Selective transarterial embolization for arterial hemorrhage after upper third molar extraction: illustrative cases

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BACKGROUND The present report describes 2 cases of arterial bleeding after removal of the upper third molar that were successfully treated with selective transarterial embolization.

OBSERVATIONS The first patient underwent removal of the left upper third molar. A few hours later, facial swelling and massive bleeding appeared near the extraction socket involving the posterolateral wall of the maxillary sinus. Angiography showed a pseudoaneurysm involving the posterior superior dental artery, and the lesion was selectively embolized with an N-butyl cyanoacrylate (NBCA)-lipiodol mixture. The second patient underwent removal of the left upper third molar, and massive bleeding occurred from the extraction socket involving the greater palatine foramen. Angiography revealed the pseudoaneurysm of the greater palatine artery, and the lesion was selectively embolized with an NBCA-lipiodol mixture. Both patients were discharged uneventfully, and no recurrent bleeding was observed during the 82- and 5-month follow-up periods.

LESSONS Massive arterial bleeding after a third molar extraction occurs from either the posterior superior dental artery or the greater palatine artery, which is associated with the location of the extraction socket. Selective transarterial glue embolization is a useful option for the treatment of arterial bleeding after the removal of the upper third molars.

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KEYWORDS anatomy; transarterial embolization; removal of third molar; maxillary artery; complication

Arterial hemorrhage after a third molar removal is rare,1 but it can be a life-threatening complication. Endovascular embolization has been used for the hemostasis of significant bleeding after third molar extraction,2 however, only sporadic case reports have been published in the literature.3–7 Knowledge of the arterial anatomy relevant to the third molar tooth is important for successful selective embolization without the development of complications. In particular, the upper third molar is located deep within the maxilla, which has a more complicated vascular supply than the lower third molar.

Herein, we review and demonstrate 2 cases of arterial bleeding after upper third molar extractions, which were treated via selective transarterial embolization with glue, and we discuss the relevant vascular anatomy.

Illustrative Cases

Case 1

A 35-year-old female without a significant medical history underwent the removal of the left upper third molar. Facial swelling and massive bleeding near the extraction socket appeared 3 hours later. Contrast-enhanced computed tomography (CT) was performed based on a suspicion of arterial bleeding, and the CT revealed a pseudoaneurysm that was superior and lateral to the extraction socket at the maxillary tuberosity at the posterolateral wall of the maxillary sinus (Fig. 1A). The patient was not in a shocked state, and she subsequently underwent angiography and embolization while under local anesthesia. A 5-Fr guiding sheath was advanced into the left external carotid artery (ECA). Selective angiography of

ABBREVIATIONS CT = computed tomography; D5W = 5% dextrose solution in water; DPA = descending palatine artery; ECA = external carotid artery; GPA = greater palatine artery; LPA = lesser palatine artery; MA = maxillary artery; NBCA = N-butyl cyanoacrylate; PSDA = posterior superior dental artery.

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the left maxillary artery (MA) showed a pseudoaneurysm arising from the descending portion of the posterior superior dental artery (PSDA) (Fig. 1B). A 1.6-Fr/2.7-Fr coaxial system (Carnelian Marvel, Tokai Medical Products; Sniper 2 high-flow system, Terumo Clinical Supply Co. Ltd.) was navigated into the PSDA (Fig. 1C), just proximal to the pseudoaneurysm. Then, an N-butyl cyanoacrylate (NBCA)-lipiodol mixture (2:1 ratio) was injected through the microcatheter that was primed with a 5% dextrose solution in water (D5W) prior to embolization. The embolic material filled the pseudoaneurysm and the PSDA just distal and proximal to the pseudoaneurysm (Fig. 1D). Left ECA angiography after embolization showed disappearance of the pseudoaneurysm. No complications were observed during or after embolization. The patient was discharged uneventfully 2 days after the embolization. During the 82-month follow-up period, no recurrent bleeding was observed.

Case 2
A 78-year-old male underwent removal of the left upper third molar before surgery for an infected (or regrowing) abdominal aortic aneurysm post-endovascular aortic repair. He had been taking an antiplatelet drug since he had a percutaneous coronary intervention 13 years earlier. Repeated bleeding from the extraction site occurred after the extraction, which was treated with packing. On postoperative day 28, recurrent massive bleeding occurred. His laboratory data showed anemia (hemoglobin: 9.2 g/dL), and contrast-enhanced CT revealed a pseudoaneurysm in the extraction socket involving the greater palatine foramen (Fig. 2A) located deeply in the maxilla. He subsequently underwent angiography and embolization while under local anesthesia. A 4-Fr guiding sheath was advanced into the left common carotid artery. Left common carotid angiography revealed a pseudoaneurysm of a branch of the ECA. Severe stenosis was also seen at the origin of the internal carotid artery (not shown). Selective angiography of the MA showed a pseudoaneurysm arising from the greater palatine artery (GPA) (Fig. 2B and C). A 1.3-Fr microcatheter (Deflector, Medicoz Hirata) was advanced through a 3.2-Fr inner catheter (Tactics, Technorat Corp.) into the origin of the GPA (Fig. 2D). An NBCA-lipiodol mixture (3:1 ratio) was delivered through the microcatheter that was primed with D5W prior to injection. The embolic material filled the GPA and the pseudoaneurysm. Left ECA angiography after embolization showed disappearance of the pseudoaneurysm (Fig. 2E). No complications were observed, and the patient was uneventfully discharged 5 days after the embolization. During the 5-month follow-up period, no recurrent bleeding was observed.
Patient Informed Consent

The necessary patient informed consent was obtained in this study.

