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Application of Dural Suture Technique in Transnasal Endoscopic Skull Base Surgery

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Abstract

Objective: To investigate the effectiveness of dural suture in the prevention of cerebrospinal fluid leakage during endoscopic transnasal skull base surgery.

Methods: a total of 162 patients undergoing endoscopic skull base surgery in our hospital were collected. According to the degree of cerebrospinal fluid leakage, they were divided into four grades: no obvious cerebrospinal fluid leakage in grade 0, small flow cerebrospinal fluid leakage in Grade 1, medium flow cerebrospinal fluid leakage in grade 2 and significant cerebrospinal fluid leakage in grade 3.The patients with grade 1 and 2 cerebrospinal fluid leakage were simply sutured with sellar base dura for skull base reconstruction, while patients with grade 3 cerebrospinal fluid leakage were treated with suturing dura mater and fascia lata and covering nasal septum mucosal flap.

Results: among 162 cases, 108 cases (66.6%) had cerebrospinal fluid leakage during operation. According to the grade of cerebrospinal fluid leakage, 54 cases were grade 0, 40 cases were grade 1, 35 cases were grade 2 and 33 cases were grade 3. In 108 cases of intraoperative cerebrospinal fluid leakage, suturing technique was used to repair the cerebrospinal fluid leakage. Two cases (1.85%) were found to have cerebrospinal fluid leakage after operation, which belonged to grade 3 cerebrospinal fluid leakage patients.

Conclusion: dural suture is a simple and effective method for skull base reconstruction in endoscopic transnasal skull base surgery.

Keywords: skull base tumor neuroendoscopy; cerebrospinal fluid leakage; skull base reconstruction

Introduction

With the development of medicine, transnasal neuroendoscopic treatment of skull base tumors has been more and more widely used, including pituitary tumors, craniopharyngiomas, meningiomas in the midline of skull base, trigeminal neurilemmoma, etc.However, the cerebrospinal fluid leakage caused by endoscopic sinus surgery can not be ignored.It has been reported that the incidence of cerebrospinal fluid leakage after the operation of tuberculum sellae meningioma and craniopharyngioma is 4.6% - 40%(Esposito et al.,2007; Garcia et al.,2013; Gardner et al.,2008; Koutourousiou et al.,2014).In recent years, there are more and more reports on the intraoperative repair methods for cerebrospinal fluid leakage, such as artificial dura, fat fascia lata, free mucosal flap, pedicled nasal septum mucosal flap, dural suture, gasket technology, in situ bone flap, etc. single or multi-layer skull base reconstruction can also be selected, but the standard and unified repair principle has not been formed, and the order and effective rate of multi-layer reconstruction are also differentWhether lumbar cistern drainage is needed after operation is also controversial.At present, especially for grade 3 high flow cerebrospinal fluid leakage, the multi-layer reconstruction method of artificial dura fat fascia fascia nasal septum mucosal flap has been widely reported and used. Some scholars have reported that the incidence of postoperative cerebrospinal fluid leakage is 5.7%.In our clinical cases, we used dural suture technique for skull base reconstruction. For patients with small flow cerebrospinal fluid leakage, we simply sutured the sellar base dura for skull base reconstruction, while for patients with high flow cerebrospinal fluid leakage, we sutured fascia lata and sellar base dura mater, covered with nasal septum mucosal flap for

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reconstruction, and postoperative lumbar cistern placement was not routinely performedTube drainage.In the past, we all know the importance of dural suture in the prevention of cerebrospinal fluid leakage and infection in craniotomy, but there is no detailed report on the dural suture in nasal cavity and skull base surgery. This paper discusses the effectiveness of dural suture technology in preventing cerebrospinal fluid leakage in endoscopic transnasal surgery by introducing our methods and efficiency.(Alvarez et al.,2016; Cavallo et al.,2009; Cavallo and Solari et al.,2019)(Iacoangeli et al.,2014; Nishioka et al.,2009; Conger et al.,2018)(Zanation et al.,2009)

