Chondromyxoid Fibroma of the Mastoid: A Rare Entity with Comprehensive Literature Review

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Cite this article as: Elsamanody A, Van den Aardweg M, Smits A, Willems S, Topsakal V. Chondromyxoid Fibroma of the Mastoid: A Rare Entity with Comprehensive Literature Review. J Int Adv Otol 2020; 16(1): 117-22.

Chondromyxoid fibroma (CMF) is the least commonly occurring bone tumor of cartilaginous origin. It is usually situated in the metaphysis of long bones of the lower limbs. Localization of the tumor in the skull is extremely rare. The definitive diagnosis is challenging and depends on radiological and histological examinations. To the best of our knowledge, only 14 cases of CMF involving the temporal bone have been reported to date, 7 of which were within the mastoid. The most common clinical symptom is headache; however, these symptoms vary greatly according to site, size, and extension of the lesion. Surgical removal is the treatment of choice. A literature review of the diagnostic challenges, histological difficulties in differential diagnosis, imaging, clinical features, and recommended modalities of treatment have been discussed in the present case.

KEYWORDS: Chondromyxoid fibroma, differential diagnosis, mastoid neoplasm, skull base lesions, temporal bone tumor

INTRODUCTION

Chondromyxoid fibroma (CMF) is a rare, slow-growing, benign tumor of chondroplastic origin that was first reported as a distinct entity by Jaffe and Lichtenstein in 1948. It represents less than 5% of all bone tumors. Involvement of the metaphysis of the long bones, particularly those around the knee joint, is considered to be the most common site occurrence of this lesion. The overall incidence of CMF in the craniofacial bone ranges from 2% to 5%, while isolated temporal bone involvement is particularly rare. In the skull, CMF develops from embryonic cell rests that are entrapped at the suture lines during endochondral ossification. No predisposing factors have been described; however, it is believed that this tumor has a genetic origin. The genetic mechanism underlying the pathogenesis of CMF, despite extensive target gene analyses, remains poorly understood. Recurrent cytogenetic findings have implicated gene(s) on chromosome 6. Associations with recurrent rearrangements of chromosome bands 6p23-25, 6q12-15, and 6q23-27 have been reported. Although radiological images show characteristic features, an ultimate diagnosis cannot be made with imaging alone and biopsy is necessary for histopathological examination. Since this lesion is so rare in the temporal bone, we have shared our case and the management strategy we employed based on a review of the literature.

METHODS

A chondromyxoid fibroma in the mastoid part of temporal bone was reported. The clinical presentation and key radiographic and histopathological features of the tumor were discussed. Also, the literature was reviewed to further characterize this pathology and to assess management strategies.

A literature review in PubMed, Scopus, the Cochrane library, and Embase was conducted using the search terms chondromyxoid fibroma in combination with temporal bone and/or mastoid and/or skull base. A total of 131 reports were retrieved and their abstracts were screened. Non-English reports and lesions outside the temporal bone were excluded. Also, other histopathological findings that were not consistent with CMF were excluded from further reading.
RESULTS

An otherwise healthy 21-year-old man was referred to our tertiary medical center for the evaluation of an incidental computed tomography (CT) finding within his right temporal region following blunt head trauma. He was employed as a construction worker with an irrelevant past medical and surgical history. He had no prior otological complaints and presented normal findings on otolaryngological and neurologic physical examination. His pure tone and speech audiometry revealed normal thresholds for age and sex.

The CT scan demonstrated a soft tissue lesion infiltrating almost the entire right mastoid with the destruction of bony septa and a thin bony cortex around the lesion, except for partial erosion toward the cerebellum. The posterior fossa dura appeared intact. Magnetic resonance imaging (MRI) displayed a 4.7 cm×2.6 cm×3.6 cm lobulated mass in the right mastoid part of the temporal bone, extending anteriorly to the jugular foramen and posteriorly to the bony plate overlying the posterior fossa dura, which was eroded without evidence of intracranial extension (Figure 1). The lesion had a diffuse hypointense signal on T1-weighted images and a heterogenous hyperintense signal on T2-weighted imaging, with significant post-gadolinium diffuse contrast enhancement (Figure 2). Because of its heterogeneous nature and the involvement of the jugular vein, the radiological report mentioned a possible glomus jugulare tumor. However, magnetic resonance angiography showed the tumor to be avascular. Since a neoplastic process was mentioned in the differential diagnosis, surgical access to obtain a tissue diagnosis was recommended.

The patient was taken to the operating room and mastoidectomy and surgical debulking were performed via a retro-auricular approach. An irregular, firm, and bloody lesion was excised intraoperatively for histopathological evaluation (Figure 3).

Microscopic examination revealed a distinct lobular architecture, with cellular areas of chondrocytes and stellate cells at the periphery of the lobules alternating with central myxoid areas that were less cellular and showed cystic degeneration. The cells ranged from spindled to stellate, containing round to ovoid normochromatic nuclei with indistinct to eosinophilic cytoplasm. There were no areas of necrosis and no discernible mitotic activity. These features are consistent with the histopathological diagnosis of chondromyxoid fibroma.

