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Localization and infliction pattern of iatrogenic skull base defects following endoscopic sinus surgery at a teaching hospital

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Abstract

Objective: Aim of this study is to evaluate the incidence, infliction patterns and management of dural injuries with cerebrospinal fluid (CSF) rhinorrhea following endoscopic sinus surgery at a teaching hospital. We present our results of over 14 years of experience from endoscopic repair of CSF rhinorrhea with long-term follow-up.
Methods: A retrospective study was performed by screening 14 years of sinus surgeries for iatrogenically inflicted CSF leaks of the anterior skull base. Obtained data were analyzed to determine the infliction pattern and location of CSF leaks, surgical closure techniques and outcomes. All incidences were further evaluated with regards to the surgeons training status.
Results: 144 patients out of 6908 sinus surgeries were diagnosed with CSF rhinorrhea and underwent subsequent surgical repair. 52 patients had iatrogenic CSF leaks with 32 of the defects inflicted by the department's physician personnel. Average follow-up was 62 months, with a range of 10–168 months. The side distribution was 56.3% to the patient's right side and in 40.6% to the patient's left side. 68.7% became apparent during the initial surgery whereas 31.3% only after surgery. The most common defect location was the anterior ethmoid at the attachment of the medial concha base with 43.7%, followed by the junction between the ethmoid and sphenoid sinus with 21.9%, the frontal sinus aditus with 18.7% and the medial ethmoid region with 9.4%. With increasing training status, surgeons were more prone to cause defects at the frontal sinus aditus whereas surgeons with lesser training status caused more defects at the anterior ethmoid at the medial concha base. The posterior ethmoid and sphenoid sinus was equally prone to defects over all stages of surgical training. Initial endoscopic repair was successful in 87.5% of patients and 95% after revision surgery.
Conclusion: The obtained data confirm the safety of the endonasal sinus surgery according to Wigand's technique. The incidence of iatrogenic CSF leaks at a teaching hospital is not higher than at specialized rhinology departments. We observed a distinct pattern of inflicted skull base defects with different hot-spot areas, prone to damage in various stages of the surgeon's status of expertise.

Keywords: Sinus surgery; CSF leak; Frontal skull base defects

1. Introduction

Endoscopic paranasal sinuses surgery as treatment for chronic sinusitis is among a rhinologist's standard surgical measures. The technique generally applied in our clinic is based on the surgical concept of endonasal sanitation of the paranasal sinuses via a suction-irrigation endoscope established by Wigand in the early 1980s [1–5]. By applying an endoscope as optical aid, it became possible to reduce the rate of complications occurring in the course of surgery [6]. Complications following sinus surgery are commonly categorized in minor and major complications [7–9]. There is broad consent on the definition of complications following sinus surgery. Postoperative haemorrhage, minor pain, eyelid swelling or local inflammation is considered as minor complication. Haemorrhage requiring blood transfusion with damage to the internal carotid artery, deterioration or loss of vision due to optic nerve or eyeball damage, damage to the

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skull base with cerebrospinal fluid (CSF) leakage and accordingly the risk of occurring meningitis, intracranial hematoma or a brain abscess are considered as major complications. These severe complications are, however, occurring rather infrequently, as extensive collective statistics state rates of less than 0.5% for severe and between 5 and 15% for minor complications [10–13].

When evaluating rates of complications, the facility's teaching focus has also to be taken into account. In larger hospitals and university facilities with wide-range surgical teaching activity, the overall complication rate of 8–34% is remarkably higher than in hospitals with minor or no teaching activity, which is stated to be between 2 and 5% [14,15]. The diverse group of surgeons at teaching hospitals raises the question as to whether the surgeons training status can be associated with predominant damage localization. Apart from the fistula incidence and etiology, the applied closure techniques are evaluated and success rates are presented with long-term follow-up data to supplement existing studies.