Methods

A total of 162 patients undergoing endoscopic skull base surgery in our hospital from January 2017 to June 2019 were collected, including 68 males, with an average age of 54.3 years, ranging from 16 to 76 years old. During the operation, we used two pairs of double nostrils and four hands with 30 ° endoscopy (German Storz). The chief surgeon was the same person, and he was a senior physician with special endoscopic training.According to the degree of cerebrospinal fluid leakage, we divided them into four grades.In the patients with grade 1-2 cerebrospinal fluid leakage, we used artificial dura mater under dura and sutured the dura mater of sellar floor for repair. The dura mater was sutured with 1-2 needles. The method of knotting out of nasal cavity was used, and then iodoform gauze was filled for supporting for 1 week (Fig. 1).For patients with grade 3 cerebrospinal fluid leakage, artificial dura was first paved under the dura mater, then fat was filled, 2-3 needles of dura mater at sellar bottom were sutured by fascia lata, and then nasal septum mucosal flap was placed and iodoform was filled for 2 weeks (Fig. 2).If cerebrospinal fluid rhinorrhea is still found for 3 consecutive days, lumbar cistern drainage should be placed, and the average daily drainage volume should be controlled at about 200ml.

Figure 1. **A: the sellar septum collapses after tumor resection, normal pituitary is attached to sellar septum, and small flow cerebrospinal fluid leakage can be seen at arrow point; B: artificial dura is embedded between sellar base dura mater and sellar septum, and fixed with hemostatic gauze around; C: dural suture for wrapping and supporting.**

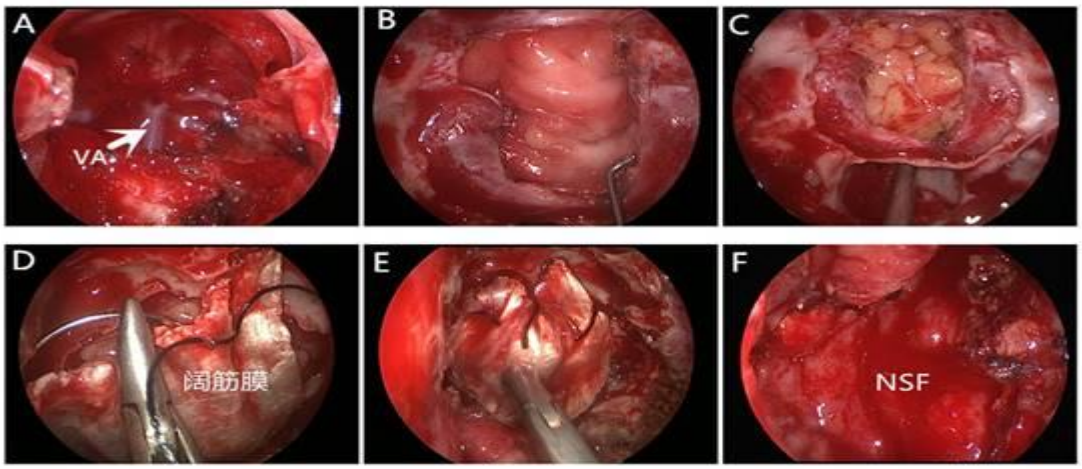

Figure 2. **A: skull base dural defect after craniopharyngioma resection, basilar artery can be seen as indicated by the arrow; B: artificial dura is embedded under the dura; C: autologous fat is used to block dural defect; D: dura mater and fascia lata are sutured; E: three stitches are sutured to show that fascia lata is in good position to prevent displacement; F: the pedicled nasal septum mucosal flap is finally covered. (VA: basilar artery; NSF: nasal septal mucosal flap)**

Results

Among 162 patients, 108 (66.6%) had cerebrospinal fluid leakage during operation, including 40 cases with grade 1 CSF leakage, 35 cases with grade 2 CSF leakage and 33 cases with grade 3 CSF leakage.The details of patients and the grade of cerebrospinal fluid leakage during operation are shown in Table 1.As mentioned above, for patients with grade 1-2 cerebrospinal fluid leakage, we used artificial dura under the dura mater and sutured the sellar bottom dura for repair, while for patients with grade 3 cerebrospinal fluid leakage, we used the method of multilayer reconstruction by laying artificial dura under the dura, then filling with fat, taking the fascia lata to suture the sellar floor dura for 2-3 needles, and then placing the nasal septum mucosal flap.Among them, there were 2 cases with continuous cerebrospinal fluid leakage after operation, 1 case was craniopharyngioma, 1 case was tuberculum sellae meningioma, and 2 cases still had continuous cerebrospinal fluid rhinorrhea after 3 days of observation. We placed lumbar cistern drainage for 2 weeks. All patients were confirmed to have no cerebrospinal fluid leakage by nasal endoscopy at discharge.

