Turbinate dysfunction & surgical modalities of treatment

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Introduction:

- Turbinate dysfunction is universal.
- Persistent dysfunction involves approximately 50% of the population.
Content:

- Anatomy of the turbinates
- Embryology of the turbinates
- Physiology of the turbinates
- Pathophysiology
- Causes
- Workup
- Treatment
Anatomy:

Fig 1(b): Lateral cross section of head

Fig 1(c): Sagittal (side) – coronal, and coronal views of the pairs of the nasal turbinates.
Inferior turbinate:

- consists of a lamina of spongy bone, curled upon itself like a scroll.
- It has two surfaces, two borders, and two extremities.
Inferior turbinate:

- Medial surface: convex, perforated by numerous grooves for the lodgement of vessels.
- Lateral surface: Concave and forms part of the inferior meatus.
Anatomy:

- **upper border** is thin, irregular:
  - the anterior articulates \(\rightarrow\) conchal crest of the maxilla.
  - the posterior \(\rightarrow\) the conchal crest of the palatine.
Anatomy

- the middle portion:
  - the anterior or **lacrimal process** is small & it articulates with the descending process of the lacrimal bone.
  - with the groove on the back of the frontal process of the maxilla, and thus assists in forming the canal for the nasolacrimal duct.
anatomy

- the **ethmoidal process**: ascends to join the uncinate process of the ethmoid.
- the **maxillary process**: curves downward and lateralward; it articulates with the maxilla and forms a part of the medial wall of the maxillary sinus.
Inferior Turbinate Bones

- The anterior articulates with the conchal crest of the maxilla.
- The posterior articulates with the conchal crest of the palatine.
- The middle portion:
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  - with the groove on the back of the frontal process of the maxilla, and thus assists in forming the canal for the nasolacrimal duct.
  - The ethmoidal process: ascends to join the uncinate process of the ethmoid.
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Blood supply:

- The arrangement was found to be constant:
  - A single main descending branch of the sphenopalatine artery entering its substance from above, 1-1.5 cm from its posterior border.

- This artery branches as it passes within the turbinate remaining close to the bone.

- They give rise to arterial arcades which remain close to or within the bone with the main artery increasing in diameter.

Cadaver studies of the anatomy of arterial supply to the inferior turbinates, Journal of the Royal Society of Medicine Volume 84 December 1991
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Nerve supply:
EMBRYOLOGY:

- At 8 weeks:
  a cartilaginous nasal capsule surrounds the nasal cavity and the nasal septum.
EMBRYOLOGY:

- Three soft tissue elevations or preturbinates can be identified within the nasal cavity.

EMBRYOLOGY:

- 9 to 10 weeks: two cartilaginous flanges that penetrate the soft tissue elevation of the inferior and middle turbinate.

**EMBRYOLOGY:**

- **17 to 18 weeks’**
  - Initial ossification of the cartilaginous precursor of the inferior turbinate occurs at the angle where the inferior turbinate budded from the lateral cartilaginous capsule.

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EMBRYOLOGY:

- next 3 to 4 weeks, ossification progresses to involve the middle turbinate.
- As with its inferior counterpart, ossification of the middle turbinate commences at its site of origin from the lateral cartilaginous capsule.
EMBRYOLOGY:

- By 24 weeks lateral nasal wall is close to complete:
  the superior and middle turbinates have developed and ossified from the ethmoid bone.
  the inferior turbinate has emerged from two origins, the maxilla and the lateral cartilaginous capsule.
Histology:

- Lined by pseudostratified ciliated columnar epithelium containing numerous goblet cells.
- The submucosa is serous glands.
- Venous sinusoids surrounded by smooth muscle fibres which are controlled by the autonomic system.
Physiology:

- 85% to 95% of inspired air gets saturated in the nose.
- The degree of saturation:
  - atmospheric temperature
  - Relative humidity
  - inspiratory rate
  - shape of the nasal passages and degree of nasal resistance.
The etiology of turbinate dysfunction

- Multifactorial
- Its rich in blood supply & para-sympathetic nerves.
Symptoms:
- Nasal congestion (mild to severe), positional.
- Postnasal drainage.
- Midfacial headaches.
- Facial pain and discomfort.
Causes:

- Allergic rhinitis (The most common)
- Vasomotor rhinitis
- Drugs
- Hormones
- Condensation rhinitis
- Rhinitis of disuse
- Rhinitis medicamentosum
If the turbinate is anatomically abnormal:

- paradoxically bent.
- (concha bullosa), 30% of the population & its incidental finding in the CT.

