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Intracranial Involvement of Ameloblastoma: A Highly Perilous Entity

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Abstract

Background: Ameloblastoma is a rare, asymptomatic, aggressive, slow growing, benign odontogenic tumor arising from the residual epithelium of tooth germ, lining of odontogenic cysts and enamel organ. occurring primarily in the lower jaw. They represent 1% of all jaw tumors. Ameloblastomas show a locally aggressive behavior, rarely associated with a malignancy. They are the second most common odontogenic tumor after odontomas. Almost 80% of the cases are seen in mandible while as the rest are seen in the maxilla.

Methods: A comprehensive literature search was conducted to identify relevant studies. Different database and search engines were explored, PubMed, Scopus, Google Scholar, Web of Science, Indexed Copernicus. The search strategy employed a combination of keywords like ameloblastoma, intracranial ameloblastoma, ameloblastoma of brain. The search was limited to English language studies.

Results: Although a rare entity, Intracranial Ameloblastoma when encountered is associated with the poor prognosis. Major factor involved in progression of ameloblastoma to brain is its aggressive nature and recurrence.

Conclusion: Ameloblastoma is highly invasive and rarely infiltrate base of skull, infratemporal fossa, paranasal sinus, pterygopalatine fossa, orbit and paraphyrangeal space. The intracranial spread of ameloblastoma is a rarely detected condition but its knowledge can save lives of many patients.

Keywords: Ameloblastoma; Mandible; Intracranial Involvement

Introduction

Ameloblastoma is a benign odontogenic tumor arising primarily through enamel organ type tissue within a mature fibrous stroma devoid of odontogenic ectomesenchyme that failed to differentiate into tooth structure [1]. Ameloblastoma is predominantly reported in the mandible. Although it is a benign tumor but it is locally aggressive, about 70% of the cases result in malignancy and 2% metastasize to other locations [2,3]. It is the second most common odontogenic tumor after odontoma and comprises of 1% of all tumors and 9-11% of odontogenic tumors [4]. Ameloblastoma is reported more in the developing countries. Incidence of ameloblastoma is 0.5 cases per million persons in a year

[5]. Ameloblastoma is more likely to occur in the African American populations as compared to Caucasian. It accounts for about 60.3% of all odontogenic tumors in Indian population with the peak incidence in 30.2 years. Males are slightly more susceptible, with the ramus of mandible being the most common location [6]. Although Ameloblastomas are benign neoplasms but they are very aggressive and can infiltrate to a great extent resulting in facial asymmetry, tooth displacement, malocclusion and pathological fractures. Incidence of Metastasizing ameloblastoma is only 2%, mainly to lungs (80%) and lymph nodes (20%) [7]. Intracranial involvement of ameloblastoma is no doubt a rare pathology and it requires multidisciplinary treatment to ensure maximum surgical radicality [8].

Epidemiology

Ameloblastoma shows a variable global prevalence with an incidence of 0.92 cases per million persons. It exhibits varying prevalence rates across different geographical regions worldwide. This disparity suggest that environmental, genetic, and socioeconomic factors might influence the development and detection of ameloblastoma. A study done on Brazilian subjects reported 6231 oral lesions, 185 among them were benign odontogenic tumours [9]. Most common tumor was ameloblastoma followed by keratocystic odontogenic tumor and odontoma. While as a study done on Chinese subjects revealed Keratocystic odontogenic tumor to be the most frequent followed by ameloblastoma [10]. Similarly in United States and Canada, odontoma is the most common odontogenic tumor followed by ameloblastoma [11].

A study done in Maharashtra, reviewing records from 1992-2012 revealed that among 125 benign odontogenic tumors, keratocystic odontogenic tumor (45%) was the most common followed by ameloblastoma (35%), odontoma (7%) and adenomatoid odontogenic tumor (5%) [12].

Ameloblastoma can affect any age but most commonly seen in fourth and fifth decade with the peak age of detection is 35. It shows a slight male predilection.

Metastasizing Ameloblastoma

Metastasizing ameloblastoma is a type of ameloblastoma that exhibits metastatic behavior, despite being histological benign. Metastasis is one of the hallmarks of malignant tumors, but few entities like metastasing ameloblastoma, metastasizing leiomyoma, metastasizing pleomorphic adenoma, and giant cell tumor of bone can also exhibit metastasis. The most common region of metastasis of ameloblastoma is lungs followed by lymph nodes. Metastasising ameloblastoma is more commonly seen in males, encountered mostly in fourth to fifth decade of life. Mandible is the most common region of origination of tumor. Metastasizing ameloblastoma is an ambiguous odontogenic tumor as it consists of features of both benign ameloblastoma and its malignant counterpart [13,14].

