



Modified Protocol for Management of ICA Injury in Endoscopic Sinus Surgery

Akshaya Raman, BA¹; Carl H. Snyderman, MD, MBA²

¹University of Pittsburgh School of Medicine, ²UPMC Center for Cranial Base Surgery

Background

Internal carotid artery (ICA) injury during endoscopic sinus surgery (ESS) is a rare but catastrophic complication. Contemporary series place overall major ESS complication rates at ~0.3–0.9% while reported incidence of ICA injury ranges from 0–0.1%¹. Injury risk is heightened during sphenoid work where bone overlying the ICA is thin or dehiscent, the ICA often bulges into the sinus², or bony landmarks are obscured by pathology.

Unlike cranial base surgery cases employing two experienced surgeons and a 4-hand technique, often culminating in neurosurgical repair of minor injuries, ESS case literature repeatedly documents first-line field control by packing and rapid coordination with neuro-interventional teams, underscoring the need for an ESS-specific, damage-control algorithm^{3,4,5}.

Objectives

To compare resource availability between skull base and ESS operating rooms and, using peer-reviewed reports of ICA injury in ESS, derive a practical management protocol with educational application

Methods

We conducted a review of peer-reviewed reports of ICA injury during ESS (1988–2022) using carotid injury, sphenoidotomy, hemorrhage, and endovascular search terms. Eligible studies described ICA injury during ESS with extractable operative details; skull base and non-ICA vascular injuries were excluded. Data on imaging, OR resources, hemostasis, and endovascular management were abstracted and compared with skull base practice. Recurrent steps were mapped onto our institution's TEAM-ICA framework and refined with multidisciplinary input to develop an ESS-specific management protocol.