The ostiomeatal complex may be compromised → acute or recurrent acute rhinosinusitis.
Evaluate the patient:

- patient's history
- Examination of the nasal and ITs both before and after topical decongestion is conducted.
- Nasal endoscopy, nasal septum, polyps, a "mulberry tip" (polypoid changes of the tail of the IT) or in rare cases neoplasms.
Work up

- Sinus CT scanning is useful for delineating the extent of disease in patients who have underlying chronic rhinosinusitis or acute recurrent rhinosinusitis.
Work up

- Rhinomanometric testing is useful as a research tool
- comparing nasal airflow from side to side and also in the preoperative evaluation of nasal airflow as compared with the postoperative situation
When we treat TD:

- a clinical history of bothersome nasal congestion and postnasal drainage with or without paranasal sinus disease or a significant septal deformity.
How we will treat:

- careful history rolling out all the risk factors
- patient continues to have symptoms, we initiate medical therapy.
- Surgical therapy is reserved for those patients who do not respond to appropriate medical therapy.
Surgical management:

- whether the hypertrophy is bony, mucosal, or a combination of both.
- various techniques
- Selection depends on: cost; efficacy; desire for general anesthesia; minimizing postoperative complications such as bleeding, adhesion formation, and crusting.
Inferior turbinate hypertrophy: Review and graduated approach to surgical management

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ABSTRACT

Background: Surgical techniques for managing inferior turbinate hypertrophy (ITH) vary widely and have evolved substantially in the past four decades as new technologies have emerged.

Methods: Literature review.

Results: Inferior turbinate (IT) procedures can be categorized as: simple turbinate outfracture; turbinoplasty techniques such as extramucosal destruction, and submucosal tissue removal; and extramural turbinate resection (partial or complete). Each of these approaches has advantages and drawbacks. Considerations in technique selection include clinical setting (in-office versus operating room), cost of the devices used, efficacy of the procedure to relieve nasal obstruction, and minimizing postoperative complications such as nuisance bleeding, adhesion formation, and crusting.

Conclusion: There are a variety of contemporary surgical techniques used for IT reduction. This article highlights the available literature and gaps in current knowledge. A graduated approach to the management of ITH will be presented.

TURBINATE OUTFRACTURE

- Lateral repositioning of the IT via out-fracturing.

- Used CT to evaluate the turbinate position before and at 9 months after the out-fracture procedure and the distance from turbinate bone to the lateral nasal wall was measured.

They found a statistically significant degree of lateralization, however, longer outcomes were not measured.

TURBINATE OUTFRACTURE

- Limitation of out-fracture procedure:
The turbinate size is not actually removed and no tissue is removed.
EXTRAMURAL RESECTION

- Total IT resection: most aggressive turbinate procedure

The limitation is:

- Although the objective criteria for a widely patent airway are certainly obtained, some patients remain symptomatically obstructed because of a phenomenon known as "empty nose syndrome"
- Hemorrhage, nasal crustsing, and synechiae formation.

EXTRAMURAL RESECTION

- Partial turbinectomy: resection of the anteromedial 1/3 of the IT similar complications of crusting and synechiae formation as total turbinectomy reported good to excellent improvement in nasal airway at follow-up between 6 months and 4 years.

