Large Cholesterol Granuloma Arising From the Frontal Sinus
—Case Report—

Hidenobu Ochiai, Yuzo Yamakawa*, Tsuyoshi Fukushima, Shinichi Nakano, and Shinichiro Wakisaka

Department of Neurosurgery, Miyazaki Medical College, Miyazaki; *Department of Neurosurgery, Sasebo Kyousai Hospital, Sasebo, Nagasaki

Abstract
A 59-year-old male presented with a large cholesterol granuloma arising from the frontal sinus manifesting as a large, fluctuated, soft mass in his brow, compressing left eye. Skull radiography showed dilation of the frontal sinus. Computed tomography and magnetic resonance imaging revealed a cystic mass extending into the left orbit and anterior cranial fossa. Gross inspection at the frontal craniotomy showed mucinous, dark green fluid intermingled with shining material. The histological diagnosis was cholesterol granuloma with epithelial lining. Large cholesterol granuloma with facial deformity is always associated with bone and cosmetic problems. Wide opening of the frontal sinus followed by cyst wall removal and plastic repair of the skull is necessary.

Key words: cholesterol granuloma, frontal sinus

Introduction
Cholesterol granuloma usually arises in the middle ear cavity, especially in the mastoid air cell and tympanic cavity. Cholesterol granuloma arising from the paranasal sinus is uncommon. Cholesterol granuloma is generally considered to be caused by poor ventilation and impaired drainage. Orbital frontal cholesterol granuloma is uncommon, although some cases have been reported. Most cases arose adjacent to the lacrimal fossa, whereas cholesterol granuloma originating from the frontal sinus is rare. Treatment of cholesterol granuloma is usually simple evacuation and drainage, but large cases causing facial deformity require more intervention for cosmetic purposes. We report a case of large cholesterol granuloma of the frontal sinus extending to the orbit and anterior cranial fossa.

Case Report
A 59-year-old male was hit on the forehead by a small stone during mowing. He did not pay much attention to this injury, which was limited to a laceration wound of the forehead without epistaxis. Six months after the injury, a swelling gradually formed in his brow and became a nodular mass. His left eye was displaced infero-laterally as the mass grew. One year after the injury, he felt decreased visual acuity in the left eye and was admitted to our department.

On admission, a mass of 6 cm diameter was seen in the left brow. He reported no pain associated with the mass. The mass was soft and showed fluctuation, with a bony hard portion at the surface of the mass. His left eye were remarkably displaced infero-laterally (Fig. 1). Visual acuity of the left eye was severely impaired, and he could not move his left eye in the superior direction. He had no previous history of nasal polyp. Skull radiography revealed the frontal sinus was remarkably enlarged (Fig. 2). Computed tomography (CT) and magnetic resonance (MR) imaging showed the mass arose from the frontal sinus and extended to the anterior cranial fossa and left orbit (Fig. 3A, B). The mass appeared as hypodense on CT (Fig. 3A) and hyperintense on both T1-, and T2-weighted MR imaging (Fig. 3B, C). The surface of the mass was covered with thinned bone at the periphery (Fig. 3A, D). The supero-medial wall of the orbit was extensively eroded (Fig. 3D). Mucocele of
the frontal sinus was considered in the diagnosis, but the intensity pattern of the mass did not always coincide with those of mucocele. Decompression for the left eye including cosmetic correction was performed under a diagnosis of mucocele with hematoma or the cholesterol granuloma.

Surgery was performed under general anesthesia. Bicoronal skin incision was performed and the skin flap was turned to expose the anterior wall of the mass. The surface of the mass was covered partially with thinned bone. Removal of this thin bone revealed a thin fibrous membrane. Incision of this fibrous membrane exposed dark green fluid intermingled with shining material. The fluid contained many cholesterol crystals. After evacuation of the cyst content, the cyst membrane was separated from the dura mater and periorbit as far as possible. The anterior calvarium of the frontal bone and the supero-medial wall of the orbit were expansively eroded, and the cyst wall adhered tightly to the dura mater and periorbit. After stripping of the cyst wall, erosive destruction of the frontal bone was repaired using Cemex isoplastic cranioplasty kit (TECRES, Verona, Italy).

Histological examination showed the cyst wall was composed of thick fibrous granulation tissue associated with cholesterol clefts. Thin epithelial lining was seen in some places. These findings were

Fig. 1 Photograph illustrating the huge cholesterol granuloma of the frontal sinus and the lateral-inferior displacement of the eyeball.

Fig. 2 Skull radiograph showing the left frontal sinus is remarkably dilated and opacified.

Fig. 3 A: Computed tomography (CT) scan showing the cyst content is hypodense. B, C: T1-weighted coronal (B) and T2-weighted axial (C) magnetic resonance images showing the cyst content as hyperintense. D: Three-dimensional skull bone CT revealing expansive destruction of medial and superior orbital wall.
thought to indicate cholesterol granuloma arising from the frontal sinus (Fig. 4).

The next day of the operation, his visual acuity and limitation of ocular movement were improved, but the infero-lateral displacement of his left eye persisted. However, one month after the operation, the eyeball had returned to the normal position completely (Fig. 5).