As shown in Table 1, among the 162 patients enrolled, 137 patients (84.56%) were pituitary adenomas, which was related to the high incidence rate of pituitary tumors. Among 108 patients with cerebrospinal fluid leakage, 85 patients were diagnosed as pituitary tumor, accounting for 78.70%. Among them, 1 had cerebrospinal fluid leakage accounting for 36.11%, 2 grade CSF leakage accounted for 32.40%, and 32.40% grade CSF leakage accounted for 36.11%.Among 33 patients with grade 3 cerebrospinal fluid leakage, 66.66% were non pituitary tumor patients (craniopharyngioma, tuberculum sellae meningioma, lac's cyst). For craniopharyngioma and tuberculum sellae meningioma, due to the nature of the tumor itself, we adopted the extended transnasal approach through the tuberculum sellae.

In our two cases of Rathke's cyst, cerebrospinal fluid leakage occurred during the operation. The reason is that the first cyst has a large volume. Most of the lac's cysts grow mainly in the intrasellar and suprasellar regions. Secondly, in order to achieve total resection and reduce the recurrence rate, we adopted strict capsular separation, and the capsular and sellar septum were closely adhered, which led to the sellar sac during the process of capsulorhexisSeptum rupture.In these 2 cases, 1 case was grade 1 cerebrospinal fluid leakage and 1 case was grade 3 cerebrospinal fluid leakage. No cerebrospinal fluid leakage was found after skull base reconstruction.

In 108 cases of cerebrospinal fluid leakage patients, no postoperative cerebrospinal fluid leakage was found in 1-2 grade cerebrospinal fluid leakage patients. In grade 3 cerebrospinal fluid leakage patients, 2 patients had postoperative cerebrospinal fluid leakage, accounting for 1.85%, and 6.06% in grade 3 cerebrospinal fluid leakage patients (Table 2).Among them, 1 case was craniopharyngioma and 1 case was tuberculum sellae meningioma. Because of the enlarged approach via tuberculum sellae, the dural defect of skull base was large (see Figure 2a), and the healing time of mucosa was prolonged.Because cerebrospinal fluid leakage was still found more than 3 days after operation, we timely placed lumbar cistern drainage tube, a total of 2 weeks, through drainage, cerebrospinal fluid leakage disappeared, avoid reoperation repair.

Table 1. **Summary of pathological classification of tumor and classification of cerebrospinal fluid leakage during operation**

Classification of cerebrospinal fluid leakage Pathological classification 0 1 2 3 total
Nonfunctional pituitary adenoma
Prolactin pituitary adenoma
Growth hormone pituitary adenoma 933015
Adrenocorticotropic pituitary adenoma
Craniopharyngioma 0.15 15
Tuberculum sellae meningioma 0.66
Lacker's cyst

Discussion

Cerebrospinal fluid leakage is a common complication in endoscopic naso sphenoid approach tumor resection, which may cause intracranial infection, meningitis and other malignant events (Chowdhury T, Prabhakar h, bithal P K, et al. Immediate postoperative complications in transphenonial pituitary surgery: a prospective study [J]. Saudi J Anaesth, 2014, 8 (3): 335-341). Therefore, ideal intracranial reconstruction should achieve the main purpose of correcting cerebrospinal fluid leakage. Meanwhile, intracranial reconstruction should restore the permanent barrier between skull base and extracranial to prevent the formation of cerebral hernia (Park JH, Choi JH, Kim y I, et al. Modi fi ed graded repair of cerebellar fluid leaks in endoscopic endonasal transsphenoidal surgery [J]. J Korean Neurosurg SOC, 2015,58(1):36-42 ）。However, there is no uniform standard for skull base

reconstruction, and many scholars have reported the efficacy of dural suture in nasal surgery.However, dural suture is regarded as a difficult and time-consuming technique in transnasal skull base surgery, which requires a good experience of endoscopic surgery and a long time of repeated practice.We used 5-0 non absorbable suture and Sakamoto in the reconstruction processProfessor n's method of knotting the nasal cavity outside the nasal cavity takes about 5 minutes on average, but the specific number of stitches needed depends on the actual situation. For patients with grade 1-2 cerebrospinal fluid leakage, 1-2 stitches can be sutured, mainly for wrapping and supporting. For patients with grade 3 cerebrospinal fluid leakage, as many stitches as possible are needed. Takeuchi (Kazuhito and Tetsuya,2015) and other scholars even reported a "shoelace type"The continuous suture method is used to suture the dura mater of sellar floor, but it may take more time and energy.(Kassam et al.,2008; Kitano et al.,2007; Sakamoto et al.,2013)