EXTRAMUCOSAL DESTRUCTION

- commonly with the carbon dioxide (CO2) and neodymium; yttrium-aluminumgarnet (Nd:YAG) lasers; however, there have been reports with the holmium:yttrium-aluminumgarnet (Ho:YAG)
- The risk of hemorrhage is less with this technique; however, there remains a risk of crusting and atrophy.
EXTRAMUCOSAL DESTRUCTION

A study in 2007 by Sroka et al. compared the Ho:YAG with diode lasers and both techniques resulted in statistically significant improvement in nasal airflow at 6 months and 3 years, postoperatively, and overall they concluded that the Ho:YAG laser had better long-term nasal patency.
cryosurgery:

- exerts its effects by the intracellular formation of ice crystals and subsequent cell membrane destruction.
- The critical temperature is -12°C.
- Thrombosis of small vessels and subsequent ischemia increase the tissue destruction.
SUBMUCOSAL LESION FORMATION AND TISSUE REMOVAL

- preserved the turbinate's mucosa but still created volume reduction through initiating fibrosis through submucosally
RADIOFREQUENCY ABLATION using the Coblator:

- Induce submucosal tissue destruction and fibrosis.
- Low frequency
- Decreased tissue penetration
- Minimal collateral tissue damage
- Surface temperatures 40° to 70° C
- Shorter current path
- Control of energy delivery
- Volumetric tissue removal
Electrocautery

- Monopolar spark between electrode and tissue
  - Localized tissue heating
    - 450° to 600° C
- Tissue desiccation and vaporization
compared the bipolar Coblator and the monopolar somnoplasty

- in a randomized, prospective study with 75 patients in each group.
- They concluded that both technologies provided similar long-term results to 20 months.

the literature overall suggests that RFA is well tolerated and provides favorable outcomes in improving the nasal airway
MICRODEBRIDER

- The microdebrider made 1990s
- Used as SMR
- More recently, advances in bipolar microdebrider technology used to cauterize the field that promotes fibrosis as well as providing hemostasis.
ULTRASONIC ASPIRATOR

- newest technique used in IT surgery.
- ultrasonic waves to emulsify bone with concurrent irrigation and microsuction of the bone particles.
COMPARATIVE EFFICACY

Nasal resistance was measured in 382 patients by anterior active rhinomanometry and nasal volume by acoustic rhinometry. Significant improvement was noted initially in all groups ($p < 0.001$); however, the duration of improvement varied.

Patients with electrocautery or cryotherapy had progressive worsening of nasal resistance and the patients who underwent laser cautery had reduced nasal volumes over the 6-year follow-up. Only the patients with submucosal resection achieved normal parameters for mucociliary transport time and secretory IgA concentration.

The submucosal resection patients also experienced better quality of life scores and when combined with outfracture, had the best results.

COMPARATIVE EFFICACY

- compared the outcomes of nasal physiology after radiofrequency turbinate reduction and partial turbinectomy. Both groups had good clinical outcomes with improved nasal function. However, there was a reduction in the number of normal cilia and a significantly more prolonged mucociliary transport time in the partial turbinectomy group, suggesting that RFA is a superior method to preserve nasal physiology.

COMPARATIVE EFFICACY

- showed that both RFA and microdebrider submucosal resection resulted in significant improvement in visual analog scale score and acoustic rhinometry at 3 and 6 months. They also measured ciliary beat frequency and saccharin transit times. There were no statistically significant differences between the groups.

GRADUATED APPROACH TO MANAGEMENT

- Decision between which technique to select for IT surgery should be individualized to the clinical situation.

<table>
<thead>
<tr>
<th>Severity of ITH</th>
<th>Technique</th>
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<tbody>
<tr>
<td>Mild</td>
<td>Outfracture</td>
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<tr>
<td>Moderate to severe</td>
<td>RFA (cautery/coblation)</td>
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<tr>
<td>Massive/underlying disease</td>
<td>SMR (microdebrider/other)</td>
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<tr>
<td>Posterior tip hypertrophy</td>
<td>Extramural resection (partial)</td>
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<tr>
<td></td>
<td>Extramural resection (microdebrider)</td>
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Key: Ensure accurate diagnosis and target pathology. May combine techniques, especially outfracture. ITH = inferior turbinate hypertrophy; RFA = radiofrequency ablation; SMR = submucous resection.
Conclusion:

- Currently, there is a trend toward mucosal sparing techniques with submucous tissue removal.
- Newer technologies and techniques offer the promise of reducing complications while improving outcomes and maximizing patient satisfaction.
Thanks