folia medica

Folia Medica 63(5):809-14
DOI: 10.3897/folmed.63.e56461

Case Report

Use of Foley Catheter in Control of Internal Carotid Hemorrhage during Endoscopic Endonasal Surgery

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Received: 13 July 2020 ♦ **Accepted:** 6 Oct 2020 ♦ **Published:** 31 Oct 2021

Citation: Alicandri-Ciufelli M, Maccarrone F, Botti C, Pavesi G, Presutti L. Use of Foley catheter in control of internal carotid hemorrhage during endoscopic endonasal surgery. Folia Med (Plovdiv) 2021;63(5):809-14. doi: 10.3897/folmed.63.e56461.

Abstract

Internal carotid artery (ICA) injuries during endoscopic endonasal surgery (EES) are rare life-threatening events. We describe a technique to manage ICA injuries based on the use of Foley catheters.

A 26-year-old female underwent endoscopic transnasal trans-sphenoidal removal of pituitary adenoma. Cerebrospinal fluid leak occurred 4 days postoperatively. During repair procedure, accidental injury of ICA occurred. Emergency nasal packing through positioning of four Foley urologic catheters was successfully performed to stop bleeding. The patient did not report neurologic deficits.

In author's opinion, Foley catheters are suitable to obtain immediate bleeding control since they are rapidly available and easily usable.

Keywords

balloon nasal packing, endoscopic endonasal surgery, internal carotid injury, internal carotid hemorrhage, pituitary surgery

INTRODUCTION

Endoscopic endonasal surgery (EES) is a mini-invasive procedure, first introduced in the management of paranasal sinus disease. It became progressively popular in surgical management of anterior skull base disease and pituitary adenoma. Complications of EES have been widely described: cerebrospinal fluid leak, orbital hematoma, damage to nasolacrimal duct, optic nerve damage, diplopia, and hemorrhage.[1]

Injury of internal carotid artery (ICA) is the most severe and frightening complication which can result in stroke, cranial nerve palsy and death. Revision surgery, radiation, previous bromocriptine treatment and acromegaly, causing fibrosis and alteration of anatomical landmarks, are risk factors for ICA injuries. The massive bleeding is hard to manage in EES because it is a one-hand technique in most cases, and the bleeding reduces visibility in the surgical field by dirtying the tip.[2]

Approaches for immediate management of ICA injuries are nasal packing, endoscopic clipping, bipolar coagulation and intraoperative angiography.[3-5]

The aim of this report was to describe a technique to first line emergency treatment of ICA injuries during EES by using Foley urologic catheters.

CASE REPORT

A 26-year-old female from North Africa presented at the Neurosurgical Department with a history of headache and visual loss. During an access to the Emergency Department, she underwent a brain CT scan that documented a large mass involving sellar and parasellar region with marked erosion of sphenoid sinus walls ***(Fig. 1A)****.*

A brain MR confirmed the diagnosis, and documented a massive encasement of carotid arteries, cerebral posterior and basilar arteries ***(Fig. 1B)****. At blood testing, a marked increase of growth hormone (GH) was found (GH 24.83 ng/mL; IGF-1 543 ng/mL). At a close clinical evaluation, the patient showed physical features partially consistent with gigantism/acromegaly, with tall height and increase of foot and finger dimensions. Laboratory and radiological findings were consistent with GH-secreting pituitary macroadenoma (3.0×2.5×2.2 cm), with parasellar extension (Hardy's classification of pituitary tumors: grade E) and encasement of intracavernous ICA (Knosp classification system: grade 4). The CT-scan showed Keros type 2 olfactory fossa and thickening of the base of skull.*

After multidisciplinary evaluation, surgical removal was planned. A transnasal, trans-sphenoidal endoscopic removal was performed. The procedure was regular, without significant complications. At post-operative CT scan, a residual of the pathology lateral to left carotid artery was found ***(Fig. 1C)****. At 4 days postoperatively, the patient showed an intermittent cerebrospinal fluid (CSF) leak with watery rhinorrhea, and persistent pneumocephalus. Hence, a CSF leak repair with fat obliteration of the sphenoid sinus and closure with nasoseptal flap was planned.*

