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Surgical Management of Allergic Rhinitis

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Introduction

The inferior turbinate is composed of a central bony structure surrounded by ciliated pseudostratified columnar epithelium.[1] Underneath the epithelium, there are mucous glands, goblet cells and venous sinusoids in the submucosa,[1] The inferior turbinate is supplied by the inferior turbinate branch of the posterior lateral nasal artery from the sphenopalatine artery.[2] The inferior turbinates humidify the air, trap particles and direct airflow throughout the nasal cavity. Due to these functions, the inferior turbinates are often the first point of contact for allergens in the inspired air. With immune responses prompted by a cascade of inflammatory mediators such as immunoglobulin E, mast cells, histamine, and leukotrienes, mucous glands become stimulated and the vasculature within the inferior turbinate engorges. This results in inferior turbinate hypertrophy, leading to increased nasal discharge and nasal obstruction. For individuals refractory to medical therapy for nasal obstruction, surgical inferior turbinate reduction techniques can be employed to help alleviate the symptoms. For those with rhinorrhea refractory to medical therapy, surgical management aimed at reducing parasympathetic innervation to the nasal cavity to reduce nasal discharge production can be also option.

Nasal septum can contribute to nasal obstruction with deviation and spurs. However, its role in the development of allergic rhinitis is unclear. The septum itself does not undergo the extent of changes that inferior turbinates do in terms of mucosal edema, engorgement, or mucosal gland hyperplasia. Therefore, surgical management of the septum is not the focus for the surgical treatment of allergic rhinitis and will not be discussed in this paper.

The paranasal sinuses can be involved in certain advanced types of allergic rhinitis, such as central compartment atopic disease. If the patient is unresponsive to medical therapy alone, endoscopic sinus surgery can be considered. Certainly, endoscopic sinus surgery can be combined with inferior turbinate surgery in refractory or advanced cases of allergic rhinitis. However, endoscopic sinus surgery techniques are not the focus of this paper. Instead, we will focus on the discussion of various techniques of inferior turbinate reduction, as well as surgical techniques to address rhinorrhea in the treatment of allergic rhinitis.

Turbinate Lateralization

Lateralization of the turbinate is the most surgically conservative technique to reduce the inferior turbinates. Outfracturing the turbinate improves the nasal airflow by repositioning the angle at which the turbinate attaches to the maxillary and palatine bones. A firm instrument, such as a Freer or Cottle elevator, is inserted lateral to the inferior turbinate in the inferior meatus and infractures the turbinate for complete fracture of the turbinate bone. Subsequently, the turbinate is outfractured from the medial aspect. The effect of turbinate lateralization can be sustained for at least 6 months postoperatively.[3] Lateralization of the turbinate may not be sufficient as a stand-alone procedure for the surgical management of severe allergic rhinitis as the bony turbinate tends to return to its original position. It often is combined with other techniques and is performed as a last resort in order to optimize soft tissue dissection without fracture.

Laser-assisted Turbinoplasty

There are various types of lasers available for the treatment of inferior turbinate hypertrophy. These include carbon dioxide (CO_2), potassium-titanyl phosphate (KTP), argonion, neodymium-yttrium aluminum garnet (Nd:YAG), and holmium-yttrium aluminum garnet

(Ho:YAG) lasers.[4] The goal of laser therapy is to induce fibrosis and reduce the turbinate surface area. The laser is applied in a linear or spot fashion, anterioposteriorly along the inferior turbinate or at the anterior aspect of the inferior turbinate. Symptomatic improvement has been reported in the literature with rates from 50–100% effectiveness with heterogeneous follow-up periods. While the advantages of laser-assisted turbinoplasty may include enhanced hemostasis and reduced postoperative pain, the laser equipment can be expensive and is not widely available in many centres, limiting its utility.

Submucosal Soft Tissue Reduction

Electrocautery

Monopolar and bipolar electrocautery can be used to cause thermal injury in the submucosa of the inferior turbinate. This leads to submucosal fibrosis and obliteration of the venous sinusoids. The needle tip(s) is(are) inserted into the submucosa and advanced toward the posterior inferior turbinate in the submucosal pocket. The electrocautery is then activated as the needle is withdrawn. However, studies of electrocautery have not shown promising long-term results.[5]

Radiofrequency Ablation and Coblation

Radiofrequency ablation (RFA) is a thermal ablation technique with the application of radiofrequency (varying from 100 to 4,000kHZ) within the submucosa, thereby leading to coagulative necrosis.[6] Both scar contracture and the formation of scar fibrosis result in reduction of the turbinate bulk with lasting effects, potentially up to 5 years.[7] It is well tolerated with minimal side effects and can be done as an in-office procedure under local anesthesia.[6,7]

Coblation is a technique within the umbrella of RFA and uses the concept of molecular activation dissection in the submucosal layer.[8] With low-temperature tissue disintegration, this technique causes less pain and therefore can be performed more commonly in the pediatric population.[8]

Submucosal Resection

The goal of submucosal resection of the inferior turbinate is to preserve the mucosa and its ciliary function while reducing the volume of the inferior turbinate. To perform this procedure, the turbinate is infiltrated with a local anesthetic with epinephrine to reduce bleeding and to help with hydrodissection. An incision is made in the anteroinferior aspect of the turbinate. A medial mucoperiosteal flap is raised along the inferior turbinate bone all the way posteriorly using a Freer or Cottle elevator. A lateral mucoperiosteal flap is raised in a similar fashion. Alternatively, some surgeons choose to sacrifice the lateral mucosa while preserving the medial mucoperiosteal flap. The inferior turbinate bone is subsequently resected with a through-cutting instrument. Submucosal resection of the inferior turbinate (including the bone) has shown superior results at the 5-year mark in comparison with electrocautery or submucosal powered turbinate reduction.[9]

