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REVIEW ARTICLE

Meningioma: Not necessarily benign and progress in its treatment.

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ABSTRACT… Meningiomas are not always benign tumours and are considered quite common primary intracranial tumours. They can represent Grade I to Grade III differentiation with varied outcomes and threats. For most low-grade asymptomatic and benign meningiomas, radiological surveillance is a go-to treatment option. In other grades, treatment options vary from surgical resection of the affected area to adjuvant radiotherapy, especially in the grade III cases. Therefore, this report takes on an approach of reviewing different literature on various treatment options and strategies by taking into consideration radiological, molecular and clinical characteristics of meningiomas.

Key words: Meningioma, Low grade Meningioma, High Grade Meningioma.

INTRODUCTION

Meningiomas are largely deemed benign and are considered to be common primary CNS tumours. A 37.6 percent of the reported cases, nearly 53.3 percent are non-threatening and non-malignant.[1] The annual incidence of these tumors corresponds to 10.5 cases in 100,000 women and 4.8 in 100,000 men, thus showing a predominance in female patients.[2] Meningiomas usually come into being on the inner surface of the dura of arachnoid cells. They can often be found in the spinal dural surface or intracranial. Quite rarely, they can be traced in extracranial organs.[3] Meningiomas can be frequently found in the black population, older age people, and females with a higher possibility of nonmalignant tumour (s).[4]

The most common practice to diagnose meningioma is through radiological tests. A biopsy is not compulsory if imaging firmly indicates meningioma.[1] In meningioma patients, Asymptomatic and slow-growing meningiomas are usually managed with observation along with routine imaging.[5] Usually, for patients who show exponential growth, the best way to be safe is to get the meningeal tumor resected to defuse the threat.[6] Unfortunately, the rate of recurrence is much higher close to 90 percent for grade III patients and 50 percent for grade II.[6]

Therefore, this makes the review of the latest literature important because it helps in encapsulating our understanding of meningiomas and determining best practices and therapeutic options.

Risk Factors

There are various risk factors associated with meningiomas including ionizing radiation to the human head especially the skull.[6,7] Such ionizing radiations caused by meningiomas are mostly aggressive and lead to many tumours, thereby increasing the risk 6 to 10 times.[8,9] Women are at an increased risk of meningiomas especially due to post-pubertal disease as well as reproduction. The former increases the risk in females by 2:1 vs males and the latter by 3:1.[1,10,11]

Clinical Characteristics

Most of the meningioma tumours are found incidentally and they are largely asymptomatic.

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The symptoms of meningioma depend on the localization and there is scarce pathognomonic clinical presentation. Usually, the growth rate of tumours is slow and on a few occasions infiltrative. These tumours sometimes show neurological symptoms (in the cranial nerve) that come with mass effect, enhanced intracranial pressure causing headache and sometimes generalized or partial seizure.[12]

Radiological Characteristics

One of the prominent radiological characteristics of meningioma is that on tomography, intra-tumoral calcification along with hyperostosis is found. MRI is the best way to diagnose meningiomas where it shows as a circumscribed dural lesion indicating tumours. The common feature of benign meningiomas is that on non-contrast sequences, tumors are isointense to gray matter and have a thicker, contrast-enhancing dural tail.[6]

Notwithstanding this, MRI is quite fruitful in monitoring non-active meningiomas, which allows radiologists to find the difference between meningiomas they already have been surgically treated by examining dural thickness.[13] In atypical meningiomas, magnetic resonance spectroscopy shows lactate peak and reduced N-acetyl aspartate.[5]

Histopathology

According to World Health Organization 2016, meningiomas can be classified into three grades.[14]

- Grade 1 Meningioma: It shows a frequency rate of 80-85 percent with the mitotic rate of <4 per 10 High-power fields (HPF). This typically shows no brain invasion.
- Grade 2 Meningioma (atypical): it shows a frequency rate of 15-20 percent with a mitotic rate of 4-19 per 10 HPFs. This shows brain invasion.
- Grade 3 Meningioma (anaplastic and malignant): It shows the frequency of 1-2 with the mitotic rate of >20 per 10 HFPs or rhabdoid histology or papillary.