Ameloblastoma is highly recurrent lesion and repeated surgeries or incomplete removal can result in development of metastasing ameloblastoma [15]. A review done by Praetorius on malignant odontogenic tumors mentioned that the important traits for metastasis are size and origin of primary tumor, mandibular posterior lesion, repeated surgeries, incomplete removal. While as the complete pathogenesis of tis tumour is not fully understood [16]. Follicular ameloblastoma was found to be the most common histological subtype followed by plexiform. Lungs are the most common site of metastasis, approximately 72.7% cases. Apart from lungs other regions affected by metastasizing ameloblastoma are lymph nodes, kidneys, pelvis and brain. Till now no exact diagnostic method is available to detect which ameloblastoma can result in metastasis. A study done by Zambrano, et al. [17] reported the detection of high amount of non-MAPK pathway genes like p63 and Ki67 linked with metastasizing ameloblastoma. Similar results were found by Ganjre, et al. [18] who found the high expression of p63 and Ki67 in metastasizing ameloblastoma. Dysregulation in the Wnt/b- catenin signalling pathway has been reported to be seen in more aggressive diseased [19].

Metastasizing Ameloblastoma vs Ameloblastic Carcinoma

Conventional ameloblastoma is an intraosseous epithelial odontogenic neoplasm having benign features. Ameloblastoma showing malignant features is known Ameloblastic carcinoma while as the ameloblatic lesion that has metastasized is called metastasizing ameloblastoma. Mortality is higher in patients with Ameloblastic carcinoma as compared to metastasizing ameloblastoma. Increased growth and faster metastasis are seen in ameloblastic carcinoma [20].

Intracranial ameloblastoma

The most characteristic feature of ameloblastoma is its aggressive infiltration and can rarely extend into the intracranial compartment leading to serious complications [21]. It can spread to base of skull, pterypalatine fossa, infratemporal fossa, parapharyngeal space, and orbit. Involvement of brain can result in many dangerous conditions like, intracranial hypertension and severe neurological defecits, even leading to death of patient [8].

Increased duration of tumor and recurrent surgeries to remove the primary tumor have played an important role for brain involvement. Metastasis of this tumor to other parts is

not suggestive of intracranial involvement. Ameloblastoma is locally infiltrative tumour and maxillary bone being spongy, paves way for the large spread of tumor to brain without restriction. Although most ameloblastomas originate in the mandible, but those originating in the maxilla are more infiltrative and expand to a larger extent triggering a relatively large, unrestricted growth which is very difficult to treat [22]. Facial regions are anatomicaly close to endocranium which can lead to direct expansion of tumor into brain, while as metastasis through blood and lyphatics is not a common way for spread of ameloblastoma to brain. However, soft tissue involvement can spark the contact with the tumor cells [7].

Surgical treatment

A multidisciplinary approach in collaboration with Neurosurgeon is used in surgical treatment of intracranial ameloblastoma. Radiological evaluation including MRI and total body CT is always required before deciding the surgical modality of the tumor. Gross total resection of tumor is indicated in the small tumors. In case of large tumors gross total resection can't be done due to the involvement many vital structures. This partial removal of tumor can further lead to higher rate of reccurence. Once the tumor crosses a point of involvement, complete resection can't be done and surgery will be opted only as palliative not as curative. Extensive surgery is most of the times adjuvant with chemotherapy and radiotherapy. Facial deformity is also one of the biggest concerns with the extensive surgery resulting in the reduction of quality of life of patients. Patients must follow a close neruroradiological follow-up [23,24].

Conclusion

Intracranial involvement of ameloblastoma is a rare and complex phenomenon that poses significant diagnostic and therapeutic challenge. The mechanisms underlying the intracranial spread of ameloblastoma are not fully understood and warrant further investigation. However, it is clear that early detection and aggressive management are crucial to improving outcomes in these patients. A multidisciplinary approach, involving oral and maxillofacial surgeons, neurosurgeons, and oncologists, is essential for optimal management of intracranial ameloblatoma. Further research is needed to develop more effective treatment strategies and to improve our understanding of this rare and fascinating condition.

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