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HEAD AND NECK

Transarterial endovascular treatment in the management of life-threatening intra- and postoperative haemorrhages after otorhinolaryngological surgery

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Abstract Management of life-threatening postsurgical bleeding is complex. If conservative or surgical therapy is demanding, an endovascular treatment can be considered. The goal of this study was to evaluate the outcome of endovascular approaches in the diagnosis and therapy of otherwise intractable postoperative haemorrhages with a study design of outcomes research. Charts of all patients with postsurgical bleedings receiving endovascular treatment were reviewed for clinical outcome, complications, and demographic data. 15 patients were identified. They had rhinosurgery (12/15), tonsillectomy (2/15) or transoral tumour debulking (1/15) prior to the endovascular procedure. In more than 70%, the source of bleeding was directly located angiographically and subsequently superselectively embolized. The remaining patients suffered from post-rhinosurgical epistaxis and underwent a bilateral embolization of the sphenopalatine artery. All bleedings were successfully controlled and no procedure-related complication was noted. In conclusion, endovascular treatment of life-threatening postsurgical haemorrhages should be considered if the source of bleeding is unknown or if surgery is difficult and may result in devastating postoperative complications.

Keywords Haemorrhage · Embolization · Surgery · Endovascular · Otolaryngology

Introduction

Postoperative bleeding is a typical complication after general otorhinolaryngological surgery. In this context, post-rhinosurgical epistaxis and post-tonsillectomy bleedings are the most common haemorrhages [1].

Although tonsillectomy is one of the most frequently performed surgeries and post-tonsillectomy haemorrhage (PTH) is rare, it is a serious and potentially life-threatening complication. Depending on the severity and duration of bleeding electrocautery, injection of vasoconstricting drugs, ligation of bleeding vessels in the tonsillar bed, and as last option ligation of the external carotid artery (ECA) or its branches have to be performed [1]. However, in most cases, a distal ligation of the bleeding vessel is challenging. Selective endovascular intervention is a promising, but rarely reported therapy for intractable PTH [1–4].

Similarly, post-rhinosurgical epistaxis can be controlled with the application of anterior and/or posterior nasal packs or endoscopic endonasal coagulation [5]. Life-threatening postoperative epistaxis requiring surgical arterial ligature or percutaneous arterial treatment is a rare event, however.

For the present study, we retrospectively identified those patients who could not be treated sufficiently by conservative and/or surgical therapy prior to the endovascular procedure. The purpose of the study is to assign the efficacy and safety of the endovascular treatment of otherwise intractable postsurgical bleedings of the head and neck region.

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Materials and methods

Study population

Over a period of almost 10 years (January 2001–August 2010), we referred 15 patients suffering from intractable postoperative haemorrhage to the department of neuroradiology for endovascular treatment. These patients' medical reports were reviewed for the following information: patient's age and sex, type of surgery, bleeding vessel, necessity of blood transfusions, length of specific treatment before endovascular procedure, length of hospitalization, complications, and outcome of the endovascular treatment. Bleedings were classified in intra- and perioperative (onset of bleeding on day of surgery) or late haemorrhages (onset of bleeding after the first postoperative day).

Superselective embolization

The embolization procedure was performed under local or full anaesthesia. The femoral artery was catheterized via a percutaneous Seldinger technique.

Angiography of the internal and external carotid artery was performed to rule out any vascular abnormality (e.g. dangerous anastomosis between the internal carotid artery (ICA) and ECA, aneurysms or arteriovenous-malformations) and to seek out the source of bleeding [6]. Then a microcatheter was advanced over a microguidewire via the ECA branches and was placed in the vessel that supplied the bleeding. For occlusion of the suspected source of haemorrhage, different materials and techniques were used: polyvinyl alcohol particles (PVA, CONTOUR™, Boston Scientific, USA) with particle sizes in the range of 150–250 μm were placed in the distal capillary bed (low blood flow area), and fibered platinum coils (GDC-10 Ultra soft, Boston Scientific, USA) were detatched proximally in the feeding artery (high blood flow area). The embolization was considered complete when the flow in the distal branches of each embolized artery was significantly reduced or stopped. Seven out of the 15 embolized patients (46.7%) were treated by injection of PVAs and 7/15 (46.7%) patients were embolized with platinum coils, respectively. One patient (1/15; 6.7%) needed an endovascular occlusion of the ICA with detachable balloons (Goldbal3, 9 × 11 mm, BALT, France).

