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INTRODUCTION

Rathke cleft cysts (RCCs) are rare, benign cystic lesions arising from congenital remnants of Rathke pouch within the sella turcica, which have failed to regress during embryogenesis. This incomplete degeneration is usually asymptomatic and requires no surgical intervention. When the cysts are large enough to become symptomatic, they may cause debilitating problems such as visual changes, hormonal imbalances, and headaches, and will often require surgical treatment.

Skull base surgeons often utilize an endoscopic, transnasal approach to access the sella and, through this, have consistently achieved a successful means of treating the patient’s symptoms. However, RCCs may nevertheless recur following surgical decompression due to scar formation.

METHODS

Patients

Seven patients underwent RCC marsupialization with no intraoperative cerebrospinal fluid leak, followed by circumferential lining of the marsupialized cavity with an NSF. In each case, no cyst re-acumulation or recurrent symptoms were noted, and the NSF lining provided long-term patency of the tract in all cases to a mean of 6.7 ± 10.1 months of follow-up, including one patient with sustained patency at 29 months follow-up.

Conclusion: Utilization of the NSF to “stent open” the RCC cavity following marsupialization is a safe and effective means to prevent restenosis. Advantages include sustained patency of RCC cavity for complete drainage and a dependable vascular supply.

Key Words: Rathke cleft cyst, marsupialization, restenosis, nasoseptal flap, endoscopic skull base surgery.

MATERIALS AND METHODS

Patients

Institutional review board approval was obtained for this study. A total of seven patients with symptomatic RCCs requiring surgical intervention were treated at a tertiary academic medical center. All patients underwent endoscopic endonasal surgery between January 1, 2016, and June 12, 2018, with marsupialization followed by circumferential NSF lining. Primary outcomes include symptomatic control, surgical complications, and RCC cavity patency.

SURGICAL TECHNIQUE

An endoscopic endonasal approach was performed in symptomatic patients with sellar RCCs. An infrasellar opening along the clival base of the sphenoid sinus was used to access the RCC cavity, which was then widely marsupialized to the limits of the clival petrous apex. The NSF flap is then placed in the RCC cavity and sutured in place. The NSF is used to line the cyst opening to promote long-term drainage and re-epithelialization of the RCC cavity.


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recess posteriorly, the bilateral cavernous sinuses laterally, and just below the anterior edge of the diaphragm sella superiorly. The patients were eligible to undergo lining of the NSF to promote tract patency if no intraoperative CSF leak was encountered. The NSF was chosen for its reliable vascular supply, well-documented reconstructive success in skull base surgeries, and excellent coverage and ability to re-mucoselize the cystic cavity.7,8

In cases in which a CSF leak was encountered, skull base reconstruction using a combination of fat and/or synthetic dural grafts as an underlay and a free mucosal graft or nasoseptal flap as an overlay was performed. These patients are monitored clinically and with subsequent imaging. If the cyst reaccumulates and causing recurrent symptom, then consideration is given to attempting to remarsupialize the cavity while keeping dissection extradural. Although this scenario has not yet been encountered, the nasoseptal flap used to close the CSF leak may be taken down and reused to line the cyst cavity.

Harvesting the Nasoseptal Flap and Placement in the Sphenoid Cavity
Following wide marsupialization of the infrasellar cyst entry point, a standard NSF was rotated over the sphenoid floor and clivus to circumferentially line the cyst cavity, providing both coverage of the diaphragm sella as well as exposed bone. The flap was trimmed as necessary if too large for the cavity. Care was taken to fully line every edge of exposed bone to prevent cicatricial scarring (Figs. 1 and 2). Following the insetting of the flap, a 0.51-mm-thick silastic spacer was trimmed and placed into the cavity to further hold the flap edges in place along the bony opening. No nasal packing was placed in any of the cases.

Postoperative Care and Outcomes Assessment
The patient was counseled on postoperative sinonasal surgery precautions and was seen in clinic 2 weeks postoperatively following discharge. Patients underwent periodic follow-ups beginning 2 weeks postoperatively to assess for cyst patency and management of postoperative sinonasal morbidity.

