

Comparison of the Results of Endoscopic Versus Transcranial Surgery for Petrous Apex Cholesterol Granuloma

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1. Abstract

1.1. Objectives and Background: Cholesterol granuloma is a special type of middle ear granulation and is considered as the most common cystic lesion of the petrous apex. We intend to compare the surgical outcome in endoscopic surgery with traditional transcranial approach.

1.2. Materials and Methods: From 2012 to 2020, all patients who were surgically treated for symptomatic cholesterol granulomas of the petrous apex were included.

In one group drainage with or without removal of the cyst lining was achieved through the middle fossa or infra cochlear approaches. The second group was operated through endoscopic transnasal surgery. Relief of symptoms, postoperative cranial nerve function, clinical and radiologic recurrence, and need for further surgical intervention were evaluated.

1.3. Results: In the endoscopy group total radiologic resection was achieved in 71.4 % and in the craniotomy group in 87.5 %. Clinical improvement of symptoms was observed in 77.2 % in the endoscopy and all patients in the craniotomy group. 1 patients required revision surgery for recurrent symptoms and lesion in the endoscopy group.

1.4. Conclusions: Determination of the appropriate surgical approach to the petrous apex is based on hearing status in the affected

ear and on the anatomic relationships between the lesion and the surrounding neurovascular structures. The endoscopic approaches are promising and less invasive and their outcome are comparable with transcranial surgeries with lower morbidities.

2. Introduction

Cholesterol granuloma is a special type of middle ear granulation tissue which is prone to bleeding and is a frequent cause of a hemotympanum. It is a rare, benign tumor or cyst that develops at the tip of the petrous. Pathologically it is an expansile cystic lesion containing cholesterol crystals surrounded by foreign body giant cells, fibrous tissue reaction and chronic inflammation [1].

Cholesterol granulomas of the petrous apex are uncommon (0/6 per million) but the most common location at the skull base is petrous apex [1].

At the skull base, it occurs secondary to chronic obstruction of air cells within the petrous pyramid [2].

Cholesterol granuloma has been identified for more than a hundred years ago and was first described in 1894 [3]. It mostly affects young adults and has no sexual preference [4].

The presentation depends on location: if located in the middle ear it presents with conductive hearing loss, dizziness and cranial nerve dysfunction. If located at the petrous apex it manifests with conductive hearing loss due to middle ear effusion, cranial nerve

dysfunction and tinnitus. The lesion may be asymptomatic and diagnosed incidentally [4, 5].

Cholesterol granuloma should be included in differential diagnosis when evaluating temporal bone masses. Cholesterol granuloma should be distinguished from other petrous apex/middle ear lesions such as: normal asymmetry of fatty marrow, pneumatization, middle ear effusion, cholesteatomas, skull base tumors (primary, metastases, chondrosarcoma). There are a few lesions can have similar radiologic appearances. Hydrated mucocoele is rare, but may have identical signal on MRI (high protein=high T1, high water=high T2, no enhancement).

Thrombosed ICA aneurysm has different signals in MRI and is usually more complex because of layered blood products, and has flow void centrally if not completely thrombosed [6].

Cholesterol granulomas are generally diagnosed after patient presents with symptoms and physician take a medical history (usually patient has a history of chronic otitis media) and order additional tests, such as CT scan and MRI.

Accurate radiologic diagnosis of petrous apex (PA) cholesterol granuloma is essential to subsequent treatment. cholesterol granuloma in CT scan, typically there is an expansile well-marginated lesion with thinned overlying bone. This may be dehiscent when the lesion is large. Faint peripheral enhancement may be seen [7]. In MRI study, T1 MRI shows overall high signal due to cholesterol component and methemoglobin+/- and low signal rim due to hemosiderin, and thinned adjacent bone. In T2 MRI there is central high signal and peripheral low signal due to hemosiderin rim, thinned adjacent bone and does not attenuate. On FLAIR, cholesterol granuloma remains high signal in fat suppression [8]. T1 MRI with contrast shows no enhancement. In DWI/ADC, there is no restricted diffusion [9].

Generally, patients with symptoms are managed surgically while non-surgical management is advocated for asymptomatic patients. Surgical management of cholesterol granuloma is performed primarily by drainage procedures via endonasal or open approach. One accepted surgical treatment is by insertion of ventilation tubes through a subcochlear or infralabyrinthine approach. In both approaches hearing can be preserved [10]. The open approaches include the infracochlear [11], infralabyrinthine [12], middle fossa, suboccipital [13], and translabyrinthine approaches [14, 15]. Traditionally neurosurgeons chose the middle cranial fossa approach [15].