Discussion

Third molar extraction is a common procedure in oral and maxillofacial surgery, and it can result in unexpected complications, which can typically include dry sockets, intra- or postoperative bleeding, infection, and paresthesia. These complications occur more often during a lower third molar removal than during an upper third molar removal. The rate of clinically significant bleeding due to third molar extraction has been reported to be 0.2% to 5.8%. Hemorrhagic complications can be associated with systemic or local factors. Systemic factors include coagulation/platelet diseases, liver disease, hypertension, and the use of anticoagulation/antiplatelet drugs. Local factors include abnormal absorption, arteriovenous malformations, and vascular injuries. Generally, most cases of unexpected bleeding during or after extraction are treated with packing/pressure, electrocauterization, and ligation. However, it is often difficult to stop the bleeding by those conventional techniques in cases of arterial hemorrhage with pseudoaneurysms. Recently, several case reports have demonstrated the utility of transarterial embolization for hemostasis of arterial bleeding after third molar extraction. For successful transarterial embolization, target embolization with both the distal and proximal sides of the pseudoaneurysm is recommended to prevent the risk of rebleeding from collateral blood flow via the anastomosis. In our 2 cases, we used a coaxial system or a distal access catheter to achieve successful embolization. The system appears to be useful for successful catheterization into the injured vessels, and it is important for safe embolization. Nontargeted and/or excessive embolization has the potential risks of rebleeding, organ necrosis, cranial nerve injury, and embolic stroke. Therefore, it is important to understand arterial anatomy relevant to the third molar. The lower third molar is located at the anterior border of the mandibular rami, which are supplied by the inferior dental artery arising from the inferior aspect of the MA at the proximal second segment. The inferior alveolar artery runs antero-inferiorly in the mandible through the inferior alveolar canal. Sagara et al. have described the relationships of the extraction socket of the lower third molar with the inferior alveolar canal and injury of the inferior dental artery and its branch in a case series treated with transarterial embolization. The upper third molar is located inside the maxillary tuberosity, whose cortical bone is thinner and more fragile than the mandible and is likely to fracture during an extraction procedure. Relevant arterial anatomy to the upper third molar is more complicated than that to the lower third molar. To the best of our knowledge, only 6 cases of arterial bleeding after extraction of the upper third molar treated with transarterial embolization have been reported (Table 1). Among the 6 cases, the PSDA is the causative artery of

![FIG. 2. Contrast-enhanced CT reveals a pseudoaneurysm (white arrow, A) within the extraction socket deeply in the maxilla. White arrowheads indicate the greater palatine foramen. The extraction socket involves the left greater palatine foramen. Frontal (B) and lateral (C) views of the left maxillary angiography and frontal view of the selective sphenopalatine angiography (D) show the pseudoaneurysm arising from the GPA (black arrows). A microcatheter was further advanced to the pseudoaneurysm, which was occluded with a 25% NBCA-lipiodol mixture. Left external carotid angiography (E) after embolization shows disappearance of the pseudoaneurysm.]
arterial bleeding in 5 cases. In our 2 cases, 2 different arteries, the PSDA and the descending palatine artery (DPA), were the source of arterial bleeding, both of which originated from the third segment of the MA more distally to the origin of the inferior dental artery.

The PSDA arises from the most proximal portion of the third segment of the MA independently or by a common trunk with the inferior orbital artery (Fig. 3). It runs antero-inferiorly on the lateral surface of the maxillary tuberosity. It feeds the maxillary bone, mucosal membrane of the maxillary sinus, buccal mucosa, and buccinator muscle. It enters the maxillary bone through the superior alveolar canal and runs antero-inferiorly toward the incisor foramen where it anastomoses with the distal branch of the DPA. The DPA originates inferiorly from the deep portion of the third segment of the MA. It runs inferiorly along with the greater palatine nerve through the greater palatine foramen (GPF) and bifurcates into the GPA and the lesser palatine artery (LPA). The GPA and LPA run across the hard palate and feed the hard plate, gingiva, and nasal septum. In the positional relationships of the upper third molar with the 2 arteries, the PSDA locates laterally and close to the molar on the surface of the maxillary tuberosity; therefore, it can be more often injured with excessive force to the superolateral portion of the maxillary tuberosity. In our case of PSDA injury, the pseudoaneurysm was superior and lateral to the extraction socket and caused swelling of the cheek with bleeding. Cheek or facial swelling was seen in 2 of the 6 cases previously reported. The DPA has not been reported to be a causative artery. In our case 2, contrast-enhanced CT showed a pseudoaneurysm, and the extraction socket extended medially and involved the greater palatine foramen in which the DPA runs inferiorly. Contrast-enhanced CT is useful to detect pseudoaneurysms, the potentially responsible arteries, and their relationship with the extraction socket.

