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Therapeutic and Diagnostic Approaches in Rhinology and Allergy

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1. Introduction

1.1. Diagnostic rhinoscopy

1.1.1. Applied anatomy of nose & paranasal sinuses

Nasal cavity is the complex structure. It is divided by the nasal septum into the left and right side. Lateral nasal wall composed of three turbinates and their meati.(figure 1).



Figure 1. Normal anatomy of left nasal cavity, shows nasal septum, inferior turbinate & meatus, and middle turbinate & meatus.

The anterior group of paranasal sinuses consists of the frontal, maxillary and anterior ethmoid sinus. The posterior group of paranasal sinuses consists of the sphenoid and posterior ethmoid sinus.

By histology, nasal and paranasal sinus mucosa is the psuedostratified ciliated columnar epithelium. The mucous blanket is moved from sinuses through their ostium. The drainage of anterior group of paranasal sinuses is through their ostium and middle meati. The posterior group is drained through the superior meati & sphenoethmoidal recess.

With the concept of ‘mucous drainage drain through meatus’, the most important structure inside the nose is called “ostiomeatal complex”, especially the middle meatus area.[1]

1.1.2. Clinical presentation of common rhinologic condition

The most common disease of nose is the inflammatory conditions – rhinitis. It can be caused by the infectious vs non-infectious causes. The non-infectious rhinitis can be further divided into allergic rhinitis (AR) and non-allergic rhinitis (NAR). When the inflammatory process extended beyond the nasal cavities, the inflammation spread into the paranasal sinuses, leads to be ‘rhinosinusitis’.

Besides the mucosal inflammation, some anatomic variations may caused the symptoms resemble to rhinitis. Those anatomic variations are pneumatization of middle turbinate (Concha Bullosa), paradoximal middle turbinate, or deviated nasal septum (DNS), etc. (figure 2).

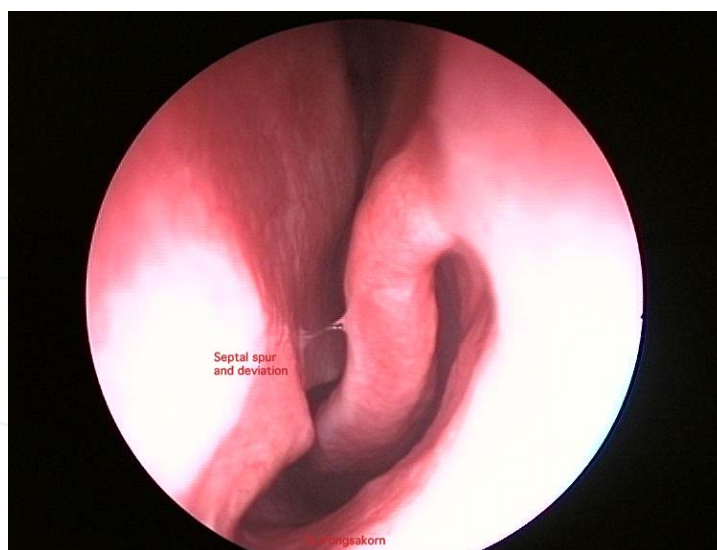


Figure 2. Deviation of nasal septum to the left, with its contact point to the inferior turbinate.

The tumor of nose & paranasal sinuses commonly arises from the maxillary sinuses and lateral nasal wall. Squamous cell carcinoma is the most common malignant type, and Inverted papilloma is the most common benign type. The other tumors are adenocarcinoma, adenoidcysticcarcinom, olfactory neuroblastoma, lymphoma, vascular tumor, etc. (figure 3).



Figure 3. Squamous cell carcinoma of left nasal cavity.

1.1.3. Diagnostic application of endoscopy

Nasal endoscopy can reveal the detail of color of nasal mucosa, the swelling, and the discharge. These detail help rhinologist to differential the various causes of rhinitis. For instances, the turbinate of AR will be in pale color with watery discharge. (figure 4). On the contrary, NAR will be injected and swelling turbinate or atrophic in some conditions.



Figure 4. Congest inferior turbinate with pale color.

Because of the tumor of nose¶nasal sinuses usually presents with the subtle symptoms. The early stage may present with minimal nasal congestion or minor nasal bleeding. Nasal endoscopy will be a good armamentarium to exam the detail of deep structure inside the nasal cavities.

According to the most recent guideline – European Position Paper of Sinusitis (EPOS) 2012, the rhinosinusitis is a disease of ‘clinical diagnosis’.[2] By using the two symptoms of nasal obstruction and rhinorrhea with the duration longer than 10 days, the diagnosis of acute rhinosinusitis (ARS) is made.[3] But if the initial treatment cannot alleviate the symptoms, nasal endoscopy should be done. Moreover, the chronic rhinosinusitis (CRS) need nasal endoscopy along with the history for diagnosis. The CRS can be subclassified into CRS with nasal polyp (CRS c NP) and CRS without nasal polyp (CRS s NP).