RESULTS
During this study period, a total of seven patients were identified as candidates for RCC decompression and included in the analysis (Table I). One patient was female, and six patients were male. In the patient cohort, the ages ranged from 16 to 68 years, and the mean age was 38 years. Indications for surgery included headache alone (n = 1) and headache in combination with other side effects such as left-sided ptosis (n = 1) and peripheral vision loss (n = 1). One patient was identified after experiencing weakness, fatigue, and loss of balance; one patient was identified after evaluation for short stature; and one patient was identified after a diagnosis of bitemporal quadrantanopsia.

No intraoperative complications occurred, including intraoperative CSF leak. Two (29%) of patients experienced headache postoperatively, and one was admitted for assessment of possible postoperative CSF leak, although re-exploration under general anesthesia was negative. One hundred percent of patients had excellent tract patency, with a mean of 6.7 ± 10.1 months of follow-up, including one patient with sustained patency at 29 months follow-up (Fig. 3).

DISCUSSION
When RCCs become symptomatic, surgical intervention is indicated for treatment of headaches, visual disturbances, or endocrinopathies.3 Reliable surgical approaches have been described for the treatment of RCCs. The current standard is an endonasal, commonly endoscopic, transsphenoidal approach.
Suprachiasmatic hypotalmic stimulation leads to a lower rate of endocrinopathies.\textsuperscript{5,6,14} Decreased risk of CSF leak when compared to total gross resection of RCC is the prevention of restenosis of the cystic cavity with wide marsupialization.\textsuperscript{5,10} Complete cyst excision is less favored than marsupialization in the absence of risk of intraoperative CSF leak due to increased risk of postoperative complications, particularly endocrinopathies.\textsuperscript{11} Specifically, Higgins et al. has shown that decompression leads to a decreased risk of CSF leak when compared to total gross resection, and Benveniste et al. found that decompression with marsupialization leads to a lower rate of endocrinopathies.\textsuperscript{5,6,14} Unfortunately, because decompression alone leaves the cyst wall intact, this has been associated with a higher level of cyst scarring and re-accumulation than is desirable.\textsuperscript{11} Alternative measures have been developed to stabilize the cystic cavity to allow for its continual drainage and with the intent to deter cystic regrowth. The benefit to decompression with added stabilization of RCC is the prevention of restenosis of the cystic cavity and thus the ability to deter cyst recurrence.\textsuperscript{15} Stenting open the cavity following marsupialization allows for effective treatment, with favorable long-term outcomes.\textsuperscript{8,15}

There have been several methods utilized to maintain patency following marsupialization of an RCC.\textsuperscript{16} In all cases, these techniques are limited to patients in whom intraoperative CSF leak is not encountered. Silicone stenting has been reported as a successful temporary method of maintaining a cyst drainage pathway.\textsuperscript{17–22} Alternatively, steroid-eluting stents reduce inflammation and prevent fibrosis of the drainage pathway, which contributes to sustained sinus patency.\textsuperscript{17,22} This decompression with stabilization of the inflated wall allows for drainage of the RCC and continued symptomatic relief. However, with insertion of a foreign object, great care must be taken to prevent trauma to the cyst wall, and to reduce bacterial infections, foreign body reactions, or potential rejection. Finally, this is a relatively new approach, and therefore further studies are needed to determine long-term outcomes. Another technique is the use of free mucosal grafting (FMG) to stabilize and re-epithelialize the cystic cavity. The FMG is harvested from the nasal septum, nasal floor, or resected middle turbinate and allows for reinforcement of the drainage site and reduction of mucosal crusting after surgery.\textsuperscript{8,15} This improvement in stenting with re-mucosalization of the infrasellar cyst opening and sellar floor has been beneficial in reducing postsurgical healing time, as well as maintain tract patency.\textsuperscript{15,24} One theoretical concern is infection risk related to leaving dura exposed to the nasal cavity, although no cases of this occurred in this small series. Nevertheless, this is worth investigation through a larger series.

