Interventional Radiology and Bleeding Disorders
What the Oral and Maxillofacial Surgeon Needs to Know

Laura Gart, DMD[a], Antoine M. Ferneini, MD[b,c,*]

KEYWORDS

• Embolization • Angiography • Bleeding • AV malformation • Epistaxis • Endovascular techniques • Orthognathic surgery • TMJ ankylosis

KEY POINTS

- Endovascular techniques are essential for controlling acute head and neck bleeding that cannot be controlled by local or systemic measures.
- Angiography is the gold standard for the diagnosis and localization of acute head and neck bleeding.
- The oral and maxillofacial surgeon should refer a patient for an embolization procedure if local measures fail to achieve hemostasis.

INTRODUCTION

Hemostasis in the normal patient population involves the interaction among four different biologic systems: (1) the blood vessel wall, (2) the blood platelets, (3) the coagulation cascade, and (4) the fibrinolytic system. Hemostasis occurs through two independent processes: the coagulation cascade and the platelet activation pathway.[1] Most perioperative bleeding in the maxillofacial region is usually controlled with local measures. Suggested management to control hemorrhage in the head and neck area includes unipolar and bipolar electrocautery, laser ablation, local anesthetics with vasoconstrictors, and direct pressure. However, when bleeding cannot be controlled with local measures, endovascular techniques are indicated to achieve adequate hemostasis.

Uncontrollable epistaxis is another bleeding state that may be encountered in patients. Most cases (70%) are idiopathic, but epistaxis can occur secondary to trauma; tumor; radiotherapy; coagulopathy; or vascular malformations or diseases, such as Osler-Weber-Rendu disease.

Another potential source of bleeding in surgical patients includes arteriovenous malformations (AVMs). Endovascular technology is actually used before surgical resection. More recently, this technology is used to provide complete and persistent occlusion of mandibular AVMs.[2] AVMs are classified based on their blood flow characteristics. AVMs contain enlarged torturous arteries and veins with collateralization from contralateral vessels. The pressure differential compared with the surrounding tissues created by the low-pressure vascular channel creates an environment where rapid shunting and recruitment of peripheral vessels can occur.[3] They are described as high-flow or low-flow. Lesions containing arteries are typically high-flow. Lesions consisting of capillary, venous, lymphatic, and venous-lymphatic

[a] Division of Oral and Maxillofacial Surgery, Yale-New Haven Hospital, 333 Cedar St, New Haven, CT 06510, USA; [b] Private Practice, Connecticut Vascular Center, PC, 280 State St, North Haven, CT 06473, USA; [c] Division of Vascular Surgery, Yale-New Haven Hospital/St. Raphael Campus, 1450 Chapel St, New Haven, CT, 06511, USA

* Corresponding author. Private Practice, Connecticut Vascular Center, PC, 280 State St, North Haven, CT 06473, USA

E-mail address: aferneini@ctvascularcenter.com

Oral Maxillofacial Surg Clin N Am ■ (2016) ■–■
http://dx.doi.org/10.1016/j.coms.2016.06.012

malformations are generally low-flow.[3,4] High-flow lesions have the greatest potential for morbidity and mortality, thus making them more difficult to treat. Severe bleeding or exsanguination may often result with these high-flow lesions.

A considerable risk for hemorrhage exists in temporomandibular joint (TMJ) ankylosis surgery. During TMJ ankylosis surgery, many vessels that lie near the medial aspect of the condylar neck are traumatized. Vessels in the pterygoid fossa are a potential bleeding source during surgery. Branches of the maxillary artery and the pterygoid venous plexus can often be sources of hemorrhage. When compression alone fails to stop the bleeding, interventional radiology is a useful tool to control bleeding that the oral and maxillofacial surgeon may encounter in the operating room.[5] Complications associated with TMJ ankylosis surgery include damage to vascular structures. Methods used to achieve hemostasis include electrocautery, laser ablation, local anesthetics with vasoconstrictors, direct pressure, embolization, and ligation.[6] The middle meningeal and maxillary arteries are injured with a minimum amount of trauma.[7] To control the bleeding, pressure should be first applied at the surgical site with packing and manipulation of the systemic blood pressure. If bleeding does not stop with pressure, electrocautery is used. If cautery is not enough, coagulation products, such as topical thrombin or oxidized cellulose, are used. If hemorrhage has not stopped with these measures, the external carotid artery (ECA) is ligated above the level of the facial artery, or fluoroscopic embolization is considered.[7] Additionally, if intraoperative bleeding is a concern, preoperative angiography and embolization are performed to localize and embolize the vessels.[8]

Endovascular technology is also used in orthognathic surgery intraoperatively to control hemorrhage and postoperative. Excessive bleeding and injury to the internal maxillary artery, although uncommon, can occur during orthognathic surgery. The inferior alveolar branch of the internal maxillary artery is vulnerable to injury when osteotomies are made. Intraoperatively, one of the first measures to control intraoperative hemorrhage includes conservative measures, such as manipulating the systemic blood pressure and pressure. Packing should be used as the first attempt to tamponade the hemorrhage. In the presence of hypovolemic shock and if conservative measures have failed, intraoperative hemorrhage is controlled via transcatheter arterial embolization or ligation.[9] Additionally, a complication of orthognathic surgery includes the formation of a pseudoaneurysm, usually 1 to 8 weeks postoperatively.[10,11] A pseudoaneurysm is treated with embolization and microcoils. Pseudoaneurysm of the ECA or one of its branches is rare. In a series of more than 8000 aneurysms, 21 pseudoaneurysms of the ECA were described, 19 of which occurred after surgery in the region of the carotid artery.[12] The rarity of an ECA pseudoaneurysm is caused by the small size of the ECA branches, which makes cross-cutting more likely than a partial laceration. Pseudoaneurysms after orthognathic surgery are also rare. The literature includes about 18 case reports of pseudoaneurysms after orthognathic surgery.[11] Depending on the side of bleeding, a selective angiogram of the ECA (of the affected side) is usually performed. Embolization can then be achieved. The goal of embolization is to deposit an embolic material within the aneurysmatic network and not to compromise the vascular supply near the injury.[13] Endovascular treatment has been used to treat pseudoaneurysms of the descending palatine artery and internal maxillary artery.[11,14] Endovascular methods to control hemorrhage are discussed in this article.

ENDOVASCULAR TECHNIQUES

Endovascular techniques have played a major role in the management of head and neck bleeding and lesions since selective embolization of the ECA was described by Djindjian and colleagues[15] in 1972. Embolotherapy or embolization has rapidly developed in recent years and is now standard of care in most hospital centers. It is defined as the percutaneous application of one or more of a variety of agents or materials to accomplish vascular occlusion and bleeding control. Embolotherapy has evolved over the past 10 years and includes a wide variety of clinical applications, including the following:

1. Vascular malformations: occlusion of congenital or acquired aneurysms (cerebral, visceral, or extremities), vascular malformations, and pseudoaneurysms.
2. Trauma: for control of acute hemorrhage or uncontrollable bleeding.
3. Uterine artery embolization: either to reduce intraoperative blood loss or devascularization of benign uterine leiomyomas.
4. Nontraumatic hemorrhage: caused by either acute or recurrent hemorrhage. This includes hemoptysis, gastrointestinal bleeding, postpartum hemorrhage, and hemorrhagic neoplasms.
5. Oncologic embolization: either palliative or curative. Embolization is performed to prevent or treat hemorrhage, relieve symptoms, reduce intraoperative blood loss, improve quality of life, and improve survival. Examples include renal cell carcinoma, primary and secondary bone malignancies, and various hepatic malignancies.