Dural Defect Repair in Translabyrinthine Acoustic Neuroma Surgery and Its Implications in Cerebrospinal Fluid Leak Occurrence

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Abstract

Cerebrospinal fluid (CSF) leak is a complication that may occur after translabyrinthine (translab) acoustic neuroma (AN) removal. The aim of this study is to verify the incidence of CSF leak using two techniques for dural defect closure in translab AN surgery and present a new technique for dural repair. A retrospective study was held, reviewing charts of 34 patients in a tertiary neurotologic referral center. Out of these 34 patients that underwent translab AN excision in a 1-year period, 18 had their dural defect repaired using only abdominal fat graft and 16 using synthetic dura substitute (SDS) plus abdominal fat tissue. One patient (5.5%) in the first group had CSF leak and 1 (6.2%) in the second group had CSF leak postoperatively. Our data suggest that there are no significant differences in CSF leak rates using both techniques, although studies in a larger series must be undertaken to conclude it. We believe that the development of some points in the new technique for dural repair can achieve better results and reduce the CSF leak incidence in the translabyrinthine acoustic neuroma surgery in the near future.

Keywords
- acoustic neuroma
- translabyrinthine
- cerebrospinal fluid leak
- dural defect

Introduction

Cerebrospinal fluid (CSF) escaping from the subarachnoid space may occur following lateral skull base craniotomies for the excision of cerebellopontine angle (CPA) neoplasms. Acoustic neuromas (also called vestibular schwannomas) account for the vast majority of these CPA tumors, followed by meningiomas of the CPA and other benign neoplasms occurring in this site.

CSF leakage represents a complication in acoustic neuroma (AN) and lateral skull base surgery, regardless of the approach used.[1] It can lead to meningitis and impaired wound healing, and it often requires surgical treatment (reoperation).[2]

CSF leakage can be observed by liquid spreading from the surgical wound or by the presence of rhinorrhea and/or otorrhea after the procedure, as the cerebrospinal liquid escapes into the Eustachian tube to the nasopharynx and nasal cavity or from the mastoid cavity to the middle ear and external auditory canal, respectively.

The incidence rates of CSF leak range from zero to 20%, depending on the surgeon, technique, or surgical team's experience described in the literature. Therefore, preventing and avoiding these CSF fistulae are very important points to a safe AN surgery.

Several techniques of wound closure in translabyrinthine (translab) AN surgery were already described in different centers worldwide. In this study, we intend to show our experience in dural defect repair after translab vestibular schwannoma removal and the incidence rates of CSF leak in each of the two techniques used. A second objective is to

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present a new method for dural closure, which is one of the two techniques reported in this article.

Materials and Methods

A retrospective study was held reviewing the charts of 34 patients that underwent AN removal in a 1-year period.

All of the patients came from the author's private clinic, which is a neurotologic private practice referral center.

The ages of the individuals of the research range from 16 to 70 years (medium age 51.47 years). There were 21 women (61.76%) and 13 (38.23%) men in our data.

The neoplasms were right-sided in 19 subjects (55.88%) and left-sided in 15 individuals (44.11%).

Tumor sizes stayed between 1.2 and 3.3 cm (medium size 2.3 cm).

The patients underwent AN excision in a tertiary private medical center.

All procedures were performed by a multidisciplinary team consisting of a neurotologist and a neurosurgeon.

The routes used in the surgical procedures were the translab and the enlarged translab approaches.

Two techniques were used to repair the dural defect after the tumor removal.

In 18 patients (52.94%), the closure of the dura was performed using only pieces of abdominal fat graft (first group).

After gently removing the tumor, we divided the abdominal fat tissue into several strips.

Bone wax and fat tissue were used to seal the remaining mastoid air cells. The strips of fat tissue were carefully placed over the posterior fossa, medially over the brainstem and facial nerve region and anteriorly over the internal auditory canal and superior to it. A second layer of fat tissue strips was placed over the sigmoid sinus and over the first layer of fat strips.