Results

Details of the patients' history and clinical course are outlined in Table 1. 12/15 (80%) patients had intractable epistaxis after rhinosurgery (Table 2). Prior to the endovascular treatment, these patients had unsuccessful otorhinolaryngeal therapy including recurrent anterior/posterior nasal packings and/or surgical endoscopic endonasal coagulation for an average time of 3.3 ± 4.3 days (range 0–13 days). Hospitalization time of these patients after endovascular treatment was 4.6 ± 2.1 days (range 2–8 days). In 8/12 (66.7%) patient's pre-embolization angiography revealed the source of haemorrhage. Here, we subsequently performed a superselective occlusion of the following arteries:

– In one patient (1/12; 8.3%), an occlusion of a pseudoaneurysm of the ICA with detachable coils while preserving the lumen of the parent artery after transsphenoidal pituitary surgery was performed.

Table 1 Patient characteristics requiring endovascular treatment due to otherwise intractable postoperative bleeding

Patient characteristics	$n = 15$
Age (years)	
Median	37 ± 23.6
Range	14–79
Sex	
Male	11 (73.3%)
Female	4 (26.7%)
Follow up (months)	
Average	20.9 ± 16.3
Range	1–51
Endovascular treatment	
Success-rate	15 (100%)
Localization of bleeding source	11 (73.3%)
Mean fluoroscopy time (min)	23.9 ± 10.2
Haemoglobin (g/dl)	
Average	8.5 ± 2.3
Range	3.5–11.7
Number of patients needing blood transfusions	6 (40%)
Onset of bleeding after surgery (days)	
Average	3.7 ± 5.8
Range	0–20
Haemorrhage	
Intraoperative	3 (20%)
Perioperative	5 (33.3%)
Postoperative	7 (46.7%)
Time of treatment before embolization by ORL (days)	
Average	4.6 ± 5.8
Range	0–15
Hospitalization after embolization (days)	
Average	5 ± 3.4
Range	2–15
Type of previous surgery	
Rhino-surgery	12 (80%)
Tonsillectomy	2 (13.3%)
Transoral tumour-debulking	1 (7.7%)

Table 2 Patient characteristics requiring endovascular treatment due to otherwise intractable postoperative epistaxis

Patient characteristics	$n = 12$
Type of previous Rhino-surgery	
Septoplasty and conchotomy	5 (41.7%)
Sinus surgery	3 (24.9%)
Transsphenoidal pituitary surgery	2 (16.6%)
Biopsy of a nasal cavity tumour	1 (8.3%)
Le Fort I Osteotomy	1 (8.3%)
Time of treatment before embolization by ORL (days)	
Average	3.3 ± 4.3
Range	0–13
Hospitalization after embolization (days)	
Average	4.6 ± 2.1
Range	2–8
Angiography findings	
No bleeding source detectable	4 (33.3%)
Bleeding source detectable	8 (66.7%)
Pseudoaneurysm of the ICA	1 (8.3%)
Laceration of the ICA	1 (8.3%)
Pseudoaneurysm of the SPA	2 (16.7%)
Laceration of the SPA	3 (25%)
Nasal cavity tumour fed by the IMA	1 (8.3%)
Used material for endovascular procedure	
Platinium coils	4 (33.3%)
PVA	7 (58.3%)
Detachable balloons	1 (8.3%)

ICA internal carotid artery, *SPA* sphenopalatine artery, *IMA* internal maxillary artery, *PVA* Polyvinyl alcohol particles

– In one patient (1/12; 8.3%), an iatrogenic laceration of the ICA during sphenoidal sinus surgery was successfully treated by endovascular placement of detachable balloons proximal and distal to the arterial lesion. Prior to definitive occlusion a balloon test occlusion was performed.
– One patient (1/12; 8.3%) needed unilateral endovascular embolization with PVA-particles of the internal maxillary artery immediately after a diagnostic biopsy of a nasal cavity tumour (metastasis of a renal cell carcinoma) due to heavy bleedings (Fig. 1).
– Angiographically detected lacerations of the sphenopalatine artery (3/12; 25%) and two postsurgical pseudoaneurysms of the sphenopalatine artery (2/12; 16.7%) were embolized unilaterally in 4/12 (33.3%) with platinum coils (3/12) (Fig. 2) or PVA-particles (1/12) and bilaterally in 1/12 (8.3%) patients with PVA-particles.
– In cases where pre-embolization angiography did not reveal the bleeding source (4/12; 33.3%), both sphenopalatine arteries were embolized with PVA-particles.