Our patient recovered well after the debulking procedure. After he was completely recovered, he was counseled about CMF in the temporal bone being a benign lesion that required further surgery. We advised complete resection but the patient refused further treatment. Therefore, as the second-best option, periodic follow-ups have been planned.

Our review identified only 14 previous case reports of CMF in the temporal bone, 7 of which were within the mastoid. All published cases were studied, a summary of which is shown in Table 1. This includes patient demographics, clinical presentation, radiological findings, and management strategies.

An analysis of the 14 reports with our case revealed a male to female ratio of 60%-40%. The vast majority (67%) of patients were affected by CMF on the left temporal bone. The mastoid was by far the most commonly affected site at 53%. The second most popular site was
equally shared between the petrous and squamous portion of the temporal bone at 20% each, while only 7% of CMF were noted in the tympanic part of temporal bone. The mean age of the patients at the time of surgery was 37 years (range: 12-67 years).

**DISCUSSION**

Chondromyxoid fibroma is the least common neoplasm of cartilaginous origin and represents less than 0.5% of all bone tumors. There is a slight predilection for males with peak incidence being in the second and third decades of life. There is a slight predilection for males with peak incidence being in the second and third decades of life. The clinical presentation varies according to the size, site, and extension of the lesion. In cases with skull involvement, it presents clinically as headache, bony swelling, neuralgia, facial pain, hearing loss, otalgia, convulsions, diplopia, exophthalmos, and facial nerve paralysis (Table 1).

Although the radiographic features of such lesions are characteristic, due to its rarity, CMF is not usually at the top of a radiologist's list of possible diagnoses. X-ray shows a radiolucent lesion with well-defined margins. CT scan findings of CMF demonstrate a relatively homogenous, well-circumscribed, osteolytic lesion with a wavy bony margin.

| Study                  | Age(y) | Sex | Presentation                  | Side | Lesion site & size                                      | Management strategy                                      |
|------------------------|--------|-----|-------------------------------|------|-------------------------------------------------------|--------------------------------------------------------|
| Tarhan et al. [20] 2000 | 44     | F   | Left side facial pain         | Left | 2.5 x 2 x 1.5 cm, in the temporal bone, compressing the temporal lobe | Complete resection                                      |
| Haberal et al. [21] 2001 | 45     | F   | Left side facial pain & numbness | Left | 2.5x2.5x1.5 cm in the anterior portion of the left tympanic temporal bone | Complete macroscopic resection after recurrence          |
| LeMay et al. [22] 1997  | 22     | M   | Headaches & mild hearing loss  | Left | 6 x 4.5 x 3 cm, from the superior & medial portion of the mastoid | Complete resection via craniotomy                        |
| Oh et al. [23] 2013     | 38     | F   | left-sided hearing loss       | Left | 4.1-cm mass within the mastoid bone                     | Complete excision with facial nerve skeletonization     |
| Kitamura et al. [24] 1989 | 48     | M   | Left aural fullness, tinnitus & dizziness | Left | Mastoid, extending to the occipital bone, foramen magnum & jugular foramen | Incomplete resection due to bleeding. Followed by revision one year later |
| Maruyama et al. [25] 1994 | 67     | M   | Headache, & facial nerve paralysis | Right | Petrous apex & extended into the posterior fossa & the jugular foramen | Incomplete resection due to jugular foramen involvement |
| Frank et al. [26] 1987  | 26     | M   | Diplopia                      | Left | Petrous apex, extending into sphenoid sinus, & cavernous sinus area | Resection via sub-temporal approach; V1 sacrificed     |
| Patino-Cordoba et al. [27] 1998 | 20 | M   | Hearing loss                  | Left | Mastoid with inferior extension                         | Resection via infratemporal fossa approach, with neck dissection |
| Suzuki et al. [28] 1999 | 49     | M   | Visual disturbance            | Left | Squamous temporal bone                                  | Preoperative embolization & resection                  |
| Otto et al. [29] 2007   | 58     | F   | Acute-onset vertigo & syncope  | Right | 1.7 x 1.3 x 1.5 cm, filling the mastoid with erosion of the posterior fossa plate | Complete resection via mastoidectomy                    |
| Thompson et al. [30] 2009 | 33     | F   | Progressive facial nerve paralysis | Left | Mastoid & protruded out of the stylomastoid foramen | Complete resection with interposition of a sural nerve graft |
| Wang et al. [31] 2011   | 31     | M   | Headache                      | Right | 2.5 x 2 x 1.5 cm in the petrous apex                     | Complete resection via craniotomy                      |
| Sharma et al. [32] 2012 | 12     | F   | Headache with left earache    | Left | 4 x 3.7 x 4.4 cm in the squamous part of temporal bone   | Complete excision                                      |
| Gupta et al. [33] 2012  | 42     | M   | otalgia                       | Right | 1.6 x 1.2 cm eroding the mastoid, facial nerve canal & sigmoid plate | Biopsy via transmastoid approach & definitive resection was scheduled |
| Our case                | 21     | M   | Incidental finding            | Right | 4.7 x 2.6 x 3.6 cm in the mastoid, & extended into the posterior fossa & the jugular foramen | Biopsy via transmastoid approach                      |

F: female; M: male; V1: ophthalmic branch of the trigeminal nerve
In the case presented, all the radiological features were characteristic of CMF. Nevertheless, a definite diagnosis could not be made and rhabdomyosarcoma could not be excluded. Therefore, biopsy was necessary to achieve a definitive diagnosis.

