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# Complications of Endoscopic Endonasal Surgery of the Skull Base

Complications of endoscopic endonasal surgery (EES) of the skull base can be categorized as “*almost never*”, *common*, and *unknown*. “Almost never” events include vascular injury. The internal carotid artery is most frequently injured in the parasellar segment and is at greatest risk with invasive tumors. Minor injuries can be managed endoscopically; major injuries require intraoperative control followed by endovascular management. A team approach is essential. Common events include postoperative cerebrospinal fluid (CSF) leak in up to 10% of patients and sinonasal complications. CSF leaks are decreased with the use of vascularized reconstruction (nasoseptal flap [NSF]) and selective use of spinal drains (large defects of the anterior and posterior cranial fossae). Saddle-nose deformity can occur with NSF reconstruction and can be prevented with the reverse septal flap. NSF necrosis is rare and can present with delayed meningitis without CSF leak. The primary risk factor is prior surgery with a narrowed NSF pedicle. Flap vascularity can be assessed intraoperatively with Doppler and indocyanine green (ICG) fluoroscopy. In case of a CSF leak or flap necrosis, secondary vascularized reconstruction includes a lateral nasal wall flap or extracranial pericranial flap. Unknown complications include neurologic injury. Cranial nerve injury can be minimized with intraoperative electromyographic monitoring of motor nerves. The impact of endoscopic surgery on neurocognitive function is unknown. For tumors of the anterior cranial fossa, such as olfactory groove meningiomas, radiographic and neurocognitive studies suggest that an endonasal approach is superior to a transcranial approach for certain tumors based on location and size. Prevention remains the best strategy for complications. Prevention tools include root cause analysis of complications and near-misses, use of preoperative and intraoperative checklists, and clinical care pathways.

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# 鼻内镜颅底手术的并发症

颅底内窥镜鼻内手术 (EES) 的并发症可分为“几乎没有”、常见和未知。“几乎没有”事件包括血管损伤。颈内动脉在鞍旁段最常受伤，最常发生于浸润性肿瘤。轻型的可以通过内窥镜治疗；重型则需要术中控制，然后进行血管内处理。团队协作是必不可少的。常见问题包括高达10%的患者术后脑脊液渗漏和鼻腔并发症。使用血管化重建（鼻中隔粘膜瓣[NSF]）和有选择地使用脊柱引流（前颅窝和后颅窝的大面积缺损）可以减少CSF漏出。鞍鼻畸形可在NSF重建中发生，可通过反向鼻中隔皮瓣来预防。NSF坏死很少见，可表现为延迟性脑膜炎而无CSF漏。主要的风险因素是之前的手术有狭窄的NSF基底。术中可以用多普勒和吲哚青绿 (ICG) 透视评估皮瓣的血管性。如果出现脑脊液渗漏或皮瓣坏死，次要的血管重建包括鼻侧壁瓣或颅外颅骨膜瓣。不明并发症包括神经系统损伤。通过术中对运动神经的肌电图监测，可以将颅神经损伤降到最低。内窥镜手术对神经认知功能的影响尚不清楚。对于前颅窝的肿瘤，如嗅沟脑膜瘤，放射学和神经认知研究表明，根据肿瘤的位置和大小，对于某些肿瘤，鼻内镜手术要优于经颅镜手术。预防仍然是应对并发症的最佳策略。预防工具包括对并发症和险情的根本原因分析，使用术前和术中检查表格，以及临床护理路径。