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CLINICAL STUDY

TRANSORAL LIGATION OF MAXILLARY ARTERY IN THE RETROMANDIBULAR FOSSA: A NOVEL ENDOSCOPIC TECHNIQUE

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SUMMARY

Objective: To introduce a novel transoral endoscopic technique for ligating the maxillary artery (MA) in the retromandibular fossa as an alternative approach for intraoperative bleeding control in juvenile nasopharyngeal angiofibroma (JNA) surgeries.

Methods: An anatomical study was conducted using two formalin-fixed cadaveric heads (four sides) with a 4 mm 0° rigid endoscope. An intraoral mucoperiosteal incision was placed on the retromolar trigon. The outer surface of the ramus from the angle to the neck of the condyle was exposed by retracting the buccal region and the masseter muscle. The retromandibular fossa was opened by incising the mandibular periosteum along the posterior border of the ramus. The MA and superficial temporal artery were identified in the parotid gland and the MA was clipped. The technique was subsequently applied in three clinical cases of JNA.

Results: In cadaveric dissections, the transoral retromandibular approach provided clear identification and successful ligation of the MA. In clinical cases, the method achieved effective bleeding control, with no significant blood transfusions required and no perioperative complications observed. All patients experienced successful tumor resections, and follow-up revealed no recurrences or adverse events.

Conclusion: The transoral endoscopic ligation of the MA in the retromandibular fossa is an effective technique for controlling intraoperative bleeding in JNA surgery. This approach can be considered in cases where traditional methods are inadequate or contraindicated and may serve as an adjunct to preoperative embolization or as an independent strategy.

Keywords: Angiofibroma; embolization; hemorrhage; maxillary artery

MAKSİLLER ARTERİN RETROMANDİBULAR FOSSA'DA TRANSORAL LİGASYONU: ENDOSKOPİK YENİ BİR YÖNTEM

ÖZET

Amaç: Bu çalışmada retromandibular fossada maksiller arterin (MA) transoral endoskopik ligasyonunu tanıtmak ve bu yöntemi, juvenil nazofaringeal anjiofibroma (JNA) cerrahilerinde intraoperatif kanama kontrolü için alternatif bir yaklaşım olarak sunmak amaçlanmıştır.

Gereç ve Yöntemler: Çalışmada, 4 mm 0° rijit endoskop kullanılarak formalinle fikse edilmiş iki kadavra başı (dört taraf) üzerinde anatomik diseksiyon gerçekleştirildi. İntraoral olarak retromolar üçgende mukoperiostal bir insizyon yapıldı. Bukkal bölge ve masseter kası retrakte edilerek mandibula ramusunun dış yüzeyi, mandibula açısından kondil boynuna kadar açığa çıkarıldı. Mandibulanın arka sınırı boyunca periost insize edilerek retromandibular fossa açıldı. Parotis bezi içinde MA ve süperfisyal temporal arter tanımlandı ve MA kliplendi. Teknik daha sonra üç JNA hastasında klinik olarak uygulandı.

Bulgular: Kadaverik diseksiyonlarda, transoral retromandibular yaklaşım MA'nın net şekilde tanımlanmasını ve başarılı ligasyonunu sağladı. Klinik vakalarda, yöntem etkili kanama kontrolü sağladı, önemli kan transfüzyonlarına ihtiyaç duyulmadı ve perioperatif komplikasyon gözlenmedi. Tüm hastalarda başarılı tümör rezeksiyonları gerçekleştirildi ve takiplerde nüks veya advers olay saptanmadı.

Sonuç: Retromandibular fossada MA!nın transoral endoskopik ligasyonu, JNA cerrahisinde intraoperatif kanama kontrolü için etkili bir tekniktir. Geleneksel yöntemlerin yetersiz kaldığı veya kontrendike olduğu durumlarda düşünülebilir ve preoperatif embolizasyona ek olarak ya da bağımsız bir strateji olarak kullanılabilir.