**Discussion**

Cholesterol granuloma is a histopathological entity caused by a foreign body reaction against cholesterol crystal. The pathogenesis of cholesterol granuloma is still unclear, but the most likely primary cause is obstruction of air drainage in the middle ear. Disturbance of air drainage would result in negative pressure in the air cavity secondary to absorption of air into the mucosa. As a result, mucosal edema and hemorrhage might occur. Hematoma from the mucosal bleeding would not be absorbed, resulting in conversion to cholesterol crystals, followed by foreign body granuloma formation. In contrast, the mucosa in the paranasal cavity produces mucinous fluid. Therefore, obstruction of the drainage may produce mucocele. The key factors for the formation of cholesterol granuloma in the paranasal cavity may be a closed cavity containing exudate and hematoma.

Cholesterol granuloma in the frontal sinus may be caused by disturbance of air drainage in the frontal sinus by a middle nose polyp (Table 1). In our case, no causative nasal obstruction such as nasal

![Fig. 4 Photomicrograph of the surgical specimen showing cholesterol granuloma. HE stain, ×100.](image1)

![Fig. 5 Photograph showing the left eyeball has repositioned one month after the operation.](image2)

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Author (Year)</th>
<th>Age/ Sex</th>
<th>Symptom</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hellquist et al. (1984)</td>
<td>57/M</td>
<td>pain above rt eye, slight exophthalmos</td>
<td>radical operation of frontal sinus</td>
</tr>
<tr>
<td>2</td>
<td>Buttler and Grossenbecher (1989)</td>
<td>26/M</td>
<td>proptosis of lt eye</td>
<td>radical operation of frontal sinus</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>37/M</td>
<td>exophthalmos, deviation of eyeball (down and outwards), lid edema and chemosis, diplopia</td>
<td>broad opening of frontal sinus, clearance and drainage of frontal sinus</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>60/F</td>
<td>retrobulbar pain, rt facial pain</td>
<td>frontal cranioplasty, clearance of granuloma</td>
</tr>
<tr>
<td>5</td>
<td>Zaunbauer et al. (1992)</td>
<td>60/M</td>
<td>retrobulbar pain, lid edema, exophthalmos</td>
<td>frontal cranioplasty, clearance of granuloma</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>37/M</td>
<td>suprabulbar pain, diplopia, lid edema, chemosis, exophthalmos</td>
<td>frontal cranioplasty, clearance of granuloma</td>
</tr>
<tr>
<td>7</td>
<td>Chiantelli et al. (1993)</td>
<td>80/F</td>
<td>frontal mass, deviation of eyeball (down and outwards)</td>
<td>frontal sinus opening, anthrostomy, removal of cyst content</td>
</tr>
<tr>
<td>8</td>
<td>Present case</td>
<td>59/M</td>
<td>frontal mass, diplopia, deviation of eyeball (down and outwards)</td>
<td>frontal cranioplasty, clearance of granuloma</td>
</tr>
</tbody>
</table>

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polyp, chronic paranasal sinusitis, or other tumorous lesion was observed. Nevertheless, our patient had a history of the blow of the frontal forehead. We propose the following sequence of events. First, a hemorrhage in the frontal sinus occurred after the blow. The blood coagulated and was retained in the frontal sinus, causing obstruction of air drainage. No escape of blood from the nasal cavity as epistaxis occurred, so the blood coagulated, and the deposition of cholesterol crystals finally caused cholesterol granuloma.

Cholesterol granuloma of the frontal sinus has no characteristic symptoms. Symptoms may be caused by the extension of the granuloma to the orbit, and usually the roof of the orbit is eroded and destructed.3) The main symptoms are bulging of the forehead and lateral-inferior displacement of the eye, accompanied by mass extension. In contrast, orbitofrontal cholesterol granuloma causes medial-inferior displacement of the eye, because the orbitofrontal cholesterol granuloma arises adjacent to the lacrimal fossa.7,11,15,21) Cholesterol granuloma has a characteristic neuroimaging appearance. T1- and T2-weighted MR imaging show a hyperintense mass except for the margin of the cyst, and usually without enhancement by gadolinium-diethylenetriaminepenta-acetic acid injection.9,12–14,17,19) However, mucocele with intra-luminal hemorrhage often shows a similar intensity pattern.20) Puncture and investigation of the cyst content may be useful to differentiate cholesterol granuloma from mucocele with hemorrhage. In our case, we did not puncture the cyst preoperatively, because the mass had destroyed the inner table of the skull, and plastic repair of the anterior skull base after craniotomy would be needed whether the lesion was cholesterol granuloma or mucocele. In a large case such as ours, three-dimensional bone CT of the skull is useful to image the bone destruction and indicate the ultimate cranioplasty including intracranial strategy.

Treatment for cholesterol granuloma arising in the middle ear cavity requires only drainage of the cyst content to improve the air drainage of the air cells.8,20) Cholesterol granuloma arising from the frontal sinus without facial deformity may also be treated by only drainage of the cyst content. However, large cholesterol granuloma with facial deformity, such as our case, is always associated with destruction of the skull bone and cosmetic problems. Wide opening of the frontal sinus followed by cyst wall removal and plastic repair of the skull is necessary.

References

Frontal Cholesterol Granuloma

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Address reprint requests to: H. Ochiai, M.D., Department of Neurosurgery, Miyazaki Medical College, 5200 Kihara, Kiyotake-cho, Miyazaki-gun, Miyazaki 889-1692, Japan.