At present, there are many reports on multi-layer reconstruction of skull base, including Garcia NavarroV [5] it is reported that the gasket seal method can greatly reduce the incidence of cerebrospinal fluid leakage after nasal skull base surgery. We have also tried to provide rigid support by shaping nasal septum or pear bone, but this method can not be applied to all cases, and there are certain safety risks, such as multiple bone defects at the same time or there is not enough bone support aroundIn addition, when the optic nerve and anterior communicating artery are widely exposed in the operation of craniopharyngioma or tuberculum sellae meningioma, rigid support is more dangerous.However, the dural suture method can be applied to almost any skull base surgery reconstruction, because the current research and investigation found that a common cause of cerebrospinal fluid leakage after multi-layer reconstruction of skull base is the displacement of fascia lata or mucosal flap. Through the method of dural suture, the incidence of the above situation is greatly reduced. In our early clinical cases, weAfter the reconstruction of skull base, we will choose the catheter balloon for support, but now we also give up this method and use iodoform gauze instead. Because we found that the use of balloon support may lead to the increase of sellar pressure and decrease of visual acuity after operation. Moreover, during the process of injecting water into the balloon, there is a possibility of displacement of mucosal flap due to pressure failure(Kassam et al.,2011; Jakimovski and Bonci,2014).

For most patients with grade 1-2 cerebrospinal fluid leakage, no matter what reconstruction method and reconstruction sequence are adopted, good repair results can be obtained. In our case, all patients with grade 1-2 CSF leakage after dural suture repair did not have cerebrospinal fluid leakage.But for patients with grade 3 high flow cerebrospinal fluid leakage, we should pay attention to the following conditions: no dead space under the mucosal flap, no displacement of fascia lata and mucosal flap, good blood supply of mucosal flap and postoperative patient compliance.

Of the 33 patients with grade 3 cerebrospinal fluid leakage treated by us, 2 cases had postoperative cerebrospinal fluid leakage, but all of them achieved the purpose of repair by placing lumbar cistern drainage.By comparing the research of different students on cerebrospinal fluid leakage after nasal surgery, it is found that the incidence of postoperative cerebrospinal fluid leakage varies from 4.5% to 20.7%. The incidence of postoperative cerebrospinal fluid leakage in this study is 6.06% (Table 2), which belongs to the relatively low level reported at home and abroad.However, due to the small number of cases in our study, further comparative study of big data and long-term follow-up observation are still needed.[4,5,7,11]

Table 2. **Summary of cases of cerebrospinal fluid leakage after skull base reconstruction with different grades**

Classification of intraoperative cerebrospinal fluid leakage cases of postoperative cerebrospinal fluid leakage
1Grade 400
2Grade 350
3Grade 33 2 (6.06%)
Total 108 2 (1.85%)

Conclusion

It is a safe, simple and effective method to use dural suture repair scheme according to different levels of cerebrospinal fluid leakage in transnasal endoscopic skull base surgery. However, in order to ensure the quality of repair, it is necessary to have solid endoscopic operation skills, long-term suture training and good patience.

References

[1] Alvarez BerasteguiGR,Raza SM,Anand VK,Schwartz TH 2016. Endonasal endoscopic

[2] transsphenoidal chiasmapexy using a clival cranial base cranioplasty for visual loss from massive empty sella following macroprolactinoma treatment with bromocriptine:case report.*J Neurosurg*. 124:1025-1031.https://doi.org/10.3171/2015.2.JNS142015

[3] Cavallo LM, Prevedello DM, Solari D 2009.Extended endoscopic endonasal transsphenoidal approach for residual or recurrent craniopharyngiomas. *J Neurosurg*. II 1:578-589.https://doi.org/10.3171/2009.2.JNS081026