Anahtar Sözcükler: Anjiyofibroma, embolizasyon, kanama, maksiller arter

INTRODUCTION

Juvenile nasopharyngeal angiofibroma (JNA) is a benign, highly vascularized tumor originating from the posterior wall of the nasopharynx and having a tendency for skull base erosion, intracranial extension, and severe bleeding.[1] It is a relatively rare neoplasm, accounting for 0.05% of all head and neck tumors and typically occurring in adolescent males.[2] The recommended treatment for JNA is surgical excision,[3] but surgery remains a challenge even for experienced surgeons.[4] Bleeding is a serious problem during surgery and may result in an increased risk of injury, incomplete resection, higher morbidity, and higher medical costs.[5]

Preoperative feeding artery embolization is a commonly performed technique to minimize intraoperative bleeding. This procedure aims to reduce the risk of significant bleeding during the surgery, but it carries its own risks. Inadvertent

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injection of embolic material into the internal carotid artery system may lead to cerebral ischemia or central retinal artery occlusion and blindness.[6,7] Furthermore, possible allergic reactions to embolic agents and contrast media add risk to the procedure.[8] In some cases, embolization is performed far in advance of the planned surgical procedure, which can lead to recanalization of the occluded vessels, diminishing the desired effect.[9] There is no published literature on the optimal timing for embolization, but the general consensus is to perform surgery within 24 to 96 hours following the procedure. Delaying beyond this period decreases the effectiveness of embolization.[10] Another challenge is that in some healthcare centers, embolization may not be readily available due to a lack of interventional radiology expertise or equipment. Given these considerations, arterial ligation may offer a viable alternative for controlling intraoperative bleeding.

The JNA receives its main vascular supply from the maxillary artery (MA), the terminal branch of the external carotid artery.[11] The MA follows a complex anatomical course in the deep and difficult-to-access spaces of the head. Surgical access to the maxillary artery involves ligating the vessel along its course in the pterygopalatine fossa, typically through a trans nasal or trans antral approach.[12] Another way to the MA is to identify the artery around the mandible. The proximal portion of the maxillary artery lies in close relation to the ramus of the mandible and courses through the retromandibular fossa.[13] By following the outer surface of the mandible, one can identify the main trunk of the MA behind the neck of the condyle.

This study introduces a transoral endoscopic technique for ligating the maxillary artery in the retromandibular fossa. To our knowledge, this is the first attempt to identify and ligate the MA in the retromandibular fossa using a transoral endoscopic approach for JNA surgery. The utility and safety of this technique are evaluated based on case presentations.

MATERIAL and METHODS

The anatomic study was performed on two adult cadaveric heads (four sides) fixed in formalin. All dissections were performed with a 4 mm 0º rigid endoscope and a full HD video camera (Karl Storz®, Tuttlingen, Germany) using basic sinonasal surgery instruments. The same surgical steps were followed in each cadaver dissection.

First, an intraoral vertical mucoperiosteal incision was made on the retromolar trigon. A subperiosteal dissection with the endoscopic assistance exposed the outer surface of the ramus from the angle to the neck of the condyle by retracting the buccal region and the masseter muscle (Fig 1A). The retromandibular fossa was opened by incising the mandibular periosteum along the posterior border of the ramus. The MA and the superficial temporal artery were identified in the parotid gland as they emerge from the external carotid artery behind the neck of the condyle (Fig. 1B).

Subsequent clinical experience consisted of three patients treated for JNA. All three cases were treated at a tertial university hospital.

The study followed ethical principles for both cadaveric research and case reports. The principles outlined in the Declaration of Helsinki were followed. Respect for the donors" bodies was obligatory. The study was deemed exempt from review by the institutional ethics committee, as Turkish legislation does not require ethical approval for cadaveric studies. For the case reports, written informed consent was obtained from the patients for publishing.

