Journal of Clinical Neuroscience 22 (2015) 48–54

Contents lists available at ScienceDirect

Journal of Clinical Neuroscience

journal homepage: www.elsevier.com/locate/jocn

Review

Risk factors for postoperative cerebrospinal fluid leak and meningitis after expanded endoscopic endonasal surgery

Michael E. Ivan [a,d,*], J. Bryan Iorgulescu [a], Ivan El-Sayed [b,d], Michael W. McDermott [a,d], Andrew T. Parsa [c], Steven D. Pletcher [b,d], Arman Jahangiri [a], Jeffrey Wagner [a,d], Manish K. Aghi [a,d]

[a] Department of Neurological Surgery, University of California, San Francisco, 505 Parnassus Avenue, M7, San Francisco, CA 94143-0112, USA
[b] Department of Otolaryngology - Head and Neck Surgery, University of California, San Francisco, CA, USA
[c] Department of Neurological Surgery, Northwestern University, Chicago, IL, USA
[d] Center for Minimally Invasive Skull Base Surgery, University of California, San Francisco, CA, USA

A R T I C L E I N F O

Article history:
Received 28 July 2014
Accepted 1 August 2014

Keywords:
BMI
CSF leak
Endonasal endoscopic surgery
Meningitis
Transsphenoidal surgery

A B S T R A C T

Postoperative cerebrospinal fluid (CSF) leak is a serious complication of transsphenoidal surgery, which can lead to meningitis and often requires reparative surgery. We sought to identify preoperative risk factors for CSF leaks and meningitis. We reviewed 98 consecutive expanded endoscopic endonasal surgeries performed from 2008–2012 and analyzed preoperative comorbidities, intraoperative techniques, and postoperative care. Univariate and multivariate analyses were performed. The most common pathologies addressed included pituitary adenoma, Rathke cyst, chordoma, esthesioneuroblastoma, meningioma, nasopharyngeal carcinoma, and squamous cell carcinoma. There were 11 CSF leaks (11%) and 10 central nervous system (CNS) infections (10%). Univariate and multivariate analysis of preoperative risk factors showed that patients with non-ideal body mass index (BMI) were associated with higher rate of postoperative CSF leak and meningitis (both $p < 0.01$). Also, patients with increasing age were associated with increased CSF leak ($p = 0.03$) and the length of time a lumbar drain was used postoperatively was associated with infection in a univariate analysis. In addition, three of three endoscopic transsphenoidal surgeries combined with open cranial surgery had a postoperative CSF leak and CNS infection rate which was a considerably higher rate than for transsphenoidal surgeries alone or surgeries staged with open cases ($p < 0.01$ and $p = 0.04$, respectively) In this series of expanded endoscopic transsphenoidal surgeries, preoperative BMI remains the most important preoperative predictor for CSF leak and infection. Other risk factors include age, intraoperative CSF leak, lumbar drain duration, and cranial combined cases. Risks associated with complex surgical resections when combining open and endoscopic approaches could be minimized by staging these procedures.

1. Introduction

Endoscopic transsphenoidal approaches are increasingly employed in the treatment of parasellar tumors due to their capacity for aggressive resection while maintaining minimal access and circumventing the need for brain retraction. Initially honed for microscopic resection of pituitary adenomas in the late 1960s, transsphenoidal approaches have since been modified and refined to permit superior outcomes compared to traditional pterional or subfrontal transcranial routes for sellar lesions [1,2]. In particular, incorporating the removal of the tuberculum sellae and the posterior planum sphenoidale, along with the dissection of the dura mater overlaying diaphragmatic sella, has enabled improved access to the suprasellar space for an array of difficult tumors; whereas inferior nasal trajectories, together with flexion of the patient's head, expand access to clival tumors [3,4]. Replacing the microscope with endoscopic techniques, largely adopted following the successes of endoscopic sinus surgery in the 1990s, afforded a panoramic and proximal surgical field of view associated with improved surgical precision manifested as greater rates of gross-total resection accompanied by lower risk for cerebrospinal fluid (CSF) leakage [5,6]. In order to limit the serious risks of postoperative CSF leakage, which can lead to significant morbidity, meningitis, and often requires reparative surgery, endoscopic transsphenoidal approaches demand precise reconstruction and closure of the sellar floor. Additionally, understanding the risk factors that predispose to CSF leakage is imperative for maximizing outcomes in these patients.

* Corresponding author. Tel.: +1 415 353 3904; fax: +1 415 353 3907.
E-mail address: Michaeleivan@gmail.com (M.E. Ivan).

http://dx.doi.org/10.1016/j.jocn.2014.08.009
0967-5868/

There is growing evidence that obesity, defined as a body mass index (BMI) greater than 30.0 kg/m^2, and its postulated sequelae of increased cranial pressure and idiopathic intracranial hypertension, are all significant risk factors for spontaneous CSF leakage [7–12]. These findings are particularly concerning as the prevalence of the obesity epidemic in the USA approaches a third of the adult and adolescent populations alike [7]. Notably, Dloughy et al. have reported a significant ability for elevated BMI to independently predict the risk of CSF leakage following endoscopic transsphenoidal resections of primarily intrasellar masses [10]. Building upon the reported findings, we sought to identify preoperative risk factors for CSF leakages and meningitis following expanded endoscopic transsphenoidal approaches for all suprasellar, parasellar, or clival tumors.