NP can be seen as the pale, semi-translucent mass protruding from the middle meatus. (figure 5).



Figure 5. Nasal polyp of the right nasal cavity.

Its etiology remains obscure but related to mucosal inflammation by eosinophilic cell.[4,5] The principle of treatment of CRS, especially CRS c NP, is topical nasal steroid. Oral prednisolone may be used for the short course of large NP ‘s treatment. Nasal endoscopy is the essential instrument to differentiate CRS c NP from CRS s NP. Due to their different natural course, these conditions should be made since the initial treatment process.

2. Therapeutic options of nasal endoscope

2.1. Rhinologic condition

2.1.1. Rhinosinusitis

Three principle treatments of rhinosinusitis (RS) are the eradication of infectious process, promotion of secretion in sinus cavity and treatment of underlying disease (eg. Allergic inflammation). Endoscopy has its role in the treatment of RS by 1) utilization of endoscope for obtaining responsible organism, and 2) utilization of endoscope as a principle instrument of surgical procedure.

The selection of antibiotic for treatment of infectious RS usually follows the guideline that depends on the prevalence of responsible organism in each community. Three most common organisms of RS are *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Moraxella catarrhalis*. [6,7] Most of the guidelines suggest the high dose-amoxicillin with/without clavulanic acid as the first –line drug. When there is little (minimal) response of RS patient, the physician may switch to the second-line drug or consider taking the microbiologic culture/sensitivity test.

The gold standard of obtaining RS specimen for culture is the sinus puncture, usually from the maxillary sinus through the inferior meatus. But the so-called maxillary Antral puncture&Irrigation (AI) is considered as an invasive procedure, which can cause the significant pain for RS patient. To avoid this limitation and minimal contamination of non-pathogenic organism in the nasal cavity, endoscopic-guided culture at the ostiomeatal complex (OMC) is the alternation procedure with comparable accuracy to AI. [8] (figure 6)



Figure 6. Endoscopic-guide culture from the left middle meatus.

If the RS patient fails to the medical treatment, the surgical procedure is needed. Conventionally, the open-approach sinus surgeries are the Caldwell-Luc (CWL) and the external frontoethmoidectomy (eg. Lynch). Prof Messerklinger proposed the breakthrough principle of mucociliary drainage through OMC in 1975. With this principle and the advancement of surgical instrument (especially the rigid endoscope), Prof Kennedy and Prof Stammberger lead the concept of “Functional Endoscopic Sinus Surgery-FESS” into the acceptable sinus procedure as a standard treatment. [9]

FESS consists of the utilization of rigid nasal endoscope and the cutting forceps to clear the pathology at OMC area. Then, obstructed secretion inside the sinus cavities can be drained out through OMC by the function of respiratory cilia.

Over the 30 years, there are tremendous improvement of surgical instrument and the adjunctive procedure. For instance, the cutting&suction instrument such as the microdebrider

helps the surgeon to minimize tissue trauma, which leads to less intraoperative bleeding and better postoperative result.[10] (figure 7). The image-guidance system also helps the rhinologist to operate in the high-risk area, such as the orbit or skull base, or the uncertain anatomy with more accuracy.[11]

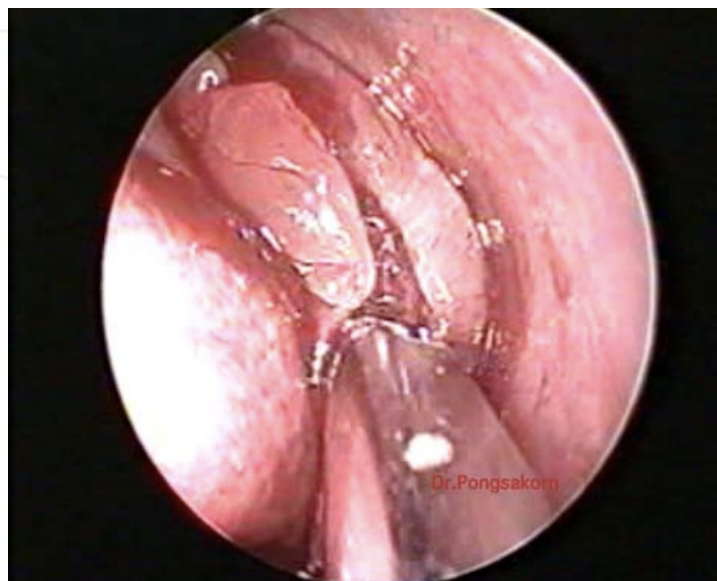


Figure 7. Endoscopic resection of left nasal polyp by microdebrider.