Although drainage procedures are often useful for a time, the ongoing secretion of bloody sludge often obstructs the drainage path. Recurrence ranges from 10 to 60% of patients [11].

In recurrent cases, the solution would be to separate the marrow compartment from the cyst cavity. This could be accomplished by middle cranial fossa approach.

Occasionally, with laterally located lesions, a transsphenoidal route of drainage is elected.

Three variations of endonasal approaches are described: the transsphenoid approach, transclival approach with or without internal carotid artery (ICA) lateralization, and transpterygoid infrapetrous approach [10].

The transsphenoidal approach (extra axial procedure) was first described by Montgomery in 1977 [16]. Fucci then modified this in 1994 using a nasal endoscope [17].

As the incidence and prevalence of cholesterol granuloma is very rare, there are only a few studies that compare the surgical outcome between endoscopic and transcranial approaches [12-16].

3. Material and Methods

In our study all the cases referred to our clinic and operated due to symptomatic skull base cholesterol granuloma from January 2012 to September 2020 were included. The demographic data such as age, sex, underlying diseases were recorded. The radiologic characteristics were recorded based on the CT scan and MRI studies. The patients were divided into two groups whether operated endoscopically or through transcranial approaches.

Our criteria for endoscopic endonasal surgeries were: developed sphenoid sinus, tumor location adjacent to sphenoid or posterior ethmoids, safe location of internal carotid artery and optic nerve relative to the lesion. Other cases were operated transcranially. The surgical outcome was recorded by the remnant size on post op image and clinical complaints of the patients. The recurrent cases were also recorded in the two groups. The follow up periods were determined by the survey of neurosurgery clinic files.

4. Results

From 2017 to 2020, 15 patients were operated in our center with the diagnosis of petrous apex cholesterol granuloma. All the patients were symptomatic. In all the patients had CT and MR studies with and without contrast injections were performed. 8 cases were male and 7 cases were female. The mean age at surgery was 42.8 years. 8 patients (53.3 %) were operated by transcranial approaches and 7 patients (46.7 %) were operated through endoscopic surgeries.

The mean follow-up in our patients was 32 months. Total Resection was achieved 71.4 % in endoscopic group. In this group symptoms improved completely in 77.2 % of cases. Epistaxis occurred in 1 case 14.2 %. Recurrence occurred in 1 case (14.2 %) 21 mo after surgery that operated again with transnasal approach and improved.

In the transcranial group, total resection achieved in 87.5% of cases. Symptoms recovery occurred all cases. We did not encounter any complication in the group.

The size of the lesion did not influence the surgical outcome.

5. Discussion

The selection of safest surgical approach depends on: position of the lesion relative to ICA, degree of tumor extension and pathology of the lesion.

There are several advantages in using the endoscopic approach; reduced risk to the facial nerve and vestibulo-cochlear function (compared with middle and

lateral fossa approaches), reduced operative time and hospital stay, and ease of nasal endoscopic examination of the postoperative site in the out-patient department [18]. The outcome of endoscopic group was not significantly lower than the craniotomy group.

Mattox reported that the addition of endoscopic visualization to the traditional microsurgical approaches allowed exposure of areas within the lesions and removal of septae that would not have been identified with the operating microscope alone [19].

Several trans-cranial approaches have been used to treat these lesions, the choice of which depends on the patient's preoperative hearing status and the lesion's location in relation to critical neurovascular structures [20-23]. These traditional lateral skull base approaches expose the inner ear and facial nerve to potential structural damage as well as add morbidities of any intracranial procedure [22]. They also have the shortcoming of often producing a relatively narrow bony opening, potentially compromising long-term drainage and preventing the use of stents between the aerated cavity and the sphenoid sinus. In addition to having recurrence rates as high as 60%, repeat trans-cranial surgeries for recurrent lesions may be associated with significant morbidities [20, 21].

6. Conclusion

The best method of surgical drainage is not clearly documented. Recently, the endoscopic endonasal approach has gained popularity in the neurosurgical community. This less invasive approach is attractive for the initial surgical management of symptomatic petrous apex cholesterol granuloma and possibly even more so for symptomatic recurrent skull base cholesterol granuloma.

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