2. Methods

2.1. Patient selection and demographics

Our institutional Committee on Human Research reviewed and approved this study. Ninety-eight consecutive endoscopic endonasal operations were performed on a total of 86 patients at the University of California San Francisco Medical Center. These patients underwent a primary transplanum, transtuberculum, transsellar, or transclival approach which was then extended appropriately to access the entire lesion (Fig. 1). At our institution, typical sellar openings for routine pituitary tumor resection are performed using a microscopic single surgeon technique with the use of devascularized tissue for repair. All patients in this series had a lesion that expanded past the sella and required a more complex approach and repair. Preoperative comorbidities (Table 1), intraoperative features and postoperative treatment data were collected. All patient records were retrospectively reviewed, and diabetes status, pulmonary disorders, prior surgery, prior radiation or chemotherapy, age, pathology, and BMI were recorded for each patient. In addition, surgical and reconstructive techniques, tumor location, use of lumbar subarachnoid drain or lumbar puncture, rate of intraoperative CSF leak, use of a nasal foley catheter, and dexamethasone administration were analyzed. Intraoperative CSF leaks were determined using intraoperative records, and postoperative CSF leaks were determined by clinical evidence of CSF rhinorrhea. Meningitis was considered for any patient with positive CSF cultures or who had clinical symptoms of meningitis.

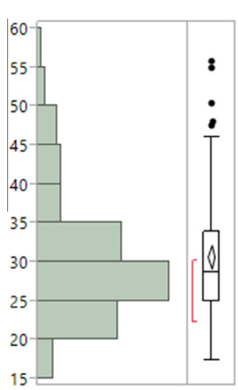

Fig. 1. Distribution of patient body mass index (BMI). Histogram with outlier box plot demonstrating the median and 25% and 75% quantile. The diamond indicates the mean of the distribution. The bracket indicates densest data.

Table 1
Patient demographics

	Number
Operations, n	98
Patients, n	86
Males	44%
Comorbidities	
Diabetes	17
Pulmonary (OSA, COPD, asthma)	28
Prior biopsy	7
Prior surgery	38
Prior radiation/chemotherapy	15
Mean age, years	52
Tumor	87
Non-adenomatous tumor	74
BMI, kg/m^2	
Normal BMI (18.5–25)	22
Abnormal BMI (<18.5 or >25)	76

BMI = body mass index, COPD = chronic obstructive pulmonary disease, OSA = obstructive sleep apnea.

2.2. Surgical technique

Surgical procedures involved a two surgeon, four handed technique including both an otolaryngologist and neurosurgeon. All patients underwent an expanded endonasal endoscopic transsphenoidal approach to the sella and parasellar region in which rigid endoscopes and instrumentation were used. In each case, the otolaryngology team provided access to the sphenoid sinus bilaterally. The middle turbinates were lateralized and not routinely resected. A posterior septectomy was created, removing mucosa and bone, and a sphenoidotomy was enlarged with a microdebrider. Typically, diamond burs were used to burr down the posterior septum, thin it out, and enlarge the sphenoidotomy. Through the sphenoidotomy, the back wall of the sphenoid sinus and both opticocarotid recesses were visualized. Frameless stereotaxy was used to confirm the borders of the sella, including the carotid arteries laterally. The anterior sella, planum, tuberculum or clivus (Fig. 2) was opened with a high-speed drill and enlarged with rongeurs. A cruciate dural incision was made, and tumors were resected with suction and ring curettes. After tumor resection, the sella was reconstructed, typically using abdominal fat autograft sandwiched between two pieces of synthetic dura (DuraGen, Integra LifeSciences, Plainsboro Township, NJ, USA). If a nasal septal flap was available, this was then laid over the collagen matrix.

2.3. Nasoseptal flap preparation

Several studies give evidence that a nasoseptal flap (NSF) decreases CSF leak rates postoperatively, and therefore we recommend NSF for all large dural defects. At the beginning of the operation, a NSF is harvested as a mucoperichondrial flap based on the posterior nasoseptal artery, with incisions as described in a previous report [13]. At the end of the case, once hemostasis is achieved, the exposed brain is covered with a synthetic dural substitute (such as DuraGen) and the edges are tucked intradurally [14]. Fat grafts can sometimes be used to cover the fascia and are in contact with the surrounding bone. The surface of the fat graft is covered with a cellulose material (Surgicel, Ethicon, Somerville, NJ, USA) to form an adherent crust [14]. The fat is then held in place with a fibrin sealant (Confluent Surgical, Waltham, MA, USA), and then the NSF is laid over it and secured with DuraSeal (Confluent Surgical). Careful attention should be made to ensure the NSF is oriented properly; the periosteal surface of the flap must contact the denuded walls of the sinonasal tract. Septal splints are placed over the denuded septal cartilage and bone and left in place for 3 to