Fig 1: *Transoral endoscopic view (0°) of the right retromandibular space.*
(A) An intraoral incision is placed on the retromolar trigon. The outer surface of the mandible is exposed by retracting the buccal region (bm: buccal mucosa, t: tongue, cm: corpus mandible)

Fig 1: *Transoral endoscopic view (0°) of the right retromandibular space.*
(B) Angle of mandible is identified. The retromandibular fossa is opened by incising the mandibular periosteum. The MA and the STA are identified in the parotid gland (p: periosteum, sta: superficial temporal artery, ma: maxillary artery)

RESULTS

Case 1

A 19-year-old male patient presented with right-sided nasal obstruction and epistaxis. Nasal endoscopic examination revealed a complete obstruction of the right nasal cavity by a mass, with a smooth and highly vascular surface. Magnetic resonance imaging (MRI) showed a tumor in the right nasal cavity extending into the infratemporal fossa with cavernous sinus involvement (Fig. 2). Based on these findings, the preoperative diagnosis was stage IIC JNA according to the Radkowski classification.[14] Preoperative angiography demonstrated that the tumor's main vascular supply was from the maxillary artery. Embolization of the right maxillary artery was performed preoperatively; however, surgery was delayed by more than a week following the embolization. Due to this time interval, surgical ligation of the maxillary artery was planned prior to tumor excision. Given that the tumor was filling the nasal cavity, we opted for a transoral retromandibular approach rather than a transnasal approach.

Under general anesthesia, we performed a transoral retromandibular approach to the right MA as previously described. The retromandibular fossa was exposed by incising the periosteum along the posterior border of the

mandibular ramus. The MA was identified and ligated with a clip (Fig. 3). The procedure then continued with the endoscopic endonasal removal of the JNA. An en bloc tumor resection was successfully performed, with no residual tumor observed in the surgical field. Total blood loss was 700 mL, and no blood transfusion was required. Postoperative pathological study confirmed the final diagnosis of JNA. The patient was discharged on the fourth postoperative day without any complications. During a three-year follow-up period, no complications or recurrences were observed.

Case 2

An 18-year-old male patient presented with a gradually increasing nasal obstruction and episodes of epistaxis. Nasal endoscopic examination revealed a solid mass filling the right nasal cavity. MRI showed a mass originating from the right nasal cavity, deviating the midline to the left, and extending into the sphenoid sinuses and nasopharynx, consistent with Radkowski stage IB JNA (Fig. 4). Since angiography images suggested that the main vascular supply of the tumor was the MA, we planned to ligate the right MA using an endoscopic transoral retromandibular approach without preoperative artery embolization. The MA was identified and ligated with a clip beneath the parotid fascia, posterior to the mandibular ramus (Fig. 5). Subsequently, endoscopic endonasal removal of the JNA was performed. The tumor was resected en bloc, and the total intraoperative blood loss was 600 mL. The patient was followed up for one year without any recurrence but was later lost to follow-up.

Case 3

A 14-year-old male patient presented with complaints of bilateral nasal obstruction and intermittent epistaxis. Initial evaluation at an external otorhinolaryngology clinic, including endoscopic and radiological imaging, identified an intranasal mass consistent with Radkowski stage IIB JNA. The patient was referred to our institution for definitive surgical management. Preoperative embolization could not be performed due to the unavailability of interventional radiology resources at the time of surgical planning, so we decided to ligate the MA. We planned a transnasal endoscopic excision of the tumor. Prior to dissection, the transoral endoscopic identification and ligation of the MA were carried out. The MA was identified in the retromandibular fossa and ligated following the same steps previously described. A total resection of the tumor was achieved, and the surgery was completed without severe bleeding or the need for a blood transfusion.