Figure 2.
ICA Injury Management Algorithm during Endoscopic Endonasal Surgery

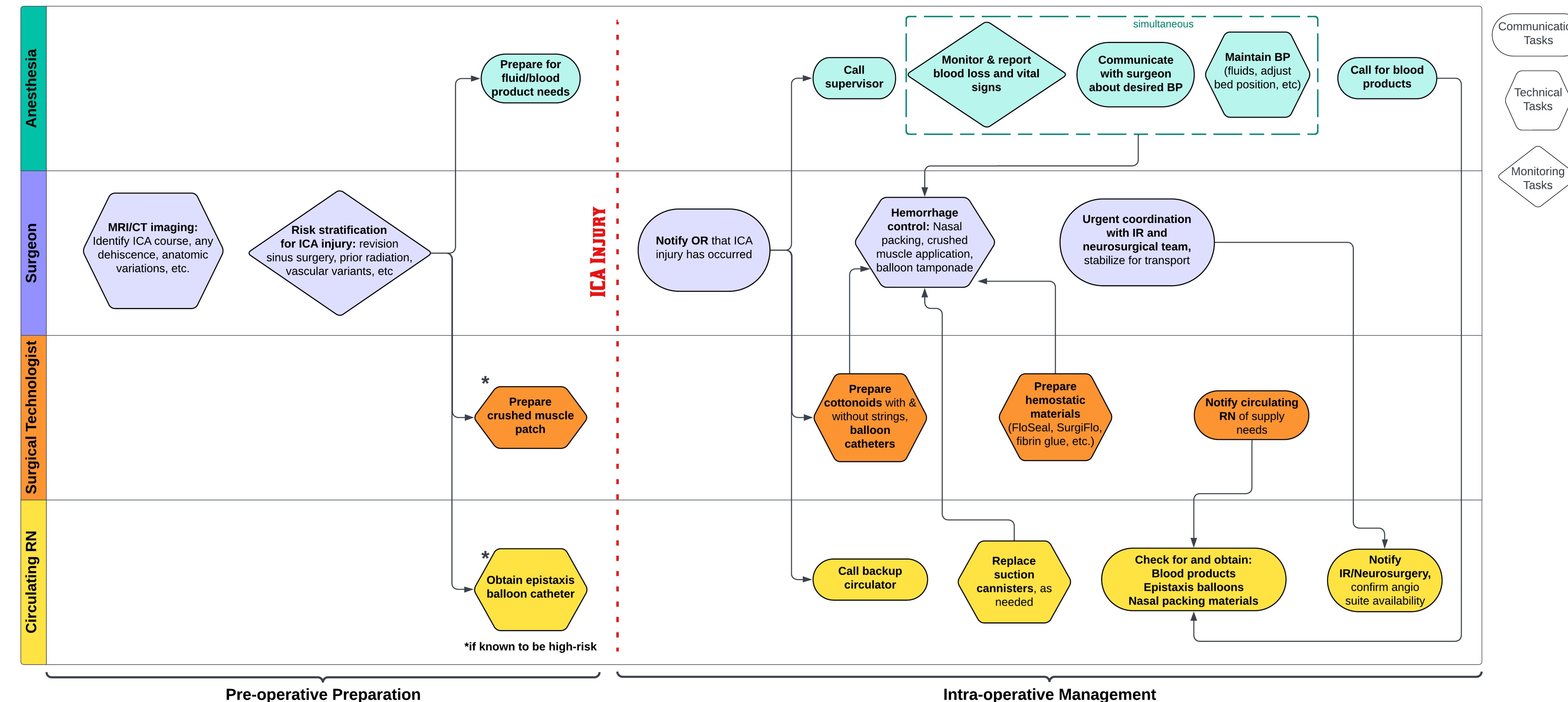
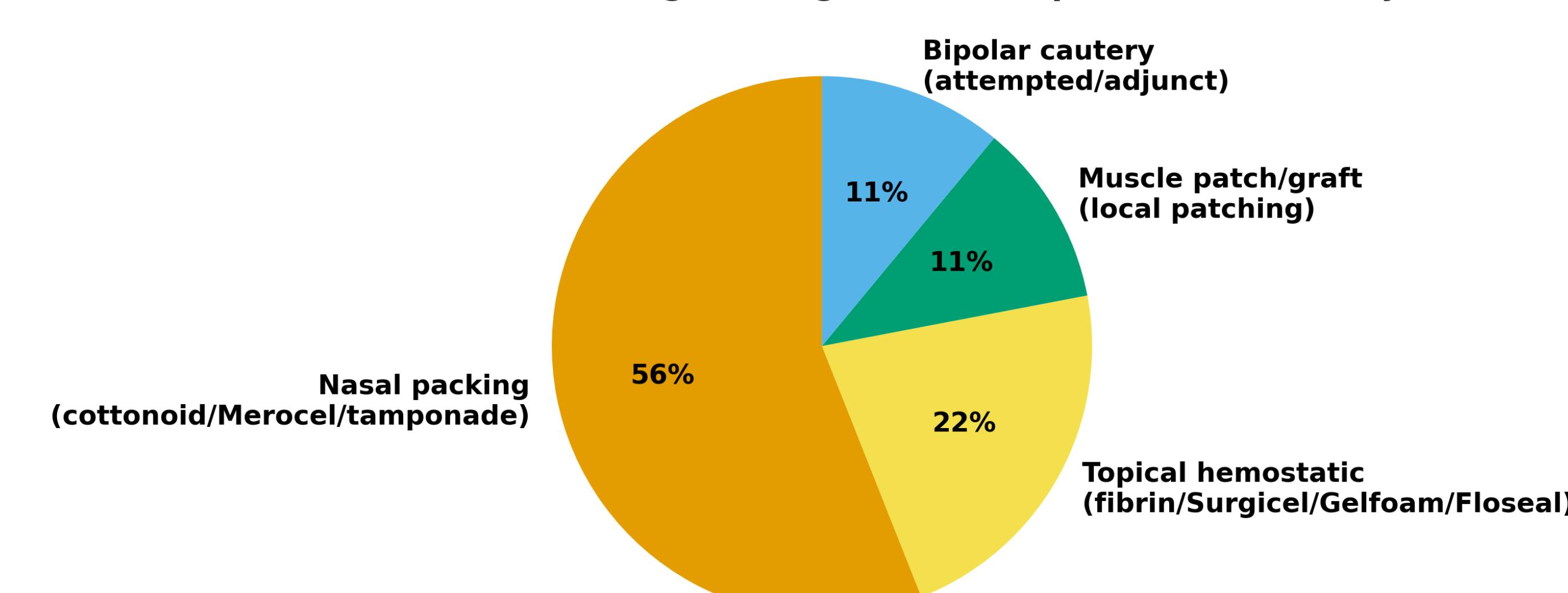


Table 1.