Nasal packings were always removed 1 day after endovascular treatment.

The reported cases of intractable PTH comprise two patients suffering from spontaneously reoccurring bleeding-episodes of one tonsillar bed. During the first 15 postoperative days after tonsillectomy, both patients had threefold operative intervention due to recurrent bleedings. Enoral coagulation and ligation of bleeding vessels in the tonsillar bed yielded only limited success. In one case the tonsillar branch of the facial artery and in the other case the ascending palatine artery were angiographically detected as source of bleeding and subsequently selectively embolized unilaterally with platinum coils (Fig. 3). These patients could be discharged 2 and 3 days after the endovascular procedure, respectively.

One patient underwent a resection of a recurrent oropharyngeal pleomorphic adenoma. Considering the very bad general condition of the patient a transoral tumour-debulking was planned. However, a massive oropharyngeal bleeding impeded continuation of the operation. An attempt to ligate the ipsilateral ECA via a transcervical approach failed, because the ECA had been ligated during the previous tumour-resection 20 years ago. The patient immediately underwent an angiography. As a rare anatomical variation, a branch of the internal carotid artery, most likely the ascending pharyngeal artery, was detected as source of bleeding and successfully embolized with platinum coils.

Discussion

Uncontrollable postoperative bleeding after ENT-surgery is a rare, but life-threatening event. If the haemorrhages are refractory to conventional conservative and/or surgical management, endovascular treatment is an effective alternative option [7].

Before embolization superselective angiography may offer more detailed information concerning the source of bleeding. In this case, a superselective embolization of the bleeding vessel allows to spare as many proximal arteries as possible.

In contrast to other studies, in which detection of the bleeding-site was successful only in a minority of cases [7, 8], we identified the bleeding artery in nearly 70% of patients. This is probably related to the fact that we concentrated on post-surgical haemorrhages while other studies did not differentiate between the aetiology of bleeding (e.g. postoperative, idiopathic, and posttraumatic). Our long-term success-rate of the endovascular treatment was 100% and no complications related to the procedure were observed.