Then, the musculoperiosteal flap, the subcutaneous, and skin plans were closed using tight sutures.

Sixteen subjects (47.05%) had their dura mater defect repaired using biosynthetic dura plus abdominal fat grafts (second group).

The technique used in the second group was not found in the literature, despite the hard search done by the authors. After removal of the vestibular schwannoma and careful hemostasia of the CPA site, we obliterated the remaining mastoid air cells using bone wax and abdominal fat tissue. Pieces of synthetic dura substitute (SDS) derived from porcine small intestinal submucosa[3] were cut and prepared to close the dural defect. We put two layers of SDS under the remaining thin bone medial to the sigmoid sinus (in the translab approach), replacing the posterior fossa dura. We sealed the dura substitute to the bone using fibrin glue. In the patients that underwent tumor resection by the enlarged translab approach, there was no bone medial to the sigmoid sinus, but only remnants of posterior fossa dura. Again, the surgeons gently put two layers of SDS under the dura remnants and sealed them with fibrin glue.

Then, strips of abdominal fat tissue were placed under the dura substitute, covering the brainstem and facial nerve sites. In addition, abdominal fat strips were used to fill the attic and to cover the middle fossa dura, the internal auditory canal, and the region superior to the jugular bulb. After that, two strips of SDS were placed covering all the abdominal fat tissue. Fibrin glue was again used to keep the fat tissue and the dura substitute in place. The musculoperiosteal layer, subcutaneous tissue and skin were closed using tight sutures.

We called this procedure "the sandwich technique" for dural defect repair, as the fat tissue was almost surrounded by the SDS.

Obliteration of the Eustachian tube (using the incus) and packing of the middle ear (using pieces of muscle) were carefully done through the facial recess in both techniques before closure of the dural defect.

The follow-up period of all the patients was at least 1 year before the preparation of this article.

Results

There were no cases of wound infection or meningitis in either group.

There was one case of CSF leak in the first group (5.5%). In this case, the spinal fluid flowed from the postauricular incision. The CSF leakage was noticed when the head dresses were removed 48 hours after the procedure, still in the intensive care unit. This patient had no otorrhea or rhinorrhea.

We decided to use conservative maneuvers to manage the situation. The patient stayed in absolute bed rest and he was advised not to cough or make any physical efforts to avoid any increase of the CSF pressure. The incision was carefully oversewed and the sterile dresses were changed daily by one of the surgeons responsible for the procedure. In addition, the patient was already under high doses of broad-spectrum intravenous antibiotics.

We observed, during the changes of the head dressing, that the amount of fluid coming from the wound incision was decreasing day by day. By the sixth postoperative day, there was no more CSF leakage. The patient stayed in the hospital for 2 more days to make sure the fluid leakage had truly stopped; he was discharged on the eighth postoperative day. There were no more signs of CSF leaks in 1 year of follow-up.

In the second group, CSF leak was seen in one (6.2%) of the 16 patients that underwent AN translab microsurgery using the "sandwich technique" for dural closure.

In this individual, we noticed, by postoperative day two, that the head dressing was partially wet in the region around the postauricular incision. We removed the head dresses and found fluid flowing out of the incision and coming from the external auditory canal as well. The patient had no rhinorrhea, and reported only a mild headache in these two postoperative days. Therefore, we considered the CSF pressure as high and opted for placement of a lumbar drain. All of the conservative measures used in the other patient with CSF leak were adopted, as well. Furthermore, we decided to use acetazolamide to decrease the CSF pressure. The neurosurgeon of our surgical team inserted a lumbar subarachnoid drain. The drain remained for 4 days as the drainage stopped,

and there was no more otorrhea or CSF flowing out of the incision. After the drain removal, the patient stayed in the hospital for 3 more days and was discharged using acetazolamide orally for the next 15 days.

No fistulae signs were found in 1 year of follow-up.

On subsequent imaging studies (magnetic resonance imaging) there were no adverse reactions to the dural substitute or local inflammation signs.