Supplies/Resources	Cranial Base vs Endoscopic Sinus Surgery	
	Cranial Base Surgery	Endoscopic Sinus Surgery
Team surgery	+	-
Specialized OR team	+/-	-
Team simulation training	+/-	-
Image navigation	+	+/-
Neuromonitoring	+	-
Arterial BP monitoring	+	-
Endoscopic bipolar electrocautery	+	+/-
Aneurysm clips	+/-	-
Doppler sonography	+	-
ICG angiography	+/-	-
Hemostatic materials	+	+/-
Adenosine	+/-	-
Interventional Radiology	+	+/-

Figure 1.
Methods of Initial Hemorrhage Management in Reported FESS ICA Injuries



Results

Comparison of skull base and ESS operating rooms showed major differences in available monitoring, vascular tools, and endovascular access [Table 1]. Literature review of ESS ICA-injury cases demonstrated nasal packing/tamponade and topical hemostatics as the most common field control methods, with bipolar cautery and muscle patch use occasionally cited, and balloon packs seldom cited [Figure 1]; definitive care almost always required catheter angiography with stent-graft or coil/balloon occlusion. Integrating these findings, we modified our protocol into a streamlined ESS-focused algorithm: **Pack → Stabilize → Transfer**. [Figure 2].

Conclusions

We present a **modified ICA injury management protocol tailored to ESS**, integrating comparative resource availability to inform immediate goals of management. The algorithm codifies pre-operative risk checks, hemostasis/airway/MAP targets, and neurovascular coordination. Future work will implement simulation-based training and formalize Interventional Radiology transfer pathways into institutional protocols.

Contact

Carl Snyderman, MD, MBA
Department of Otolaryngology
University of Pittsburgh Medical Center
Email: snydermanch@upmc.edu

References

1. Lum SG, Gendeh BS, Husain S, et al. Iatrogenic internal carotid artery injury during endonasal sinus surgery: our experience and review of the literature. *Acta Otorhinolaryngol Ital*. 2019;39(2):130-136. doi:10.14639/0392-100X-1312.
2. Brand Y, Prepageran N. Basic FESS—Step-by-step guide with surgical videos. In: Open Access Atlas of Otolaryngology, Head & Neck Operative Surgery. University of Cape Town; 2019. Accessed October 1, 2025.
3. Lingamanicker V, Irene E, Joshi Y. Management of internal carotid artery injury sustained during routine endoscopic sinus surgery. *Ann R Coll Surg Engl*. 2022;104(2):e122-e124. doi:10.1308/rcsann.2021.0278.
4. Lippert BM, Ringel K, Stoeter P, Hey O, Mann WJ. Stentgraft implantation for treatment of internal carotid artery injury during endonasal sinus surgery. *Am J Rhinol*. 2007;21(4):520-524. doi:10.2500/jr.2007.21.3013.
5. Isenberg SF, Scott JA. Management of massive hemorrhage during endoscopic sinus surgery. *Otolaryngol Head Neck Surg*. 1994;111(1):134-136.
6. May M, Levine HL, Mester SJ, et al. Complications of endoscopic sinus surgery: analysis of 2108 patients—Incidence and prevention. *Laryngoscope*. 1994;104(9 Pt 1):1080-1083.
7. Weidenbacher M, Huk WJ, Iro H. Internal carotid artery injury during functional endoscopic sinus surgery and its management. *Eur Arch Otorhinolaryngol*. 2005;262(8):640-645.