All 6 cases reported and our 2 cases of arterial bleeding after third molar extraction were successfully treated with transarterial embolization using NBCA, coils, and/or particles without complications. In our case, the injured portion of the responsible artery was located outside the extraction socket. Therefore, packing or suturing of the extraction socket would have been less effective to control the bleeding, and open surgery would have been highly invasive. Selective transarterial embolization should be considered for uncontrollable arterial bleeding with packing or suturing, and pseudoaneurysms can be detected around the socket on CT images.

Observations

In this report, we describe 2 cases of arterial bleeding after upper third molar extraction along with a literature review. The PSDA and the GPA would be causative vessels of arterial hemorrhage after third molar removal. Endovascular treatment is a useful technique in a situation in which packing and suturing are not effective in order to achieve hemostasis.

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>Age (yrs)/Sex</th>
<th>Side</th>
<th>Chief Complaint</th>
<th>Artery</th>
<th>Endovascular Treatment/ Embolic Material</th>
<th>Result</th>
<th>Complication</th>
<th>Recurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sagara et al., 2013</td>
<td>27/M</td>
<td>Rt</td>
<td>Facial swelling, nasal bleeding</td>
<td>PSDA</td>
<td>sTAE/NBCA, coil</td>
<td>Success</td>
<td>No</td>
<td>NA</td>
</tr>
<tr>
<td>Rawat et al., 2019</td>
<td>24/M</td>
<td>Rt</td>
<td>Nasal bleeding</td>
<td>NA (branch of IMA)</td>
<td>sTAE/NBCA</td>
<td>Success</td>
<td>No</td>
<td>NA</td>
</tr>
<tr>
<td>Pham et al. 2012</td>
<td>51/M</td>
<td>Multi</td>
<td>Oral bleeding</td>
<td>PSDA</td>
<td>sTAE/PVA</td>
<td>Success</td>
<td>No</td>
<td>NR/12 mos</td>
</tr>
<tr>
<td>Benazzou et al., 2009</td>
<td>71/M</td>
<td>Lt</td>
<td>Cheek swelling, oral bleeding</td>
<td>PSDA</td>
<td>sTAE/coil</td>
<td>Success</td>
<td>No</td>
<td>NR/3 mos</td>
</tr>
<tr>
<td>Stiefel et al., 2010</td>
<td>39/M</td>
<td>Lt</td>
<td>Oral bleeding</td>
<td>SDA</td>
<td>sTAE/NBCA, gelatin</td>
<td>Success</td>
<td>No</td>
<td>NR/6 mos</td>
</tr>
<tr>
<td>Sakamoto et al., 1991</td>
<td>21/M</td>
<td>Rt</td>
<td>Oral bleeding</td>
<td>PSDA</td>
<td>TAE/coil, gelatin</td>
<td>Success</td>
<td>No</td>
<td>NA</td>
</tr>
<tr>
<td>Present case 1</td>
<td>35/F</td>
<td>Lt</td>
<td>Facial swelling</td>
<td>PSDA</td>
<td>sTAE/NBCA</td>
<td>Success</td>
<td>No</td>
<td>NR/82 mos</td>
</tr>
<tr>
<td>Present case 2</td>
<td>78/M</td>
<td>Lt</td>
<td>Oral bleeding</td>
<td>DPA</td>
<td>sTAE/NBCA</td>
<td>Success</td>
<td>No</td>
<td>NR/5 mos</td>
</tr>
</tbody>
</table>

IMA = internal maxilla artery; NA = not assessed; NR = no recurrence; PVA = polyvinyl alcohol; SDA = superior dental artery; sTAE = selective transarterial embolization; TAE = transarterial embolization.
Lessons
Selective transarterial embolization is a useful and safe technique for massive arterial bleeding after upper third molar extraction. Understanding the arterial anatomy that is relevant to the third molar is important to perform successful endovascular treatment.

References

Disclosures
The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions
Conception and design: Tokuyama, Kiyosue. Acquisition of data: Tokuyama, Shimada. Analysis and interpretation of data: Tokuyama. Drafting of the article: Tokuyama. Critically revising the article: Kiyosue, Shimada. Reviewed submitted version of the manuscript: Kiyosue, Asayama. Approved the final version of the manuscript on behalf of all authors: Tokuyama. Statistical analysis: Shimada. Administrative/technical/material support: Shimada, Miyamoto. Study supervision: Asayama. Treatment of the tooth extraction fossa: Abe, Kawano.

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