Molecular Changes

There are 4 mutually exclusive ways through which meningiomas are developed according to genomic analysis.[15,16] They are stated below:

- Gene CDKN2A mutation: It is a somatic mutation causing homozygous losses, a rare mutation, which results in anaplastic meningiomas. The risk of recurrence of this mutation is relatively higher.[17]
- Gene POLR2A mutation: molecular alternation of p.Gin403Lys and p.Leu438_His439del comes under a subset of meningothelial histology. It is located in the tuberculum sallae.[18]
- Gene SMO mutation: It is a molecular alteration of Leu512Phe and Trp535Leu mutation which results in multiple pathogenic variants through enhanced hedgehog signaling.[17,19]
- Other mutations such as gene mutations are AKT1, TRAF7, KLF4, etc.

Surgical Approach

On one hand, radiological surveillance is a good option for asymptomatic meningiomas. On the other, for symptomatic and malignant meningiomas, surgery may be an appropriate option.[20] The most important thing to see is whether the bone is affected or not. If it is affected, then removal of the bone along with the tumour is recommended because it often leads to recurrence.[21] The resected area is patched which replaces dura. According to Simpson Grade, an extension of resection is divided into 5 categories[22]:

I. Biopsy
II. Subtotal resection
III. Macroscopic resection without coagulation and/or dural excision
IV. Gross total resection with dural coagulation
V. Complete resection with bone and dural.

Sadly, brain surgery may cause neurocognitive dysfunction and other risks that are associated with bone removal.[23] Modern approaches such as the endoscopic treatment approach through the nasal cavity localized at the olfactory groove may seem less harmful.[24]

RADIOTHERAPY

The irradiation approach is a potent alternative to curb the growth of meningiomas in patients with

untreatable meningiomas. However, it falls short of being effective alternative to surgery. Moreover, irradiation fails to provide a histological diagnosis. Single-fraction stereotactic radiosurgery (SSR) and extended beam radiotherapy (EBRT) can be used after surgery to improve the efficacy of surgery in removing tumours.[20,21,23] EBRT can help in preventing local recurrence in the brain invading meningioma. Unfortunately, the lack of uniformity in fractioning, doses and timing of radiotherapy is a leading cause of confusion among experts because of insufficient evidence of Phase III randomized controlled examination and trials.

CONCLUSION

In conclusion, meningioma is elusive, especially during its initial stages. It is usually found accidentally, which means that most patients find tumours during grade II and grade III. Therefore, it is a malignant disease. Although the rate of incidence is relatively low as compared to other tumours, the treatment options are many including but not limited to surgery. Most often, multiple treatment options are recommended along with surgery such as radiotherapy to reduce the incidence of recurrence. Lastly, there is a greater need for phase III randomized trials to ascertain the role of radiotherapy and also to standardize the procedure to treat patients with meningiomas.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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REFERENCES