2. Patients and methods

In a retrospective chart survey with long-term follow-up, 144 patients with skull base defects that have been surgically treated at our department between 1990 and 2004, were analyzed and have been evaluated with regards to etiology of the defect, surgical procedure and outcome. Our patient collective ($n = 144$, male = 91 (63%), female = 53 (37%), median age = 47 years [range 1–77 years]) was divided in those with skull base defects originating ($n = 52$) or not originating ($n = 92$) from prior sinus surgery, as carried out in the treatment of chronic rhinosinusitis. Average follow-up was 62 months (range 10–168 months).

The surgical approach at the Otorhinolaryngology Department of the University of Erlangen was applied according to the ''Wigand'' technique of endoscopic sinus surgery. During this period of time (1990–2004), a total of 6908 bilateral ''Pansinus'' surgeries with a bilateral full exposure of the frontal skull base were carried out. All skull base defects with CSF-leakage were diagnosed and confirmed either by beta-2 transferin protein positive rhinoliquorrhea and/or fluorescein endoscopy.

The group of patients with iatrogenically inflicted CSF leaks is described as follows. 3 patients (2%) suffered iatrogenic CSF leaks following transfacial oncologic sinus surgery and 32 patients (22%) following endoscopic sinus surgery at our department. Another 17 patients (12%) suffered iatrogenic CSF leaks following endoscopic sinus surgery at external institutions and were treated as referrals at our department for CSF-leakage closure. Within the group of patients with non-iatrogenic CSF leaks, 49 patients (34%) suffered CSF leaks caused by head trauma, 26 patients (18%) had a disease related CSF leak and 17 patients (12%) suffered from spontaneous CSF leaks.

Fistula closure was performed by either an underlay or onlay technique and is described in brief. The neighboring mucosa around the defect is thoroughly removed over a distance of up to 4 mm. A free mucosal or mucoperiostal graft is harvested from either the inferior or middle turbinate. With the onlay technique the graft is directly placed onto the defect and fixed by tissue glue, with the underlay technique a free flap of fascia lata is placed below the bone margins and secondarily covered by the free mucosal flap and fibrin glue.

Cases with iatrogenic defects originating from sinus surgery were evaluated considering underlying anatomy, pathology and resulting defect closure. Apart from the closure techniques, intra- and perioperative complications, the training status of the defect inflicting surgeon as well as previous surgical treatment, were all being documented and analyzed. In order to analyze the correlation between defect localization and the respective surgeon's training status, the surgeons were divided into four groups according to their surgical training status at the time of surgery. Since the German training system does not easily translate into the American or British system, an average number of performed endoscopic sinus surgeries is also given in order to assess the surgical experience. Those surgeons, who were still in the first half of their residency (experience <100 sinus surgeries) were allocated ''Grade I''; those, who were already in the second half of their residency (experience <300 sinus surgeries), were allocated ''Grade II''. Specialists (experience >1000 sinus surgeries) were allocated ''Grade III'' and attending physicians or senior doctors (experience >2000 sinus surgeries) were allocated ''Grade IV''.

For better visualization of troublesome anatomical sites, the patients' original CT scans have been analyzed, as far as they were still available, and the individual anatomic as well as pathologic conditions were taken into account. To complete the follow-up, all patients were telephone-interviewed and asked for surgical defect closure, other than that carried out at our hospital.

3. Results

During 1990–2004 a total of 6908 endoscopic sinus surgeries were carried out. Out of this patient collective, a total of 32 (0.46%) skull base defects with CSF-leakage following sinus surgery at our department were found. In the following paragraph the observation refers exclusively to these 32 patients with iatrogenic defects after sinus surgery at our department. 20 patients (62.5%) were undergoing primary surgery, 12 patients (32.5%) had revision sinus surgery. In regards to the side distribution, there were with 18 patients (56.3%) a number of defects occurring on the patient's right side, whereas 13 defects (40.6%) occurred on the patient's left side. Only 1 patient (3.1%) suffered from bilateral defects. Out of the 32 iatrogenic defects, 22 cases