), transitional (2 cases), psamomatous (1 case) followed by angiomatous (2 cases) - WHO grade I tumors. Clear cell and atypical - grade II. Papillary, anaplastic variant - grade III. In our study common age involved is 41-60 years. In which females more likely from 41-50 years and males more likely from 51-61 years of age.Meningiomas are the most frequent nonglial cerebral tumours and have been known for a long time. Primary intracranial neoplasms are the most often reported.The majority of meningiomas are benign.[5] In our study Grade I meningioma was 78.94% which highest among all three grades.Although Grade II meningiomas were formerly discovered in only around 5% of instances, following the adoption of the WHO criteria in 2000 and 2007, they now account for 20%–35% of newly diagnosed meningiomas.[5] In our study Grade II meningioma was 10.53%. WHO Grade III meningiomas account for less than 3% of newly diagnosed meningiomas (also termed anaplastic or malignant).These are aggressive tumors with considerably poorer local control and overall survival than lower grade meningiomas. In our study Grade III meningioma was 10.53%. one patient from Grade III succumbed within 1 month of postsurgery. Although there is little disagreement about the need for aggressive treatment, which typically includes surgery and radiation therapy, treatment remains contentious when it comes to the required extent of surgery, the preferred type of radiation therapy, as well as dosing and target volume constraints. Local control is difficult to achieve even with vigorous care, and metastasis, albeit uncommon, can occur. Treatment paradigms must be improved.[15]Even after complete removal, it is estimated that meningiomas will recur in 10 to 32% of cases within 10 years. Aside from the degree of tumor removal, other risk factors for relapse in benign meningioma are not well understood.[16] Although in our study there is no recurrence till now.Previous research has identified risk factors for high-grade meningiomas. Male sex and convexity location have both been linked to an increased risk of atypical meningiomas. while in our study female and male ratio is equal 1:1 and common location involved is parietal, peritemporal and temporo-occipital. Convexity meningiomas are more prevalent than skull base meningiomas, unusual tumours can develop along the skull base. Convexity and falx/parasagittal meningiomas were more likely to be higher grade than skull base tumours.[14] The most prevalent sites for intracranial meningiomas are:convexity(lateralhemisphere)(20%–34%).[17]Tumourslocatedintheconvexityareoftendeemed curable by surgical resection. but intraventricular and skull-based meningiomas have a worse prognosis due to the more difficult resection.[18] In our study lower grade tumor belongs to mainly convexity, parasagittal, intradural and spinal cord. Exposure to ionising radiation (IR) is the most common environmental risk factor for meningioma, with risks ranging from six to 10 times higher. A variety of results, notably the higher incidence of post-pubertal illness in females vs males (2:1), with the greatest ratio of 3.15:1 during the peak reproductive years, have shown a link between hormones and meningioma risk. Since Harvey Cushing's time, head trauma has been identified as a risk factor for meningioma. Breast carcinoma,occupation/diet/allergy, cell phone usage - all uncertain risk factors for meningioma.[19] Meningiomas, particularly recurring illness, remain a difficult clinical challenge despite breakthroughs in imaging, neuropathology, microsurgery, and radiation.[11]

Conclusion:-

Meningiomas are slow growing tumors arising from the meningothelial cells. Commonly they are benign WHO grade I with female predominance. Early detection helps in the treatment and improves quality of life.

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