During surgery, granulation tissue and inflammatory material was found at the surgical site, consistent with the recent operation. A preliminary exploration and landmark identification from the right nasal fossa were performed, and during demucosization of the previously uncovered lamina papyracea, a marked bleeding was verified. The bleeding was provoked by elevation of granulation tissue by a suction cannula, in the region between lateral wall of sphenoid sinus and lamina papyracea. Surgical field was immediately obscured by blood that could not be suctioned by any kind of aspiration cannula. The suction tube without any aspiration cannula was then used, directly inside the right nasal fossa, but also in this case, the surgical field was not cleared. At this point, any kind of packaging (cottonoids, Merocel, coagulation) was deemed impossible, due to the presence of the aspiration tube and the insufficient view of the surgical field. In this extremely urgent conditions, it was then decided to use a balloon packaging by 14 Fr Foleys urologic catheters, using the technique herein described

Operative technique description: Foley catheter packaging for endonasal carotid bleeding

After removing the aspiration tube from nasal cavity, the first two Foleys are rapidly placed to close the posterior nasal fossa at the level of the choanae ***(Fig. 2A)****. To perform this, is can be very useful to overcome the nasal fossa, and feeling the caudal bending of the catheter. Then the catheter is filled with 10-15 cc of water* ***(Fig. 2B)****, and then pulled back to occlude the ipsilateral choana* ***(Fig. 2C)****. The same procedure is performed for the contralateral part. At this point, nasal fossae are separated completely from other cavities (i.e. the nasopharynx). The catheter already positioned helps and guides the further ones to be placed in the sphenoethmoidal region, since the most inferior part of the nasal fossa is occupied by*

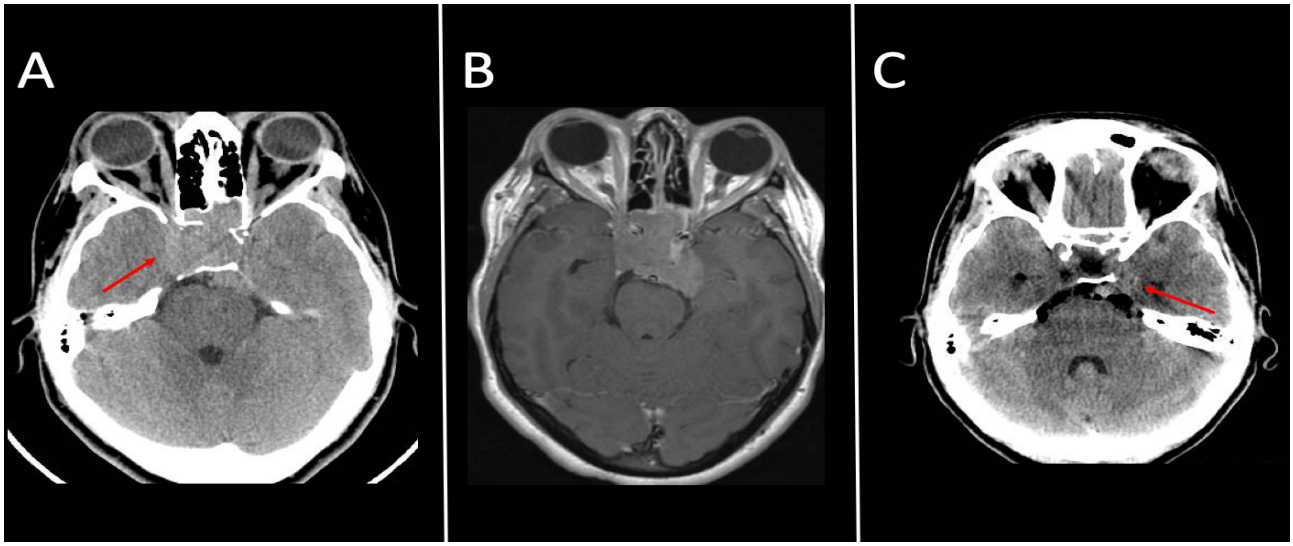

Figure 1. A. Preoperative brain CT scan, showing a mass involving sellar and parasellar regions. Erosion of sphenoid sinus walls is present; **B.** Preoperative brain MR showing the mass encasing the carotid, cerebral posterior and basilar arteries; **C.** Postoperative brain CT scan: residual lesion can be noticed lateral to left carotid artery.

