Imaging of the Paranasal Sinuses

Mitigation, Identification, and Workup of Functional Endoscopic Surgery Complications

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KEYWORDS

• CT • Computed tomography • Paranasal sinus • Sinuses • Complications • FESS
• Functional surgery

KEY POINTS

- Preoperative computed tomography (CT) is necessary to evaluate the anatomy of the nasal cavity and paranasal sinuses, identify anatomic variations, determine the extent of disease, and identify prior surgical changes, if present.
- Surgical complications are often identified at the time of surgery. Some major complications are only evident postoperatively, and many require detailed imaging evaluation. The most common, although overall rare, complications necessitating imaging evaluation are cerebrospinal fluid (CSF) leak, vascular injury, intracranial infection, and orbital injury.
- β_2-transferrin assay use has limited the utility of radionuclide cisternography for the identification of CSF leak.
- High-resolution CT is the choice imaging modality in the preoperative evaluation as well as in postoperative complications. CT cisternography is the most widely accepted imaging examination performed to localize and define CSF leaks.
- MRI is used for the evaluation of the extent of orbital injury, intracranial injury, characterization of postoperative skull-base defects, and as the imaging modality to further clarify equivocal CT findings. Catheter angiography with possible treatments to include embolization, stenting, or balloon occlusion remains to be the definitive imaging study when vascular injury is suspected, although CT angiography may be an alternative in selected cases.

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APPLICATION OF IMAGING TO REDUCE FUNCTIONAL ENDOSCOPIC SURGERY COMPLICATIONS

Introduction

In the early 1980s, endoscopic sinus surgery (ESS), now referred to as functional endoscopic surgery (FESS),[1] replaced the external approach procedures and is the treatment of choice for a long list of sinonasal pathologic abnormalities, including inflammatory and neoplastic pathologic abnormalities, as well as skull-base and orbital lesions. The introduction of advanced endoscopes, cutting instruments, imaging techniques, including image guidance, facilitated the surgery and aimed to improve the safety of the procedure. Over the past 3 decades, there has been a steady increase in the number of FESS procedures.[2] Preoperative computerized tomography (CT) is widely accepted as a necessity before entering the surgical theater, because it provides an anatomic roadmap and guidance for the endoscopic procedure.

The close proximity of the surgical site to the orbit and the intracranial compartment, however, continued to associate FESS with a variety of complications. As early as 1929, Mosher[3,4] opined that intranasal ethmoidectomy was "the easiest way to kill a patient". One would have expected that the introduction of advanced surgical instrumentation, advances in imaging, and the introduction of image-guided surgery would avoid these complications. However, because of individual anatomic variations and the lack of correlation between subjective and objective findings, FESS remains an unstandardized procedure; this in turn results in a broad range of surgical strategies. The serious complications have significantly decreased throughout the past decades, but continue to occur (**Table 1**).

The objective of this article is to address how the imaging information might be better used to further reduce FESS complications and avoid serious complications. The emphasis is on identifying, defining, and discussing the most pertinent anatomic

Table 1
Complications of endoscopic sinus surgery, review of literature from 1979 to 2014

Author [Reference], Year	Number of Patients	Major (%)	Minor (%)
Freedman & Kern,[36] 1979	1000	0.6	2.3
Stankiewicz,[5] 1987	90	8	—
Stankiewicz,[6] 1989	90	2	—
Friedman & Katsantonis,[37] 1989	255	0.9	2.1
Levine,[38] 1990	250	0.7	8.3
Wigand & Hosemann,[39] 1991	1000+	0.1	—
Stammberger,[40] 1991	6000	0.6	1.2
Kennedy,[41] 1992	120	—	—
May et al,[42] 1994	—	—	—
Their cases	2108	0.85	6.9
Reviewed cases	2583	1.1	5.4
Gross et al,[43] 1997	1106	13.9	—
Li and Xu,[44] 1998	1089	1.2	4.5
Danielsen & Olofsson,[45] 2006	1915	0.47	5.6
Eviatar et al,[46] 2014	1190	0.31	1.37
Krings et al,[7] 2014	—	—	—
Primary FESS	78,944	0.36	—
Revision FESS	4151	0.46	—