1. Ogasawara C, Philbrick BD, Adamson DC. **Meningioma: A review of epidemiology, pathology, diagnosis, treatment, and future directions.** Biomedicines. 2021; 9(3):319.
2. Salles D, Santino SF, Malinverni AC, Stávale JN. **Meningiomas: A review of general, histopathological, clinical and molecular characteristics.** Pathology-Research and Practice. 2021; 223:153476.
3. Ostrom QT, Gittleman H, Liao P, Vecchione-Koval T, Wolinsky Y, Kruchko C, et al. **CBTRUS Statistical Report: Primary brain and other central nervous system tumors diagnosed in the United States in 2010–2014.** Neuro Oncol. 2017; 19(Suppl. 5):v1-v88.
4. Achey RL, Gittleman H, Schroer J, Khanna V, Kruchko C, Barnholtz-Sloan JS. **Nonmalignant and malignant meningioma incidence and survival in the elderly, 2005–2015, using the Central Brain Tumor Registry of the United States.** Neuro Oncol. 2019; 21(3):380-391.
5. Alruwaili AA, De Jesus O. **Meningioma.** In StatPearls [Internet]. StatPearls Publishing. 2023.
6. Buerki RA, Horbinski CM, Kruser T, Horowitz PM, James CD, Lukas RV. **An overview of meningiomas.** Future Oncol. 2018; 14(21):2161-77.
7. Baldi I, Engelhardt J, Bonnet C, Bauchet L, Berteaud E, Grüber A, Loiseau H. **Epidemiology of meningiomas.** Neurochirurgie. 2018; 64(1):5-14.
8. Walsh KM. **Epidemiology of meningiomas.** In Handbook of Clinical Neurology. 2020; 169:3-15. Elsevier.
9. Benjamin C, Shah JK, Kondziolka D. **Radiation-induced meningiomas.** In Handbook of Clinical Neurology. 2020; 169:273-284. Elsevier.
10. Maiuri F, Mariniello G, Somma T, Guadagno E, Corvino S, Pagano S, et al. **Meningiomas in premenopausal women: Role of the hormone related conditions.** Frontiers in Oncology. 2020; 10:556701.
11. Portet S, Banor T, Bousquet J, Simonneau A, Flores M, Ingrand P, Bataille B. **New insights into expression of hormonal receptors by meningiomas.** World Neurosurgery. 2020; 140:e87-e96.
12. Perry A. **Meningiomas.** In Practical surgical neuropathology: A diagnostic approach. 2018; 259-98. Elsevier.
13. Nakasu S, Nakasu Y. **Natural history of meningiomas: Review with meta-analyses.** Neurologia Medico-chirurgica. 2020; 60(3):109-20.
14. Salami AA, Okunlola AI, Ajani MA, Onakpoma F. **WHO classification of meningiomas–A single institutional experience.** Neurochirurgie. 2021; 67(2):119-24.

15. Abedalthagafi M, Bi WL, Aizer AA, Merrill PH, Brewster R, Agarwalla PK, et al. **Oncogenic PI3K mutations are as common as AKT1 and SMO mutations in meningioma.** Neuro Oncol. 2016; 18(5):649-655.

16. Clark VE, Harmancı AS, Bai H, Youngblood MW, Lee TI, Baranoski JF, et al. **Recurrent somatic mutations in POLR2A define a distinct subset of meningiomas.** Nat. Genet. 2016; 48(10):1253-1259.

17. Brastianos PK, Horowitz PM, Santagata S, Jones RT, McKenna A, Getz G, et al. **Genomic sequencing of meningiomas identifies oncogenic SMO and AKT1 mutations.** Nat. Genet. 2023; 45(3):285-89.

18. Clark VE, Erson-Omay EZ, Serin A, Yin J, Cotney J, Ozduman K, et al. **Genomic analysis of non-NF2 meningiomas reveals mutations in TRAF7, KLF4, AKT1, and SMO.** Science. 2013; 339:1077-80.

19. Boetto J, Bielle F, Sanson M, Peyre M, Kalamarides M. **SMO mutation status defines a distinct and frequent molecular subgroup in olfactory groove meningiomas.** Neuro Oncol. 2017; 19:345-51.

20. Islim AI, Kolamunnage-Dona R, Mohan M, Moon RDC, Crofton A, Haylock BJ, et al. **A prognostic model to personalize monitoring regimes for patients with incidental asymptomatic meningiomas.** Neuro Oncol. 2020; 22(2):278-89.

21. Meling TR, Da Broi M, Scheie D, Helseth E, Smoll NR. **Meningioma surgery – are we making progress?** World Neurosurg. 2019; 125:e205-e213.

22. Sumkovski R, Micunovic M, Kocevski I, Ilievski B, Petrov I. **Surgical treatment of meningiomas-outcome associated with type of resection, recurrence, Karnofsky Performance Score, mitotic count.** Open access Macedonian Journal of Medical Sciences. 2019; 7(1):56.

23. Corniola MV, Meling TR. **Functional outcome and quality of life after meningioma surgery: A systematic review.** Acta Neurol. Scand. 2021; 143(5):467-74.

24. Cappabianca P, d'Avella E, Cavallo LM, Solari D. **Meningiomas: Criteria for modern surgical indications.** Mini-invasive Surg. 2020; 4:83.

25. Unterberger A, Nguyen T, Duong C, Kondajji A, Kulinich D, Yang I. **Meta-analysis of adjuvant radiotherapy for intracranial atypical and malignant meningiomas.** Journal of Neuro-Oncology. 2021; 152:205-16.

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