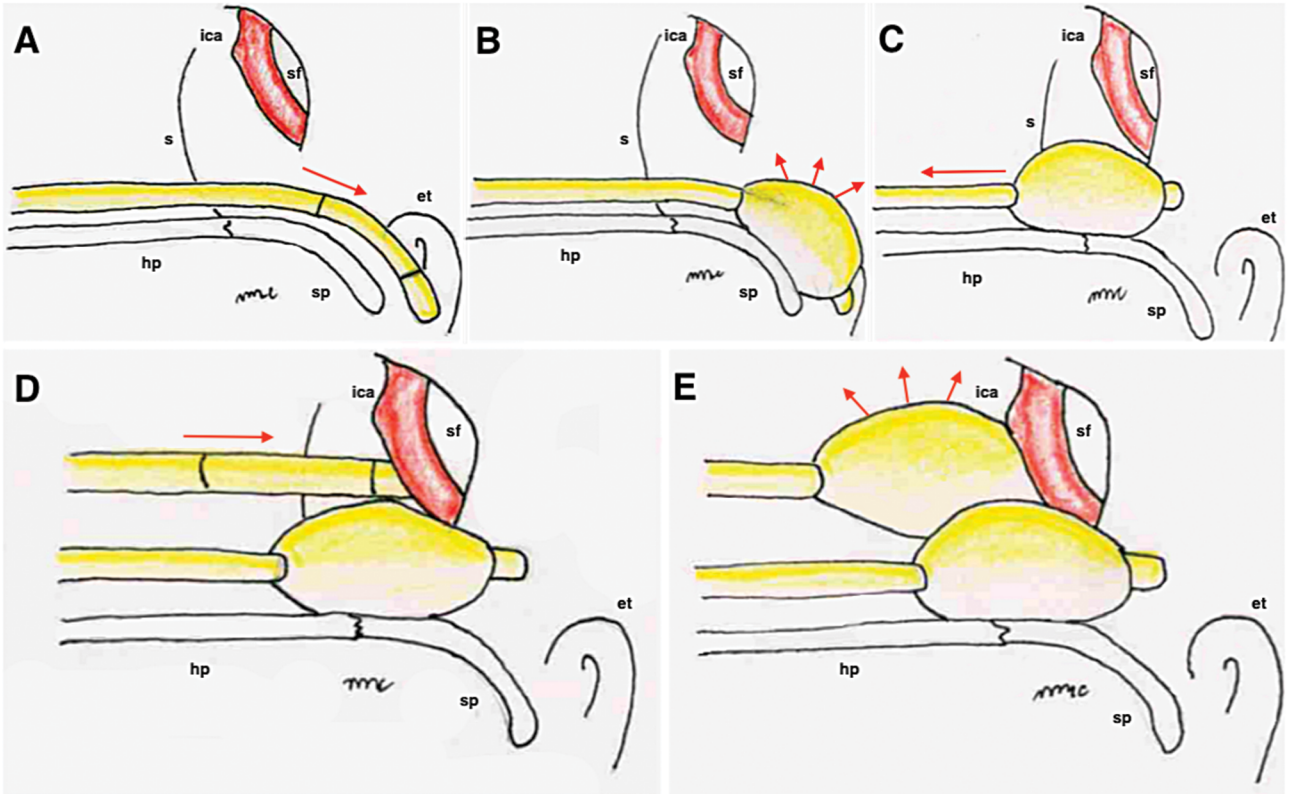

Figure 2. Foley catheter packaging procedure during endonasal carotid bleeding. The first Foley catheter is placed through each nasal cavity until it reaches the rhinopharynx (**A**), and it is filled with 10-15 cc of water in the rhinopharynx (**B**). The catheter is then pulled back to occlude the choana (**C**). A second Foley is put in the nasal fossa (**D**) and then it is filled with saline solution (**E**) to obtain the hemostasis. The procedure is made bilaterally. *S*: nasal septum; *ica*: internal carotid artery; *sf*: sphenoidal sinus; *et*: Eustachian tube; *hp*: hard palate; *sp*: soft palate.