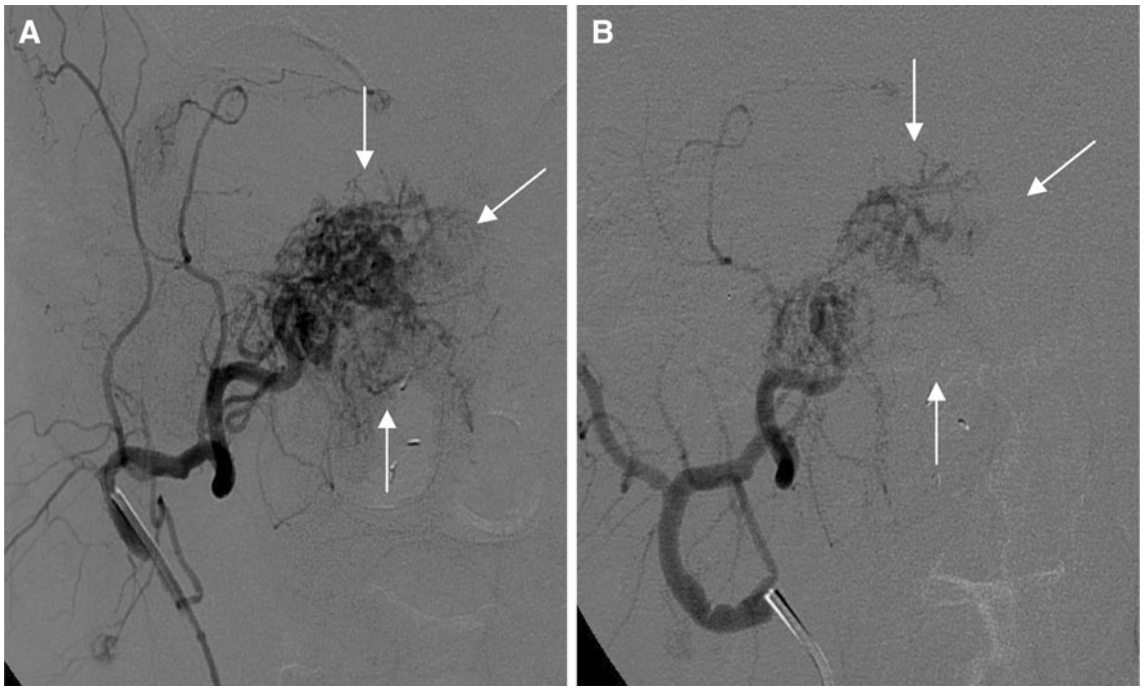

Fig. 1 Patient with massive epistaxis after diagnostic biopsy of a nasal cavity tumour (hypernephroma). **a** Arteriography (lateral view) revealing a vascularized tumour (*arrows*) with the guiding catheter placed in the internal maxillary artery. **b** Arteriography (lateral view) after selective embolisation with polyvinyl alcohol particles (PVA) via the sphenoidal artery (positioning of microcatheter not shown) proofs a significant reduction of tumour perfusion (*arrows*)

The present study is—to the best of our knowledge—the first description of the outcome of an endovascular treatment of postsurgical bleeding in the head and neck region; most other studies solely deal with (postsurgical) epistaxis. Thereby success-rates of 77.3% up to 94.6% [5, 9–14] and major complication rates under 2% are reported [5, 10, 12, 14, 15]. In a retrospective study of Powitzky et al. [16], eight patients with head and neck cancer sustaining a carotid blowout syndrome underwent endovascular treatment. Even for this massive bleeding event, the endovascular approach was favoured as treatment of choice as comparing with surgical ligation lower rates of mortality and neurologic morbidity were reported. Nevertheless, this high success- and low complication-rate supports the significance of an endovascular approach.

While our patients were treated unsuccessfully for 4.9 days prior to embolization, average hospitalization after embolization was 5.1 days. The duration of hospital stay was necessary due to the impaired general state of health. Furthermore, 35.7% of patients had to receive blood transfusions prior to embolization for haemodynamic stabilization. Hence, an earlier decision for embolization might reduce the duration of hospitalization and the necessity of blood transfusions. Based on the rareness of an endovascular treatment of postsurgical haemorrhages, a limiting factor of this study is the low number of patients, however.

Prior to endovascular therapy the majority of patients suffered from intractable epistaxis after rhino-surgery. The complex nasal vasculature is shown in Fig. 4. The sphenopalatine artery represents the dominant vessel of nasal blood flow and is responsible for most cases of severe posterior epistaxis [7]. Surgical trauma to vessels of the sinonasal region can lead to intractable epistaxis, which originates from a distal branch of the sphenopalatine artery. These bleedings develop shortly after surgery. However, delayed postsurgical epistaxis may occur due to a traumatic arterial damage causing an arterial pseudoaneurysm. This latent period, which can vary from days to years, is probably due to a progressive weakening of the arterial wall [17, 18]. This variable latency period complicates the diagnosis [19]. However, early diagnosis is vital because a mortality rate of 30% has been reported for pseudoaneurysms of the ICA [19]. An effective treatment can be achieved by endovascular coil-embolization or balloon occlusion of the artery. In our study, three patients were identified with postsurgical pseudoaneurysm of either the sphenopalatine artery or the ICA. The onset of bleeding was on the 4th and 10th postoperative day. All three patients were successfully treated by coil-embolization. Apart from a lacerated ICA, which was successfully treated by balloon-occlusion, all other cases of postsurgical epistaxis ceased after unilateral or bilateral embolization of the sphenopalatine artery. As collateral arteries between branches of both ECAs occur, a