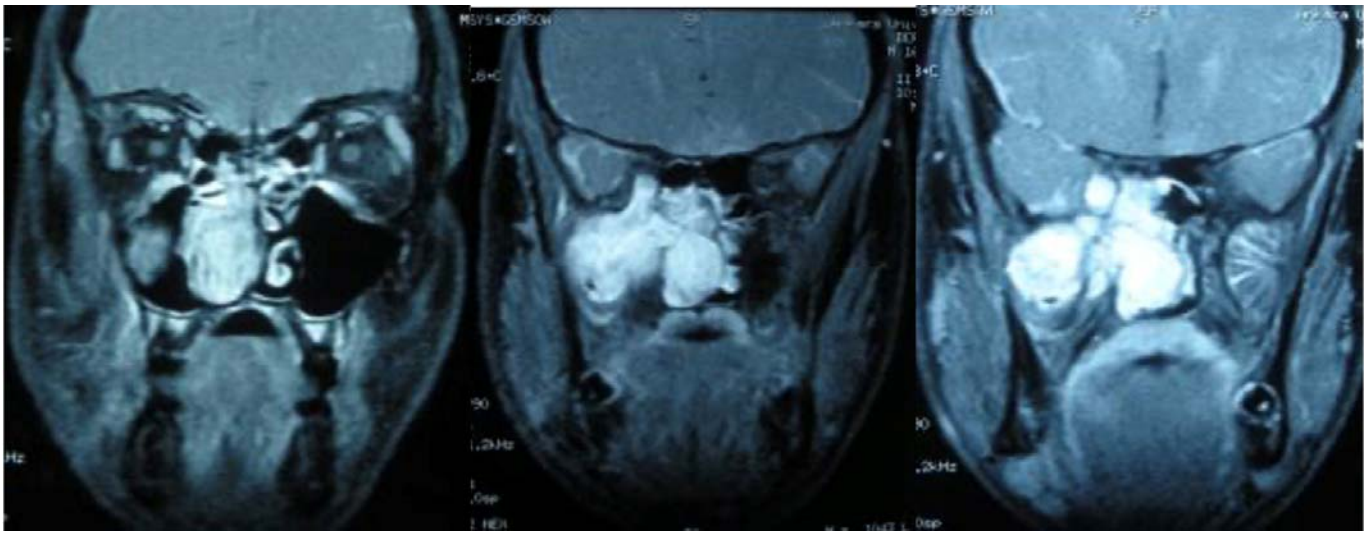

Fig 2: *Preoperative MRI with contrast enhancement.*
Mass in the right nasal cavity, paranasal sinuses, nasopharynx, and infratemporal fossa.

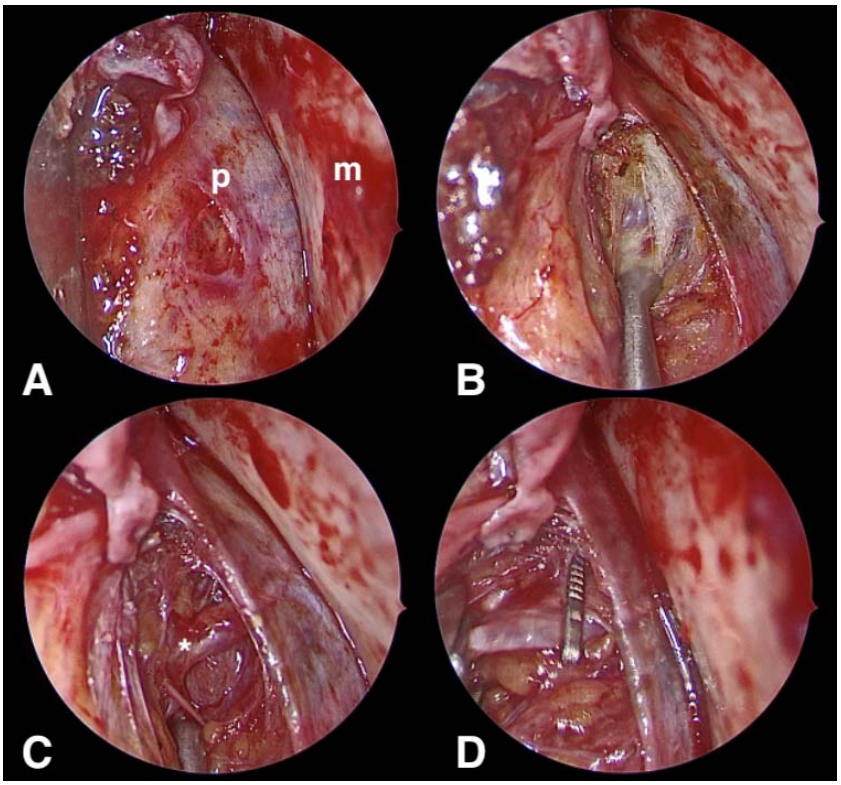

Fig 3: *Transoral endoscopic ligation of right maxillary artery (Case 1).*
(A) Subperiosteal dissection (m: mandible, p: periosteum) (B) İncision along the periosteum. (C) Identification of maxillary artery. (D)Clipped maxillary artery.