the first ones. A third Foley can so be placed and filled with saline in the nasal fossa of bleeding ***(Figs 2D, 2E)****, having the true hemostatic purpose. The fourth Foley is placed on the contralateral side to avoid displacement of the previous one. The final result is shown in* ***Fig. 3****.*

At the end of the procedure, the bleeding stopped immediately. The patients underwent at first angiography that failed to identify the origin of bleeding, most probably because of the packaging in place. An angio-CT scan was performed two days later and a pseudoaneurysm, created by surgical trauma, was identified ***(Fig. 4A)****. The position of the Foley compared to the lesion was also verified* ***(Fig. 4B)****. A stenting was then performed with success, although an occlusion of the carotid was verified 48 hours after the procedure. The patient had a good contralateral supply through the anterior communicating artery, so she did not show any brain ischemia. On the third day after the event, a repair of the fistula was performed as planned in advance, by obliterating the sphenoid sinus with adipose tissue and then covering the repair with mucoperichondrial graft obtained from nasal septum. The patient did not report any neurologic deficit after the procedures and was discharged 20 days after the event, with indications to endocrinology and radiologic follow-up for her residual.*

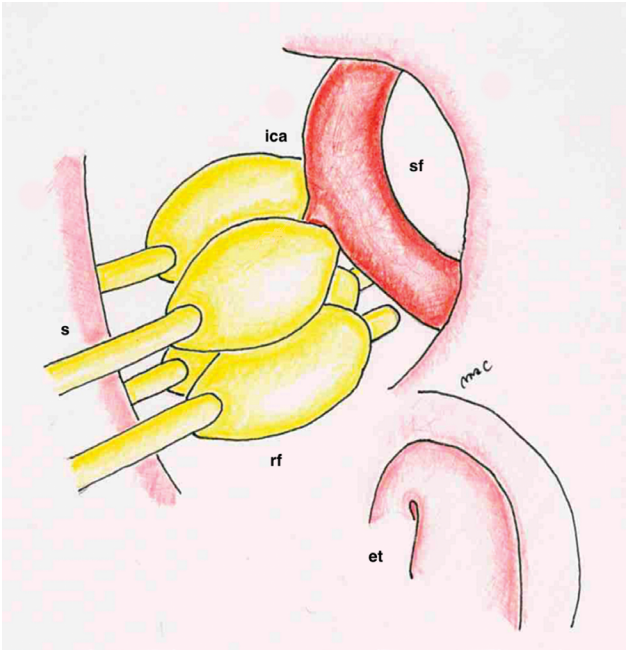

Figure 3. Complete packaging with four Foley catheters. *S*: nasal septum; rf: rhinopharynx; *ica*: internal carotid artery; *sf*: sphenoidal sinus; *et*: Eustachian tube.

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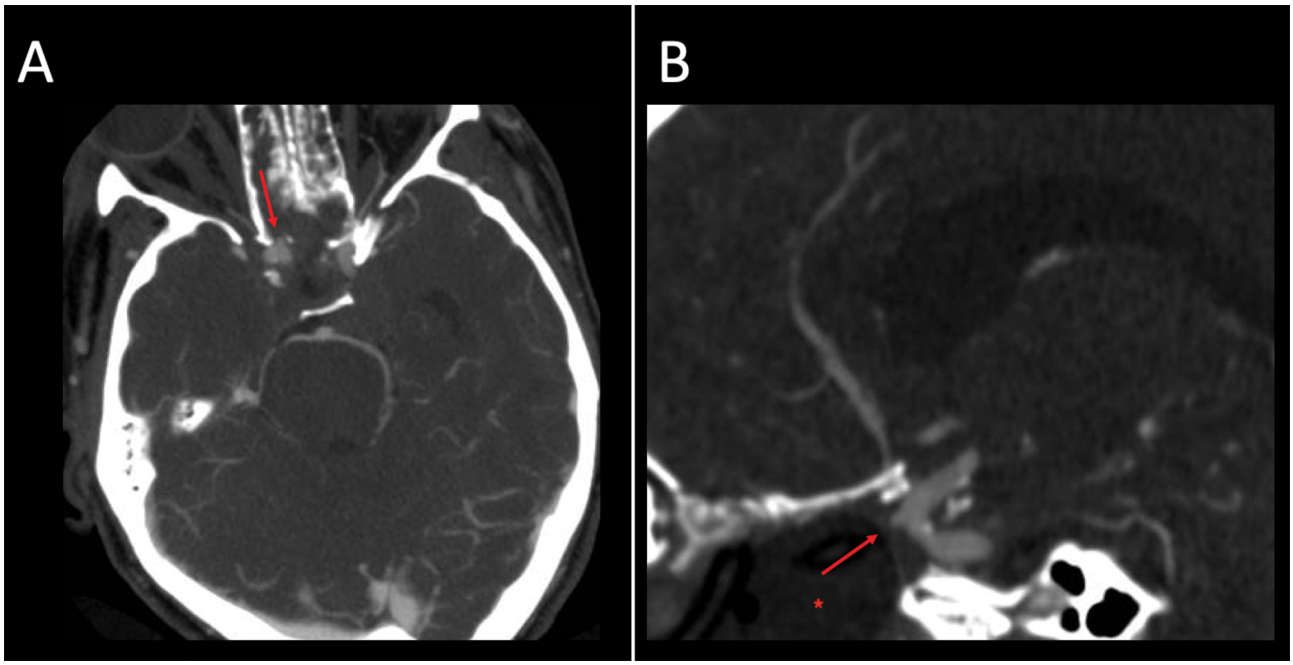

