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## Salvage treatment of hemorrhagic arteriovenous malformations in jaws



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### ABSTRACT

**Objective:** To present our clinical experience on embolotherapy of arteriovenous malformations (AVMs) in jaws with acute hemorrhage.

**Materials and methods:** Twelve patients with a history of hemorrhage were selected for this study. Continuous interdental sling suture, digital pressure on the extraction socket, and iodoform gauze packed into the socket and fixed with sutures to the adjacent gum were used for temporary hemostasis before embolization. Fiberoptic bronchoscopy was used in all cases to facilitate endotracheal intubation. Absolute ethanol combined with coils was used as method of embolization.

**Results:** Eight patients presented with intermittent interdental gum bleeding or controlled hemostasis before embolization. Four patients presented with torrential hemorrhage around the tooth, controlled by continuous pressure on the tooth and bilateral gum for temporary hemostasis. All patients were successfully salvaged before embolization. Ten of 12 patients were cured, and 2 had partial remission. Follow-up ranged from 12 to 26 months (mean, 16.5 months) for all patients, and there was no recurrence of the lesions.

**Conclusions:** The treatment of hemorrhagic AVMs of the jaw requires a multidisciplinary team approach; such cases can be successfully salvaged and stably controlled by embolization with coils and absolute ethanol.

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## 1. Introduction

Approximately 50% of arteriovenous malformations (AVMs) occur in the head and neck region (Seehra et al., 2006). High-flow AVMs of the maxillofacial region are dangerous, because these lesions may cause hemorrhage either spontaneously, from incidental trauma or during routine dental procedures such as tooth extractions (Sakkas et al., 2007; Kluba et al., 2007).

AVMs of the jaws are especially rare and potentially life-threatening lesions. Being in proximity to the teeth, and presenting with pulsatile expansion of the cortex, interdental gingival bleeding and post-extraction socket hemorrhage are typical features of high-flow lesions. Due to the risk of catastrophic hemorrhage, these vascular malformations are a major

challenge that requires an integrated team approach and efficient treatment, which includes participation of oral and maxillofacial surgeons, interventional radiologists, and anesthesiologists (Baciu et al., 2009; Su et al., 2006; Lamberg et al., 1979; Bergeron et al., 2013; Davidson et al., 1984; Engel et al., 1995; Kacker et al., 2000).

We hereby report 12 cases of AVMs in the jaw with hemorrhage and summarize the emergency salvage procedure for acute hemorrhage before embolization, anesthesia, embolization procedure, and postembolization operative manipulation in order to achieve results that are effective, are durable, and allow normal skeletal development, especially in children and adolescents.

## 2. Material and methods

### 2.1. Patients

We obtained approval from the institutional review board of our hospital for the review and use of patient medical and imaging

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records. All patients provided written consent for the procedure after a discussion about the advantages and risks of the procedure. A total of 32 consecutive patients with symptomatic AVMs of the mandible and maxilla were treated between January 2012 and January 2014. Among these patients, 12 had a history of hemorrhage that presented with chronic intermittent interdental periodontal bleeding, torrential hemorrhage following tooth extraction, or spontaneous hemorrhage. The mean age was 16.5 years (range, 9–22 years).

Seven patients had intermittent interdental periodontal bleeding and loose tooth, two patients had hemorrhage following tooth extraction, 2 patients had spontaneous hemorrhage in soft tissues involving AVMs in the mandible, and 1 patient had massive intra-operative hemorrhage but was misdiagnosed as ameloblastoma. Two patients were transferred from other hospitals with severe hemorrhage with prophylactic tracheotomy to prevent asphyxia.

All patients in this group presented either with obvious unilocular varix (10 cases) or with multilocular “soap bubble” appearance (2 cases) on computed tomography (CT).

## 2.2. Emergency salvage

For cases of chronic intermittent interdental gum bleeding, continuous interdental sling suture was used. For cases of torrential hemorrhage around the tooth, continuous pressure was applied to the tooth and bilateral gingiva was necessary for temporary hemostasis, followed by general anesthesia and embolization. Continuous interdental sling suture is also effective after the embolization as a precaution against retrograde infection.