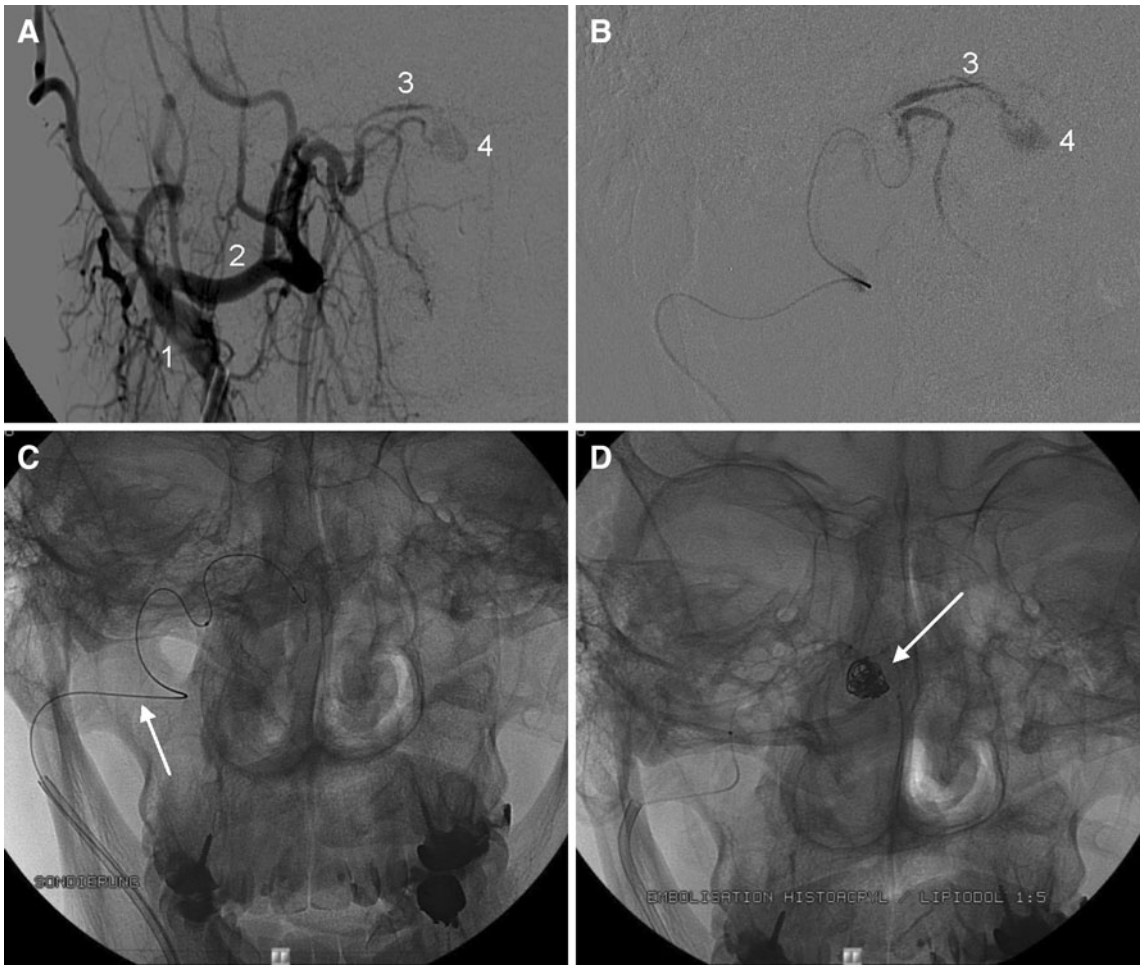

Fig. 2 Patient presenting with uncontrollable epistaxis after rhinosurgery. **a**, **b** Arteriography (anteroposterior view) shows the external carotid artery (*1*), and the internal maxillary artery (*2*) with its terminal branch, the sphenopalatine artery (*3*). A pseudoaneurysm of the sphenopalatine artery (*4*) was detected as source of epistaxis. **c**, **d** Anteroposterior view before embolization shows the microcatheter positioned into the sphenopalatine artery (**c**, *arrow*). The pseudoaneurysm was occluded with detachable platinum coils (**d**, *arrow*) and the parent artery was filled with glue (Histoacryl)

bilateral embolization of the sphenopalatine artery was performed if angiography did not reveal the bleeding vessel. Otherwise, only the bleeding artery was embolized until the blood-flow was stopped. Epistaxis arising from the ethmoidal arteries is rare and may be seen either after traumatic skull base fractures causing a tear in the vessel wall, or it can occur iatrogenic during endoscopic sinus surgery [20]. It is essential to know that embolization of the ethmoidal artery with particles is not possible because the ethmoidal artery arises from the ophthalmic artery, resulting in a high risk of blindness caused by a reflux of particles [21].