[4] Cavallo LM,Solari D,Somma T,Cappabianca P.2019.The3f(fat, flap&flash)technique for skull base reconstruction after endoscopic endonasal suprasellar approach.*World Neurosurg* 03.125.https://doi.org/10.1016/j.wneu.2019.03.125

[5] Conger A, Zhao F, Wang X 2018.Evolution of the graded repair of CSF leaks and skull base defects in endonasal endoscopic tumor surgery:trends in repair failure and meningitis rates in 509 patients.*J Neurosurg*.130:861-875.DOI: https://doi.org/10.3171/2017.11.JNS172141

[6] Esposito F, Dusick JR, Fatemi N, Kelly DF.2007; Graded repair of cranial base defects and cerebrospinal fluid leaks in transsphenoidal surgery. *Neurosurgery*. 60:295-303. https://doi.org/10.1227/01.NEU.0000255354.64077.66

[7] Garcia-Navarro V, Anand VK, Schwartz TH 2013. Gasket seal closure for extended endonasal endoscopic skull base surgery:effificacy in a large case series.*World Neurosurg*.80:563-568. https://doi.org/10.1016/j.wneu.2011.08.034

[8] Gardner PA, Kassam AB, Thomas A.2008; Endoscopic endonasal resection of anterior cranial base meningiomas. *Neurosurgery*. 63:36-52.https://doi.org/10.1227/01.NEU.0000335069.30319.1E

[9] Iacoangeli M, Di Rienzo A, di Somma LG 2014. Improving the endoscopic endonasal transclivalapproach: the importance of a precise layer by layer reconstruction. *Br J Neurosurg.* 28:241 - 246.https://doi.org/10.3109/02688697.2013.835375

[10] Jakimovski D, Bonci G.2014; Incidence and signifificance of intraoperative cerebrospinal flfluid leak in endoscopic pituitary surgery using intrathecal flfluorescein. *World Neurosurg*. 82: 513-523.https://doi.org/10.1016/j.wneu.2013.06.005

[11] Kassam AB, Prevedello DM, Carrau RL. 2011; Endoscopic endonasal skull base surgery: analysis of complications in the authors' initial 800 patients. *J Neurosurg*.114:1544-1568.https://doi.org/10.3171/2010.10.JNS09406

[12] Kassam AB, Thomas A, Carrau RL 2008;Endoscopic reconstruction of the cranial base using a pedicled nasoseptal flflap. *Neurosurgery.* 63: ONS44-52. https://doi.org/10.1227/01.NEU.0000297074.13423.F5

[13] Kazuhito Takeuchi,Tetsuya Nagatani.2015;How I do it:shoelace watertight dural closure in extended transsphenoidal surgery.*NEUROSURGICAL TECHNIQUES*.157:2089-2092. https://doi.org/10.1007/s00701-015-2612-4

[14] Kitano M, Taneda M, Nakao Y. 2007;Postoperative improvement in visual function in patients with tuberculum sellae meningiomas: results of the extended transsphenoidal and transcranial approaches. *J Neurosurg.* 107:337-346.https://doi.org/10.3171/JNS-07/08/0337

[15] Koutourousiou M, Fernandez-Miranda JC, Stefko ST, Wang EW, Snyderman CH, Gardner PA. 2014;Endoscopic endonasal surgery for suprasellar meningiomas: experience with 75 patients.*J Neurosurg*. 120:1326-1339.https://doi.org/10.3171/2014.2.JNS137677

[16] Nishioka H, Izawa H, Ikeda Y, Namatame H, Fukami S, Haraoka J.2009; Dural suturing for repair of cerebrospinal flfluid leak in transnasal transsphenoidal surgery. *Acta Neurochir (Wien)*. 151: 1427-1430.https://doi.org/10.1007/s00701-009-0406-2

[17] Sakamoto N, Akutsu H, Takano S, Yamamoto T, Matsumura A.2013; Useful “sliding-lock-knot” technique for suturing dural patch to prevent cerebrospinal flfluid leakage after extended transsphenoidal surgery. *Surg Neurol Int*. 4:19.doi: 10.4103/2152-7806.107546

Zanation AM, Carrau RL, Snyderman CH 2009. Nasoseptal flflap reconstruction of high flflow intraoperative cerebral spinal flfluid leaks during endoscopic skull base surgery. *Am J*

Rhinol Allergy. 23:518-521.https://doi.org/10.2500/ajra.2009.23.3378