The differential diagnosis of CMF based on histopathological criteria includes several chondroid lesions such as chondroblastoma, enchondroma, chondrosarcoma, chordoma, giant cell tumor, and fibrous dysplasia (Table 2). The World Health Organization defines CMF as a benign tumor characterized by lobules of spindle-shaped or stellate cells that proliferate within an abundant intercellular matrix, which can be either myxoid or chondroid in nature.

Intramural calcification is reported to be more closely related to craniofacial CMF than CMF in long bones (4-10). Consistent with these results, our case also exhibited matrix calcification that was apparent on CT. MRI is used to determine the extension of the lesion to the dura and the intracranial space. Chondromyxoid fibromas are typically hypointense (low signal) on T1-weighted MRI and heterogeneously hyperintense (high signal) on T2-weighted imaging. The lesion is markedly enhanced after gadolinium contrast administration (11-13).
er, histopathologically it lacks stellate cells [17]. Immunohistochemical analysis is not helpful in differentiating chondrosarcoma, chondroblastoma, and CMF since they all express vimentin and S100 protein [11, 17]. Conversely, immunohistochemical analysis is useful in diagnosing the chondroid form of a chordoma, as the expression of cytokeratin and epithelial membrane antigen is positive in chordoma and negative in CMF. Chordomas can be also be distinguished from CMF by the anatomical location, as they are mostly located in the midline and display more bone destruction with extrasosseous extension [18]. Fibrous dysplasia has characteristic radiological and histopathological features, however, myxoid changes might occur, which may result in another diagnostic challenge. Chondromyxoma-like low-grade osteosarcoma can mimic CMF, which may also be a challenge for the cytologist to identify. Nevertheless, osteosarcomas often show lobular arrangement of cartilaginous areas and the presence of osteoid. Lastly, giant cell tumor was considered in the differential diagnosis. However, it lacks chondroid differentiation and contains numerous clustered giant cells [19].

Apart from its rarity and unexpected diagnosis, another histopathological diagnostic challenge is the excision of a small biopsy specimen that contains only part of the characteristic features of CMF. Therefore, the ultimate diagnosis is usually reached after complete surgical excision. The surgical approach in skull base lesions is to drill out the tumor, removing as much as possible. The risks of post-operative neurological deficit have to be weighed against benefits of complete excision [4, 8, 9, 11].

With regard to the current review, follow-up data was only available in less than half of the cases, ranging from 3 months as reported by LeMay et al. [5] and Morimura et al. [18] to 4 years as described by Oh et al. [20]. Interestingly, a 1-year post-operative follow-up showed recurrence and required revision surgery [4].

The surgical challenges seem to depend on the site, size, and extension of the lesion. Though complete surgical excision was described in 12 reports of CMF of the temporal bone, 6 of these patients experienced major post-operative complications. These complications included hearing loss, hoarseness, sacrifice of the ophthalmic branch of the trigeminal nerve, sacrifice of the facial nerve, and recurrence. Biopsy was carried out with definitive resection planned in more than one report, similar to the presented case. Incomplete resection due to encountering a challenging surgical situation was also mentioned. Unfortunately, the follow-up of these cases were not reported [21, 22].

Although malignant change of CMF is very low, radiotherapy does appear to increase the incidence [16, 22]. Nevertheless, some authors use radiotherapy for incomplete resection or recurrence after surgical excision, particularly for skull base lesions [11, 12, 17, 21].

CONCLUSION

Chondromyxoid fibroma is a benign but potentially aggressive tumor. Involvement of the skull base, particularly the temporal bone, is extremely rare and therefore it is difficult to establish treatment protocols that are universally applicable. Although CMF has a very characteristic radiological appearance, histological differentiation from other lesions with chondroid origin necessitates biopsy. Whenever possible, complete resection is recommended, since radiotherapy for inoperable or recurrent lesions carries the risk of malignant transformation.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – V.T., S.W.; Design - A.E., V.T.; Supervision - V.T., S.W.; Data Collection and/or Processing - A.E., M.A., A.S.; Analysis and/or Interpretation - A.E., M.A., A.S.; Literature Search - A.E., M.A.; Writing – A.E., M.A., A.S.; Critical Reviews - V.T., S.W.

Acknowledgements: We would like to thank the pathology department UMC Utrecht for providing the images.

Conflict of Interest: The authors declare no potential conflicts of interest.

Financial Disclosure: The authors declared that this study has received no financial support.

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