Depending on the definition of post-tonsillectomy haemorrhage (PTH), the reported rates for PTH vary from 1 to 40% [22]. Fortunately, life-threatening PTH is a rare event. Due to a complex arterial tonsillar blood-supply—including branches of the lingual, the facial, and the internal maxillary artery—successful haemostasis after tonsillectomy can be challenging (Fig. 5). In case of massive PTH, a last option is the surgical ligation of the ipsilateral ECA or its branches. Injury of the superior laryngeal or vagus nerve, cerebrovascular accidents, and diminished vascular reserve in the arterial distribution of the ligated vessels are risks of this surgical approach [23]. In our study, selective endovascular embolization proved to be successful in otherwise intractable PTH refractory to repeated conservative and local surgical treatments. Feeding arteries were identified and the bleeding vessel was individually embolized under direct observation leading to a cessation of bleeding. If surgical control of PTH is difficult and the source of bleeding not clearly known, we claim that endovascular embolization offers a promising alternative.

We experienced one case of massive intraoperative haemorrhage during a transoral surgical tumour-debulking of a recurring oropharyngeal pleomorphic adenoma. Via angiography, a branch of the internal carotid artery, most likely the ascending pharyngeal artery, was detected as

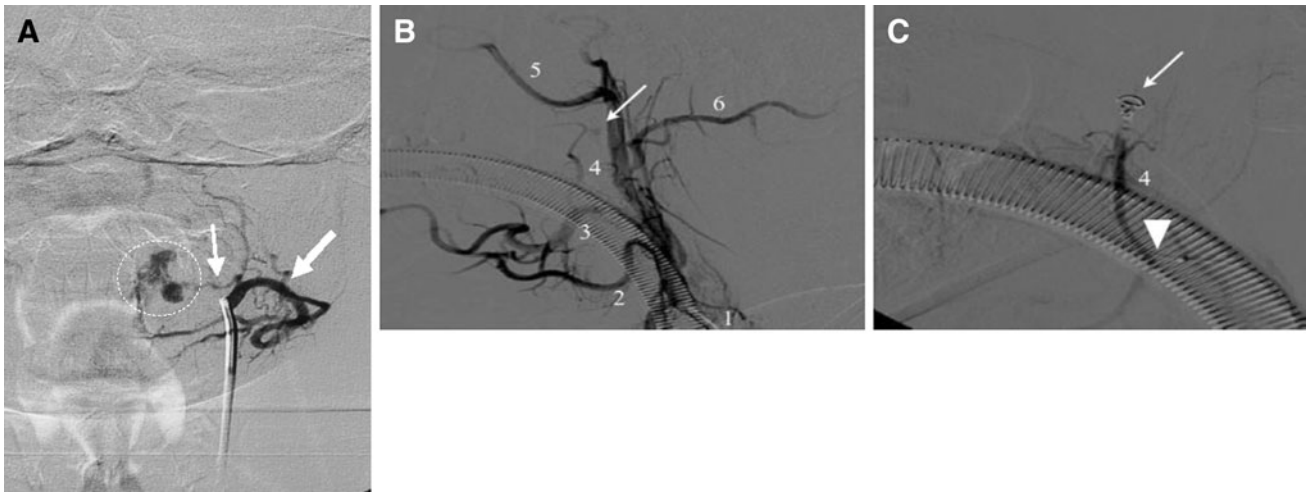

Fig. 3 Patients presenting with uncontrollable post-tonsillectomy haemorrhages. **a** (Patient 1) Anteroposterior angiogram revealed free extravasation of contrast material from the tonsillar branch (*small arrow*) confirming the source of haemorrhage. *Large arrow* facial artery. **b** (Patient 2) Lateral angiography of the external carotid artery (*1*) discloses the bleeding site in the right palatine tonsil (*arrow*) maintained by the ascending palatine artery (*4*) arising from the facial artery (*3*). Further branches, lingual artery (*2*), maxillar artery (*5*), and occipital artery (*6*) are labelled. **c** (Patient 2) After superselective intubation of the ascending palatine artery with a microcatheter (*open arrow*), coils are placed in the distal part of the artery (*arrow*) and hence the bleeding is stopped