Discussion

CSF leakage rates have remained stable in recent decades despite numerous innovative attempts to improve dural closure, seal transected air cells tracts, and occlude anatomic pathways.[4]

Our findings and CSF leak rates in both techniques suggest that abdominal fat graft alone and the use of porcine small intestinal submucosa dural substitute associated with fat graft are useful and safe methods for dural defect repair, despite the necessity of more studies in larger series to confirm this conclusion, especially considering the new technique performed in the second group.

Selesnick et al reported a CSF leak rate of 9.5% in 3118 procedures using the translab approach for AN removal.[5] On the other hand, Goddard et al reported no CSF leaks using a technique with abdominal fat graft harvest and layered closure, and also said that success in wound closure and CSF leak prevention after translab craniotomy for the removal of ANs did not require the creation of a facial recess, manipulation of the ossicles, direct Eustachian tube plugging, or the use of alloplastic space-occupying materials.[6] There is a degree of controversy on this point, because we still believe in the necessity of the creation of a facial recess and the Eustachian tube plugging to prevent CSF leakage in the translab approach. We also think that the obliteration of the middle ear with small pieces of muscle plays an important role in the avoidance of CSF leaks.

Wu et al showed that the use of abdominal fat graft alone in the translab approach led to a lower CSF leak incidence (7.4%) than using temporalis muscle fascia associated with fat tissue graft.[7]

Falcioni et al reported a series of 200 patients that underwent enlarged translab vestibular schwannoma removal without any CSF leaks postoperatively. In this article, the authors emphasized the importance of taking appropriate measures, such as total conservation of the fascioperiosteal flap, obliteration of all petrosal cells communicating with the middle ear, removing the incus in a correct way, closing the attic with periosteum, obliterating the surgical cavity with strips of abdominal fat inside the CPA, suturing the musculoperiosteal layer in a correct way, and fixing the skin flap to the underlying surface.[8] All of these steps were carefully followed in our surgical procedures, as well, but we could not reduce our CSF leak rates to null.

No patients in our series presented rhinorrhea, and our fistulae cases were treated with conservative measures—and lumbar drain in one case. Although conservative measures are effective for the management of wound leaks, they are less effective in the treatment of patients with rhinorrhea, whose probability of a second surgical intervention is high.[9]

The "sandwich technique" for dural defect repair in translab craniotomies can be improved in many points and achieve even better results. It is a useful means of dural closure, as there is a replacement of the posterior fossa dura mater and there is an obliteration of the CPA with the abdominal fat grafts inside it simultaneously. The dural substitute is attached to the remnants of the posterior fossa dura (when we use the enlarged translab approach) or to the thin bone left medial to the sigmoid sinus (when the conventional translab approach is performed) using fibrin glue. The synthetic dural substitute could be sutured to the posterior fossa dura remnants or to the thin layer of bone that protects the posterior fossa dura in the conventional translab approach.

The strips of abdominal fat tissue obliterate the CPA and also the posterior fossa, as the strips pass under the dura substitute until they finally reach the posterior fossa and seal it. Therefore, in this technique the location of the posterior fossa is closed by two layers of dura substitute and abdominal fat tightly sealed with fibrin glue.

The development of some points in this technique can make it one of the procedures of choice in dural defect repair and in the prevention of CSF leaks in the near future.

Conclusion

The first group's technique for dural repair in translab AN surgery is by far the most used and reported in the literature. The use of abdominal fat tissue alone is an excellent method for dural closure, despite all of the different specific modifications employed by many authors in many centers worldwide.

To the best of the authors' knowledge, the dural repair technique described for the second group in this paper has never been reported before in the literature.

Furthermore, we assume that the CSF leak rates reported in both groups are inside the ones presented by many well-known surgeons.

Thus, these two methods for dural repair represent safe and useful techniques.

We firmly believe that the improvement of both techniques (particularly the second one) reported in this study can further reduce the CSF leak rates in the translab AN surgery and minimize the morbidity associated with this procedure.

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