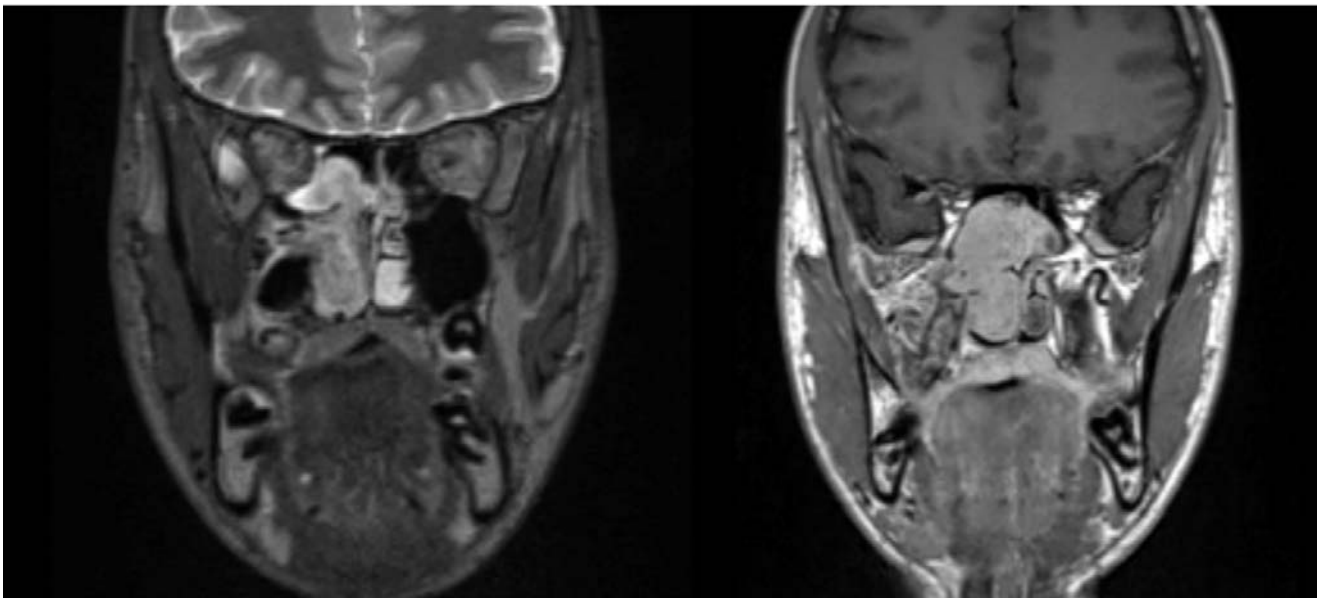

Fig 4: *MRI examination of the tumor that extends from the right nasal cavity to paranasal sinuses.*