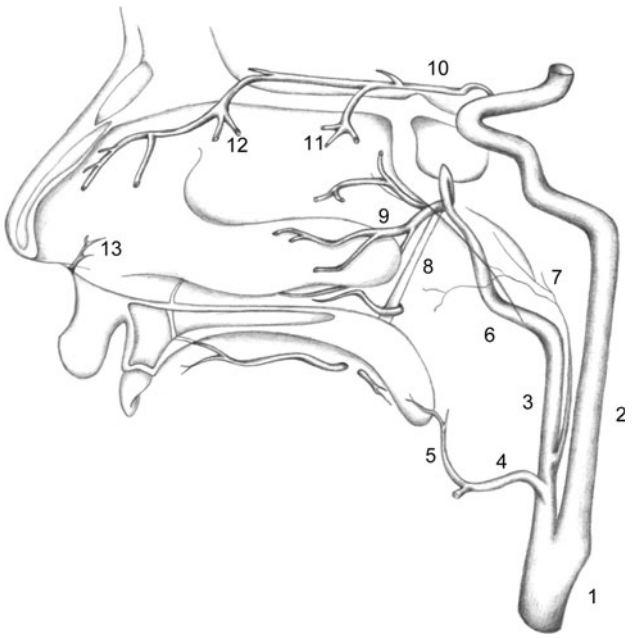

Fig. 4 Nasal arterial blood supply *1* common carotid artery, *2* internal carotid artery, *3* external carotid artery, *4* facial artery, *5* ascending palatine artery, *6* internal maxillary artery, *7* ascending pharyngeal artery, *8* descending palatine artery, *9* sphenopalatine artery, *10* ophthalmic artery, *11* posterior ethmoidal artery, *12* anterior ethmoidal artery, *13* superior labial artery

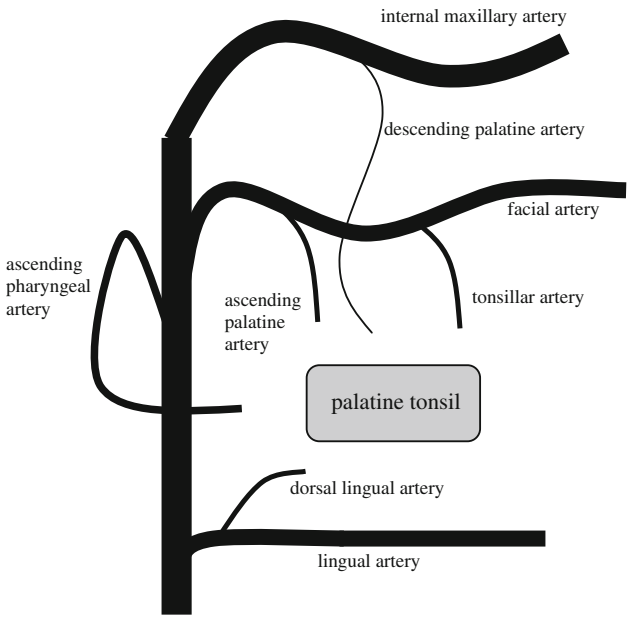

Fig. 5 Schematic illustration of the arterial blood-supply of the palatine tonsil

source of bleeding and successfully embolized with platinum coils. The ascending pharyngeal artery branching off the cervical segment of the internal carotid artery is a rare event [24–26] with a reported incidence between 2% [27] and 4.8% [28]. Especially in case of a massive intraoperative bleeding during revision-surgery with an unknown preoperative vascular status, the surgical situs can be confusing. An angiography clearly illustrates the source of haemorrhage and offers the possibility of a selective embolization of the bleeding vessel.

Conclusion

Endovascular treatment of intractable intra- and postsurgical bleedings allows obliteration of the most distal vessel of

the bleeding site. In addition, this technique is minimally invasive, safe and efficient. We claim that earlier endovascular intervention of life-threatening intra- and postoperative bleedings which is refractory to conservative and/or surgical management might reduce the hospitalization time and the necessity for blood transfusions.

Conflict of interest The authors declare that they have no conflict of interest.

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