In 2006, Hadad et al. presented their novel technique of using the highly vascularized NSF in endoscopic endonasal skull base surgery.\textsuperscript{24} Since this time, the NSF has become the “cornerstone” in endoscopic reconstructive surgery and proven to be a reliable and beneficial approach to promote healing and long-term patency. In an analogous application, the surgical management by Karligkiotis et al. employed a pedicled nasoseptal flap to treat cholesterol granulomas of the petrous apex, which has shown significant promise with conferred long-term cystic cavity patency.\textsuperscript{7} Comparing this method to the current surgical approaches demonstrates that using marsupialization with a NSF lining shows promise in reducing cystic scarring and recurrence.

We have shown that the NSF is a new and highly effective surgical technique for the treatment of RCCs, much like

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**TABLE I. Clinical and Surgical Data of Rathke Cleft Cysts Treated Through an Endoscopic Endonasal Approach Using the Nasoseptal Flap.**

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (years), Sex</th>
<th>Symptoms</th>
<th>Prior Surgery</th>
<th>Interoperative Complications</th>
<th>Postoperative Complications</th>
<th>Sustained Patency (months)</th>
<th>Recurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>26/F</td>
<td>H, PVL</td>
<td>No</td>
<td>None</td>
<td>None</td>
<td>29</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>62/M</td>
<td>H, LH</td>
<td>Yes</td>
<td>None</td>
<td>None</td>
<td>2</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>16/M</td>
<td>NS</td>
<td>No</td>
<td>None</td>
<td>H, NV, S, FP</td>
<td>4</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>61/M</td>
<td>H, HS, LP</td>
<td>No</td>
<td>None</td>
<td>None</td>
<td>3</td>
<td>No</td>
</tr>
<tr>
<td>5</td>
<td>68/M</td>
<td>W, B</td>
<td>No</td>
<td>None</td>
<td>HY</td>
<td>5</td>
<td>No</td>
</tr>
<tr>
<td>6</td>
<td>19/M</td>
<td>MBQ</td>
<td>No</td>
<td>None</td>
<td>I</td>
<td>5</td>
<td>No</td>
</tr>
<tr>
<td>7</td>
<td>16/M</td>
<td>SS</td>
<td>No</td>
<td>None</td>
<td>H</td>
<td>6</td>
<td>No</td>
</tr>
</tbody>
</table>

B = balance issues; F = female; FP = facial pain; H = headaches; HS = hoarseness; HY = hypertension and hypernatremia; I = infection; LH = lightheaded; LP = left-sided ptosis; M = male; MBQ = mild bitemporal quadrantanopsia; NS = not significant; NV = nausea and vomiting; PVL = peripheral vision loss; S = syncope; SS = short stature; W = weakness.

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![Fig. 3. The same patient at 6 weeks postoperative clinic visit, demonstrating widely patent cyst cavity with no accumulation of contents and no residual symptoms. The diaphragm sella has completely mucosalized.](image-url)
in the case of cholesterol granulomas. The common ground is the remarkable and swift ability of the nasoseptal flap to adhere down to the surrounding bony edges, which provides an additional “stenting” effect. Furthermore, coverage of any exposed dura, particularly the diaphragma sella, allows for an extra layer of protection and likely promotes rapid mucosalization. Of importance is the creation of an infrasellar drainage pathway to allow for maximal bone coverage inferiorly along the clival recess and a gravitationally directed trajectory for cyst contents. If the flap is too bulky, it may be readily trimmed for proper contouring. This technique has been able to maintain cyst patency in the long term, although longer follow-up would be indicated to confirm this.

CONCLUSION

We have utilized the pedicled NSF in the marsupialization of RCCs and have achieved the ability to retain drainage and safely provide a means of re-epithelialization to advance healing, maintain patency, and improve postsurgical outcomes in our patients. Lining this cavity with the NSF has allowed for successful sustained patency of the RCC cavity, leading to complete drainage and, we believe, a high probability for reduction in cystic recurrence. The NSF is advantageous for its dependable vascular supply and ability to reduce CSF leakage, and its use for re-mucosalization of the tract has no added surgical morbidity. Long-term follow-up and increased patient population size is necessary to assess the true clinical impact of NSF stenting following RCC drainage.

BIBLIOGRAPHY