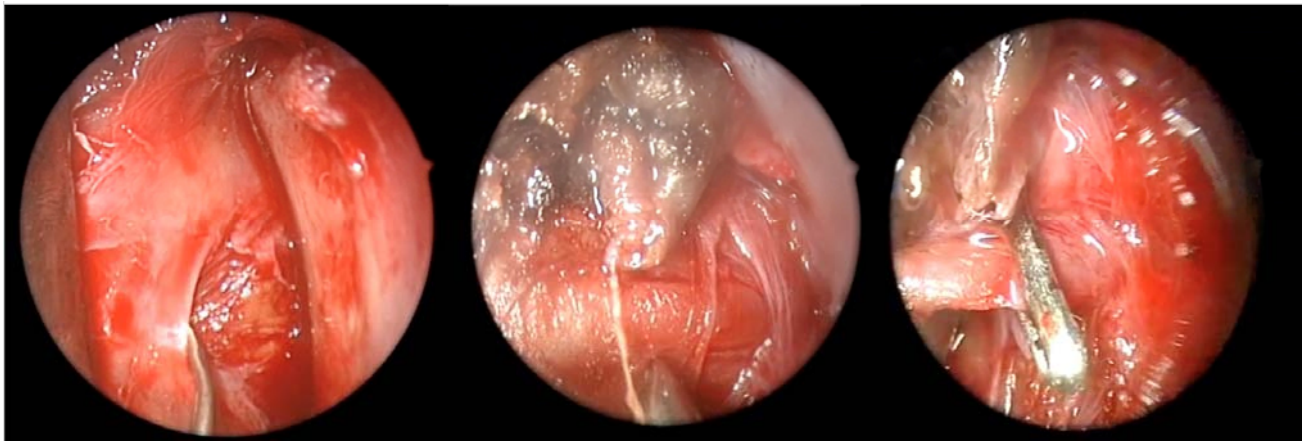

Fig 5: *Transoral endoscopic retromandibular approach to maxillary artery. Subperiosteal dissection is performed, and maxillary artery is identified within the parotid gland, then ligated with a clip.*

DISCUSSION

Effective hemostasis is crucial during surgical management of JNA to prevent incomplete resection and minimize complications. Preoperative embolization and MA ligation are common techniques used to reduce intraoperative bleeding. In the literature, some authors recommend routine preoperative embolization, while others highlight the risks associated with the procedure and suggest ligating the MA either before or during surgery as an alternative.

The choice of ligation approach varies depending on the tumor location, the segment targeted for ligation, and surgeons" expertise. Chandler and Serrin described a transantral approach through a gingivobuccal incision to access the third portion of the artery within the pterygomaxillary fossa.[15] Although this technique is a well-established option for managing posterior epistaxis, it has limitations when the tumor extensively involves the maxillary sinus or the pterygomaxillary fossa. Additionally, this approach carries a risk of inadvertent trauma to adjacent structures, such as the maxillary nerve, sphenopalatine ganglion, or vidian nerve.[16]

To address these issues, Maceri et al introduced a transoral approach to the MA, in which the artery is identified in the infratemporal fossa between the ramus of the mandible and the temporalis muscle.[17] This technique avoids complications related to the maxillary and vidian nerves, but it presents a potential risk for trismus and facial swelling because of the extensive dissection required around the temporalis and pterygoid muscles. Subsequent modifications, such as the endoscope-assisted transoral technique described by Polev et al., aimed to improve visualization while minimizing muscle manipulation, thus providing a more direct route to the artery.[18]

The presented study introduces a novel transoral endoscopic approach targeting the MA in the retromandibular fossa. This approach has several advantages over previously described methods. First, the risk of collateral bleeding is minimized by reaching the artery proximally, before it branches into smaller vessels. Second, the retromandibular fossa is a relatively less crowded anatomic area compared to the pterygopalatine fossa, reducing the likelihood of injury to nearby critical structures such as the sphenopalatine ganglion or maxillary nerve. Finally, endoscopic visualization offers high precision, allowing clear identification and ligation of the MA with minimal dissection. In our cadaveric study, we confirmed that the transoral retromandibular route provides excellent access to the proximal MA and in our clinical cases, this approach successfully controlled intraoperative bleeding in JNA resections, even in advanced-stage tumors.

The most important limitation of this technique is the potential injury to the facial

nerve and salivary gland complications. In our clinical practice, we did not observe such complications; however, considering the anatomical proximity, these risks remain a potential concern. Moreover, the operating space in the retromandibular fossa is relatively narrow, requiring advanced endoscopic skills and specialized instrumentation. Additionally, the utility of this approach may be limited in cases where the MA is difficult to visualize due to anatomical variations or extensive tumor involvement.

CONCLUSION

The transoral endoscopic ligation of the MA in the retromandibular fossa is an effective technique for controlling intraoperative bleeding in JNA surgery. This approach can be considered in cases where traditional methods are inadequate or contraindicated and may serve as an adjunct to preoperative embolization or as an independent strategy. We propose that this method could be a valuable addition to the surgical armamentarium.

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