Case Report

Delayed Breakdown of an Onlay Pericranial Flap Following Endoscopic Craniofacial Resection

Xu Xinni1, Sein Lwin2, and Ong Yew Kwang1*

1Department of Otolaryngology - Head & Neck Surgery, National University Hospital, Singapore
2Division of Neurosurgery, National University Hospital, Singapore

Abstract

The pericranial flap is a well-vascularized, robust flap which is used to reconstruct anterior skull base defects following resection of skull base tumours. Failure of this flap is uncommon. However, when it occurs, the consequences are potentially disastrous and it poses a challenge to further reconstruction. We report the first case of onlay pericranial flap breakdown following endoscopic craniofacial resection. Possible contributing factors are identified and further management is discussed. With the endoscopic approach being increasingly utilised for craniofacial resection, it is imperative to be mindful of these factors to minimize the risks of onlay pericranial flap failure.

ABBREVIATIONS

MRI: Magnetic Resonance Imaging

INTRODUCTION

The pericranial flap is the workhorse for reconstruction of the skull base following resection of anterior skull base tumours. It is easily harvested and covers the entire anterior skull base from the posterior frontal sinus wall to the sella [1]. It is a robust, vascularized flap which withstands radiation well, and radiotherapy may commence 4 to 6 weeks following surgery without compromising flap viability [2]. In open craniofacial resection, the pericranial flap is laid down in an underlay fashion deep to the skull base following the frontal craniotomy. In contrast, during endoscopic craniofacial resection, this flap is placed in an onlay manner to reconstruct the anterior skull base. The rate of delayed post-operative complications of vascularized flaps is low, with a reported 0% incidence of cerebrospinal fluid leak more than 3 months after reconstruction [3]. Similarly, failure of the pericranial flap is uncommon, with only 1 such case reported in the literature following open craniofacial resection [4]. To the authors’ knowledge, this is the first report of a delayed breakdown of an onlay pericranial flap following endoscopic craniofacial resection and adjuvant radiation.

CASE PRESENTATION

A healthy 57-year old female, non-smoker, presented with right-sided nasal obstruction for 3 months. Nasoendoscopy showed a large mass occupying the right nasal cavity and biopsy revealed a Hyams grade 2 esthesioneuroblastoma. MRI showed it had eroded through the septum and right fovea ethmoidalis into the intracranial cavity (Kadish C).

She underwent endoscopic craniofacial resection, with a resultant defect size of 3.6 cm x 2.7 cm (9.72 cm²). Reconstruction was performed with a pericranial flap. The flap was tunneled through an osteotomy performed through the nasal process of the frontal bone. Bovine pericardium was used as an inlay graft deep to the dura edge while the pericranial flap was laid over the dura. Post-operatively, the flap healed well with no cerebrospinal fluid leak. She received adjuvant radiotherapy 66 Gy in total and concurrent chemotherapy with paclitaxel.

One year following surgery, she presented with headache and unsteady gait. Nasoendoscopy showed a large eschar in the center of the pericranial flap. MRI revealed a 3.2 cm abscess in the right frontal lobe, and a separate 1.3 cm abscess at the right lateral margin of the pericranial flap (Figure 1).

She underwent right frontal craniotomy and drainage of both abscesses. Intraoperatively, the bovine pericardium was found to be adherent to the surrounding tissue. There was no identifiable tract between the nasal and intracranial cavity. The bovine pericardium was removed and a section of parietal dura was cut and folded over the skull base defect. This was then sealed with a fibrin sealant (Figure 2). Surgical sealant film comprised of synthetic polymers (TissuePatchDural™) was then placed over the parietal dura defect.

Post-operatively, she recovered well with no neurological deficits and no cerebrospinal fluid leakage. Cultures from the abscesses grew Methicillin-sensitive Staphylococcus aureus. She

Central

received 6 weeks of intravenous cloxacillin, followed by 2 weeks of oral cloxacillin. Her post-treatment scans showed resolution of the abscesses. The eschar over the center of the flap was managed by monthly debridement in the office to allow healing by secondary intention. Following 1 year of repeated debridement, the necrotic area of the flap was finally covered by granulation tissue. During this time, she remained well and there was no evidence of cerebrospinal fluid leak.