Figure 4. Angio-CT scan showing the cuffed Foley (*), a pseudoaneurysm (arrow) of the ICA, and the close relationship between the pseudoaneurysm and the ending of the Foley. **A**. Axial section. **B**. Sagittal section.

DISCUSSION

EES is considered worldwide the gold-standard technique for diseases of nasal cavity, paranasal sinus and anterior skull base, since it offers significant advantages over open approaches including lack of external incisions, direct access to the tumour without frontal lobe retraction, improved visualization using high-definition endoscopes with dynamic endoscopy, less postoperative pain, and reduced length of hospital stay. However, the expansion of the surgical field in EES exposes more of the ICA, increasing the potential risks of its injury and, hence, massive intraoperative bleeding. Moreover, profuse bleeding during EES can cause loss of intraoperative orientation and obscuration of surgical field.[5,6]

Management of catastrophic hemorrhage requires the skills of an experienced skull base surgeon familiar with the endoscopic hemostatic techniques and an experienced anesthesiology and radiology team familiar with the medical and surgical management of cerebral ischemia including endovascular stenting and revascularization. Risk factors for ICA injury have been identified by numerous groups and include the following: prior surgery, radiation, prolonged bromocriptine, acromegaly (tortuous arteries), anatomical variations (dehiscent carotid), and invasive tumours.[5]

Prevention of ICA injury is the best surgical strategy. The knowledge of the anatomical intracranial course of the ICA and preoperative imaging evaluation are fundamental requirements to minimize the risk of iatrogenic ICA injuries.

The most common segment injured is the cavernous segment due to its anatomic intimate relationship with the lateral wall of the sphenoid sinus. The lateral wall of the sphenoid sinus can be thinned because of anatomical conformities or because of the expansion of the pathology. Incautious surgical maneuvers in the sphenoid sinus and anterior skull base can lead to a damage of ICA.[3]

Chin et al.[5] recently described all possible surgical interventions in case of ICA rupture, reporting nasal packing (72%) using various material (Surgicel, cottonoid, Merocel), endoscopic clip sacrifice (16%), bipolar cautery (8%).

Immediate cessation of the procedure to perform direct hemostasis should be followed by immediate intraoperative or early post-operative angiography to assess ICA injury.[5] Angiographic findings can show either carotid cavernous fistula or a pseudo-aneurism, stenosis, dissection, and thrombosis of the ICA. In the case reported, angiography failed to identify the site of injury, and angio-CT scan was necessary to identify a pseudo-aneurism which was then treated by stenting. If stenting is unsuccessful, endovascular balloon occlusion or coil embolization should be the next treatment, with high risk of ischemic complications.[5]