Hemorrhage following tooth extraction can be well controlled by immediate digital pressure on the extraction socket followed by iodoform gauze packed into the socket and fixed with suturing to the adjacent gum (Fig. 1). In some severe cases, continuous pressure on the iodoform gauze pack was necessary, which allowed the patient to be intubated for general anesthesia.

One case was suspected of being an ameloblastoma, and biopsy was performed on the lesion in the operating room under general anesthesia, which resulted in massive hemorrhage. The bleeding was controlled by packing the biopsy site and fixing with sutures to the adjacent soft tissues.

Blood transfusions and supportive therapy were given to patients according to the extent of deterioration of their general condition.



**Fig. 1.** Hemorrhage following tooth extraction can be well controlled by immediate digital pressure on the extraction socket, followed by iodoform gauze (arrow) packed into the socket and fixed with suturing to the adjacent gum.

## 2.3. Anesthesia

Fiberoptic bronchoscopy was used in all cases to facilitate endotracheal intubation. All embolization procedure was performed under general anesthesia with transnasal fiberoptic endotracheal intubation, because most of the time the oral cavity was filled with packing or continuous occlusion pressure was given to attain hemostasis.

During the embolization procedure, selective hypotensive anesthesia was used to help limit bleeding. Blood pressure, electrocardiogram findings, oxygen saturation, and end-tidal carbon dioxide levels were constantly monitored during the injection of absolute ethanol.

## 2.4. Embolization

Direct-puncture embolization was used to reach the nidus for embolization. Routes of vascular access to attack the nidus were chosen according to the initial angiogram and CT scan. Direct-puncture embolization was indicated in 10 patients with obvious unilocular varix and transarterial ethanol embolization combined with direct-puncture embolization was used in 2 cases with multilocular “soap bubble” – appearance varix, to obtain the best possible results. The enlarged mental foramen was chosen, in most cases, as the point for puncture in the mandible.

The venous pouch was directly punctured with a 16-gage needle (Lichtwitz antrum needle; MEDICON, Tuttlingen, Germany). Core needle was removed and a 2.2-French microcatheter was inserted through the needle. With the help of a guide wire, the microcatheter was inserted as close as possible to the exit of the dilated outflow vein. Then two to three electrolytically detachable coils (EDCs) were released to the proper location in an attempt to minimize the risk of coil migration to the lungs. This was followed by the release of 0.018 NEST coils (Cook, Bloomington, IN, USA), resulting in a decrease in arteriovenous shunt flow, after which absolute ethanol was injected through the microcatheter or needle to occlude the AVMs completely.

When AVMs shunts were verified in the control arteriogram, repeated injection of absolute ethanol was performed. Ethanol embolization was directed against the nidus itself and not against the vascular feeders. The goal was to embolize all or part of the nidus until complete hemostasis was achieved. If any increase in blood pressure was detected, ethanol injection was stopped until the monitored parameters returned to baseline values. The amount of ethanol used during embolization was based on the amount required to fill the portion of AVM being treated. Ethanol was manually injected after several test injections with contrast material to determine the hand pressure required and the amount of ethanol to inject. After ethanol injections, we waited for 10 min and then acquired an arteriogram to determine whether the therapy was successful. The total amount of absolute ethanol used per session was less than 1 mL/kg of body weight.

To minimize swelling and any accompanying pain, all patients received an intravenous injection of dexamethasone before the procedure, which was usually 10 mg for adults and 3–10 mg for children, depending on their body weight. Postoperative management consisted of using dexamethasone and intravenous infusion. Patients with gastrointestinal tract sensitivity to steroids can also be given ranitidine (Zantac) to protect against gastric or duodenal ulcer. Patients were usually observed in the intensive care unit overnight. The ensuing medications usually included a tapering dose of corticosteroids for 7 days and, if required, ranitidine management to prevent ulcer.

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