Microdebrider-assisted Submucosal Resection

Similar to the traditional submucosal resection, the goal of microdebrider-assisted reduction is to decrease the amount of submucosal erectile tissue while retaining the epithelium. To perform this procedure, a stab incision is made in the anterior aspect of the turbinate. A submucosal tunnel is developed using an incorporated tip elevator or a Freer or Cottle elevator. The microdebrider blade is then rotated toward the submucosal soft tissue and activated. It is crucial to perform this in a controlled fashion to avoid flap perforation. The tip of the microdebrider can also be turned toward the bone for bone resection. However, it may require formal submucosal resection if more extensive bone removal is required. Although microdebrider-assisted turbinoplasty encompasses various heterogeneous techniques, the literature demonstrates the long-term effectiveness of this technique.[10]

Turbinectomy

Total turbinectomy is the most aggressive technique available for the surgical treatment of allergic rhinitis. It can be performed with heavy scissors or endoscopic scissors. However, this practice has fallen out of favour as it can lead to severe long-term complications such as atrophic rhinitis or “empty nose syndrome”.[11] This is likely secondary to the loss of function of the inferior turbinates and leads to excessive mucosal drying, scarring, nasal discharge, and recurrent epistaxis.[12]

Complications of Turbinate Reduction

Most mucosa-sparing turbinoplasty techniques have acceptable safety profiles. Complications of inferior turbinate reduction include bleeding, nasal dryness, and crusting. A meta-analysis focused on long-term outcomes of turbinate surgery showed frequency of 4%, 2%, and 17% for bleeding, nasal dryness, and crusting, respectively, with no reported serious complications.[10] Atrophic rhinitis or "empty nose syndrome" is the most feared complication but it is rare and tends to be attributed to aggressive tissue resection.[11,12]

Surgical Techniques for Rhinorrhea

Vidian Neurectomy

Vidian neurectomy is a well-established procedure with the aim of disrupting parasympathetic supply to the nasal cavity and subsequently reducing the production of nasal secretions. The vidian nerve is formed by the greater superficial petrosal nerve and the deep petrosal nerve. While the deep petrosal nerve is formed by sympathetic fibres from the sympathetic plexus, the superficial petrosal nerve provides preganglionic parasympathetic fibres for the lacrimal, palatine, and nasal glands as well as vasodilator nerves for the nasal mucosa.[13] Vidian neurectomy was initially described by Golding-Wood in the 1960s via a transantral approach.[14] Recently, with the advancement of endoscopic techniques, vidian neurectomy has been reported to be successful in achieving 91% of patient satisfaction.[15] Vidian neurectomy can be performed endoscopically by making a mucosal incision similar to that in sphenopalatine artery ligation. The artery is ligated and a mucosal flap is raised to the face of the sphenoid sinus. The periosteum and the fat of the pterygopalatine fossa are then exposed. The vidian nerve is then identified emerging through the pterygoid canal and ligated.[13] However, vidian neurectomy has fallen out of favour due to complications such as cheek/palate numbness and dry eyes from collateral injury of the nerve fibres innervating the lacrimal glands.[16]

Posterior Nasal Neurectomy

Due to the complications of vidian neurectomy, the posterior nasal nerve has emerged as an attractive target to address rhinorrhea. The posterior nasal nerve carries postsynaptic parasympathetic fibres that innervate the nasal mucosa; it is distal to the pterygopalatine ganglion. Therefore, posterior nasal neurectomy does not carry a risk of dry eyes or palate numbness. The endoscopic technique was first described by Kikawada in 1997.[17] A vertical incision is made in the posterior middle meatus. A mucosal flap is then raised over the palatine bone to identify the sphenopalatine foramen posterior to the crista ethmoidalis. The posterior nasal nerve emerges from the sphenopalatine foramen typically below the sphenopalatine blood vessels. Either the entire neurovascular bundle or the nerve alone can be ligated. A systematic review of posterior nasal neurectomy showed that while it appeared safe and generally efficacious, there is significant heterogeneity in the reporting of outcomes thus limiting any firm conclusions on its effectiveness.[18]

Posterior Nasal Nerve Ablation

With the advent of in-office devices, posterior nerve ablation has become a popular alternative option to posterior nasal neurectomy. Cryotherapy can be used to ablate the posterior nasal nerve in the posterior middle meatus and has been found effective in many single-arm studies.[19] Similarly, radiofrequency neurolysis of the posterior nasal nerve has been found effective and well tolerated.[20] For both of these techniques, clinical benefit in nasal symptoms has been derived and they have shown to improve patient quality of life.

Conclusion

Allergic rhinitis is a very common condition. Patients refractory to medical therapy can be considered for surgical intervention. Inferior turbinate hypertrophy is the most important contributor to nasal obstruction in patients with allergic rhinitis. A variety of surgical procedures have been developed and described. Most techniques have acceptable safety profiles. There is a lack of consensus on a "gold standard" technique. Meticulous surgical dissection and thoughtful reduction of soft tissue are paramount in achieving a balance between symptom improvement and preserving normal nasal physiology. For the bothersome symptom of rhinorrhea secondary to allergic rhinitis, there are various surgical options available. The posterior nasal neurectomy technique has lower rates of complications compared to vidian neurectomy.

In addition, posterior nasal nerve ablation can be an attractive alternative with the ability to be performed in-office. However, additional studies are needed to characterize the long-term treatment outcomes of these procedures.

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