DISCUSSION

We identified 3 factors that may have contributed to the breakdown of the pericranial flap. The first factor is radiation-induced endarteritis, which can result in delayed flap failure. As the flap broke down 1 year after surgery, adjuvant radiation had likely compromised the flap’s vascular supply over time. This is similar to the only reported case of pericranial flap failure in the literature [4]. Other causes of vascular injury not specific to this case include injury to the vascular pedicle during harvesting or twisting of the pedicle during flap placement, but the insult is expected to manifest earlier. The use of electrocautery during flap harvesting can also cause thrombosis of small blood vessels resulting in flap ischaemia, therefore the use of cold steel is preferred.

The second factor is the thickness of the pericranial flap, which may be significant in withstanding radiation. In this patient, surveillance MRIs showed that the pericranial flap was less than 2 mm thick at 12 months post-operatively (Figure 1). A thin flap increases the likelihood of ischaemic necrosis of the flap, especially when compounded with radiation-induced endarteritis. There are currently no guidelines on the recommended thickness of the pericranial flap, which may be worth looking into in future studies. We propose a few methods to increase the thickness of the harvested flap. The first is to raise the flap just beneath the galea so as to include as much loose areolar tissue as possible with the fibrous pericranium. The loose areolar tissue is important as it contains the microvascular network that supplies the pericranium. A second option is to raise the galea together with the pericranial flap as a single unit (galeal-pericranial flap [5]). However alopecia or skin necrosis due to dissection in a subdermal plane, frontal scalp numbness and visible frontal bone contour irregularities are possible post-operative complications [6]. The third method is to harvest as wide a pericranial flap as possible. This can be achieved by harvesting the pericranial flap from the superior temporal line on one side to that of the other side. The flap can be overlapped during the reconstruction to achieve a thicker flap. Finally, a double vascularised flap technique using both the pericranial and nasoseptal flap has been described [7,8]. However this is not feasible if the septum is involved by tumour, as in this case.

The third factor is the use of the bovine pericardium as the inlay graft. It can be considered a foreign body, which could serve as a nidus for microorganisms. The bovine pericardium could also have prevented brain parenchyma from adhering to the edges of the dural defect and pericranial flap, thus providing a potential conduit for ascending infection from the nasal cavity when the center of the flap broke down.

Management of pericranial flap failure is challenging due to a lack of good reconstructive options. The possible alternatives in this case are the pedicled dural flap, galeal flap, anterior pedicle lateral nasal wall flap or a free flap. In this case, after craniotomy and drainage of the intracranial abscesses, a pedicled parietal dural flap was harvested and turned in to cover the defect. This flap has the advantages of allowing a wide piece of dura to be harvested to cover a large defect and it also has enough tensile strength to support the frontal lobe [9]. However harvesting of this flap requires an open craniotomy and thus has limited utility in purely endoscopic skull base cases. The galeal flap is thin, pliable and is easily tunnelled through the frontal osteotomy to reconstruct the anterior skull base defect. However, previous pericranial flap harvesting renders dissection of the galea more challenging and may also have created puncture points in the galea. Other possible complications with harvesting the galea are as mentioned earlier. The anterior pedicle lateral nasal wall flap, based on the branches of the facial and anterior ethmoidal arteries, is another consideration for covering the necrotic centre [10]. However, rotation of the flap pedicle is required to cover the defect, which effectively shortens the flap. Therefore, the flap may adequately cover a defect that is ipsilateral to the site of harvest, but not a centrally-located defect, such as in this case. Finally, free flap reconstruction is an option, but this is technically demanding, and the previous bicoronal incision may have compromised the

Figure 1 a: coronal T1-weighted MRI with contrast demonstrating the intracranial abscess (*) and the adjacent extra-cranial abscess (black arrow) at the right lateral margin of the pericranial flap. b: sagittal view showing the thin pericranial flap (white arrow) at less than 2 mm thickness.

Figure 2 A pictorial depiction of the intraoperative findings during the second surgery. The bovine pericardium was adherent to the dural defect and pericranial flap, thus providing a potential inlay graft. It can be considered a foreign body, which could serve as a nidus for microorganisms. The bovine pericardium could also have prevented brain parenchyma from adhering to the edges of the dural defect and pericranial flap, thus providing a potential conduit for ascending infection from the nasal cavity when the center of the flap broke down.
viability of the superficial temporal vessels for microvascular anastomosis.

**CONCLUSION**

While pericranial flap failure is rare, its breakdown can result in serious morbidities. Harvesting a flap of adequate size and thickness is important to ensure its viability, especially if adjuvant radiotherapy is considered. The use of a non-autologous graft during reconstruction is cautioned as it may impair healing of the layers of the repair. Management of flap failure is challenging and requires careful consideration of the pros and cons of the limited options available.

**REFERENCES**