In the case reported, successful control of bleeding was achieved by placing four Foley catheters through nasal cavity to occupy the entire nasopharynx and sphenoid cavity. The technique is inspired by classic posterior nasal packing used by otolaryngologists to stop bleedings from sphenopalatine artery branches. In those cases, it is nowadays popular to use balloon packing (e.g. Bivona®, Epistax™, etc.),

but only one catheter per time is placed in a nasal fossa. Actually, the drawback of those epistaxis catheters is that they have two cuffs (one anterior and larger and one posterior and smaller). The anterior cuff makes the catheter bulkier compared to a standard Foley urologic catheter, and this prevents the placement of two devices in a nasal fossa at the same time. On the contrary, Foley catheter has a single cuff, and the body of the device is thin and pliable. So, it is possible to place up to four Foley catheters in total, the first two occupying the nasopharynx and the second two the sphenoid cavity and they can be cuffed with water until complete hemostasis is reached. Furthermore, positioning of Foley catheters can be obtained even in cases of low visibility caused by massive bleeding, while other techniques, such as endoscopic clip position, require clear visibility of the surgical field which is hard to reach, especially in a one-hand technique. Last but not least, it is widely and rapidly available in every operative room.

CONCLUSIONS

Inadvertent intraoperative injury to ICA during EES represents a life-threatening event. Approaches for the immediate management of ICA injuries are nasal packing, endoscopic clipping, bipolar coagulation and intraoperative angiography. However, these procedures are not always feasible.

Foley catheter can be a safe, low-cost and widely accessible alternative in the immediate bleeding control in case of injury of ICA during EES.

Ethical statement

This research was conducted in accordance with the World Medical Association Declaration of Helsinki (2002) and with the ethical standards of the institutional research committee of the University Hospital of Modena.

ICMJE Statement

All authors meet the ICMJE authorship criteria.

REFERENCES

1. Battaglia P, Lambertoni A, Castelnuovo P. Transnasal endoscopic surgery: surgical techniques and complications. Adv Otorhinolaryngol 2020; 84:46–55.
2. Alicandri-Ciufelli M, Pingani L, Mariano D, et al. Rating surgical field quality in endoscopic ear surgery: proposal and validation of the "Modena Bleeding Score". Eur Arch Otorhinolaryngol 2019; 276(2):383–8.
3. Lum SG, Gendeh BS, Husain S, et al. Internal carotid artery injury during endonasal sinus surgery: our experience and review of the literature. Acta Otorhinolaryngol Ital 2019; 39(2):130–6.
4. Zhang Y, Tian Z, Li C, et al. A modified endovascular treatment protocol for iatrogenic internal carotid artery injuries following endoscopic endonasal surgery. J Neurosurg 2019; 132(2):343–50.
5. Chin OY, Ghosh R, Fang CH, et al. Internal carotid artery injury in endoscopic endonasal surgery: A systematic review. Laryngoscope 2016; 126(3):582–90.

Использование катетера Фолея для контроля внутреннего каротидного кровотечения во время эндоскопической эндоназальной хирургии

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Дата получения: 13 июля 2020 ♦ **Дата приемки:** 6 октября 2020 ♦ **Дата публикации:** 31 октября 2021

Образец цитирования: Alicandri-Ciufelli M, Maccarrone F, Botti C, Pavesi G, Presutti L. Use of Foley catheter in control of internal carotid hemorrhage during endoscopic endonasal surgery. Folia Med (Plovdiv) 2021;63(5):809-14. doi: 10.3897/folmed.63.e56461.

Резюме

Повреждения внутренней сонной артерии (ВСА) во время эндоскопической эндоназальной хирургии (ВЭХ) представляют собой редкие опасные для жизни случаи. Мы описываем методику контроля повреждений ВСА с помощью катетеров Фолея.

Женщине 26 лет выполнено эндоскопическое трансназальное трансфеноидальное удаление аденомы гипофиза. Произошло послеоперационное подтекание спинномозговой жидкости. Случайное повреждение ВСА произошло во время процедуры восстановления. Для остановки кровотечения было успешно выполнено экстренное закрытие носа путём введения четырёх урологических катетеров Фолея. Пациент не сообщал о неврологических нарушениях.

По мнению авторов, катетеры Фолея подходят для немедленной остановки кровотечения, поскольку они доступны и просты в использовании.

Ключевые слова

баллонная тампонада, эндоскопическая эндоназальная хирургия, повреждение внутренней сонной артерии, внутреннее кровоизлияние в сонную артерию, хирургия гипофиза