2.1.2. Allergic rhinitis with turbinate hypertrophy

Allergic Rhinitis (AR) is the disease mediated by ‘antigen-antibody’ reaction. The responsible antigen is the immunoglobulin E (Ig E). This pathomechanism leads to mast cell degranulation and subsequently releasing of various mediators, especially histamine and leukotrienes (LTs). The principle treatments of AR are the avoiding of responsible allergens, anti-allergic medication (eg. Antihistamine, corticosteroid nose spray), and modulation of immune response (eg. Allergen Immunotherapy – AIT).[12]

The most troublesome symptom of AR is nasal blockage/obstruction. Antihistamine (AH) and Intranasal corticosteroid (INCS) have their excellent result in alleviating of nasal obstruction. In some unresponsive AR patients, their inferior turbinates are hypertrophic from the submucous gland/vascular structures.

The original turbinate-reduction procedures are the total/subtotal turbinate resection or the cauterization by chemical agents, electrical instruments. These procedure leads into the losing of mucosal surface and subsequently crusting and dryness of nasal cavities.

More conservative procedures, with the utilization of nasal endoscopy, are done with more physiologic state. The endoscopic submucous resection (either by cutting-forceps or microdebrider) and radiofrequency volumetric tissue reduction (RFVTR) can be done with the excellent accuracy and surgical result.[13] (figure 8).

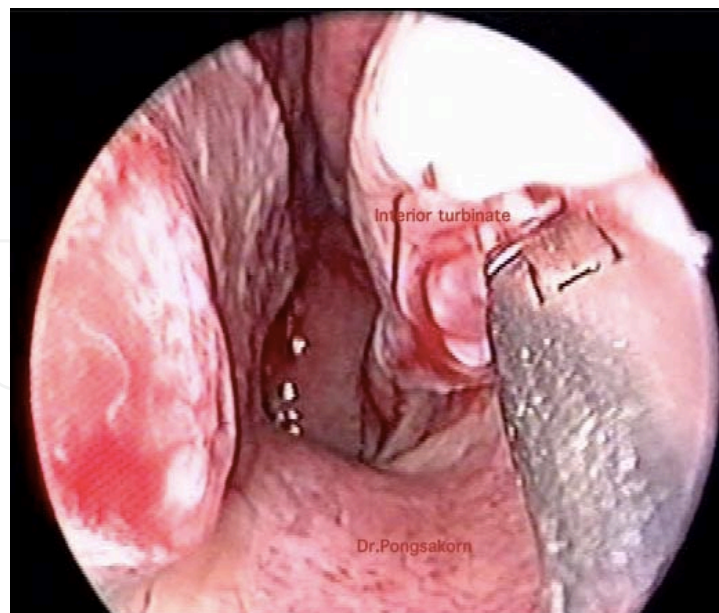


Figure 8. Endoscopic submucous resection of the left inferior turbinate.

2.1.3. Tumor of nose & paranasal sinuses (PNS)

Tumor of nose&PNS can be benign or malignant in-origin.The most common benign tumor is inverted papilloma.Inverted papilloma has its natural course of frequent recurrence due to its histologic character of 'inverted tumor cell into the attachment bony origin. So the principle of surgical treatment is the medial maxillectomy through open-approach such as the lateral rhinotomy or CWL.Nowadays, the medial maxillectomy procedure can be done under endoscope with the help of suction&cutting device (eg. Microdebrider). The endoscopic medial maxillectomy procedure reaches it comparable result as the open procedure.[14]

Another benign lesion that can be benefit from endoscopic procedure is the transnasal pituitary procedure. The hypophysectomy procedure has been done as the microscopic transeptal approach. Rhinologic surgeon can work along with neurosurgeon as a 'four-handed technique' through the nostrils by using endoscope.[15] The sphenoid sinus can be approach and further procedure of hypophysectomy can be done with the same principle of transeptal approach.

Malignant tumors of nose & PNS can be squamous cell carcinoma that commonly originates from the maxillary sinus or lateral nasal wall. Its symptom is subtle and the patient usually comes to visit the otorhinolaryngologist as the advance stage. To obtain the free-margin, the open procedure should be done to provide the good 5-years survival. But for some malignant lesions near skull base, such as olfactory neuroblastoma, the endoscope can help rhinologic surgeon to delineate the surgical margin and precise surgical resection with minimized injury to the vital structure.[16]

2.1.4. Nasal bleeding (epistaxis)

Nasal bleeding (Epistaxis) can be categorized into two groups, anterior or posterior epistaxis. Anterior epistaxis is usually bled from Little's area, which located at anteroinferior part of nasal septum. The mild degree anterior bleeding can be stopped by cold compression or cauterization. The more severe one can be stopped by standard anterior nasal packing.

The location of posterior epistaxis is around the posterior end of middle turbinate, which is supplied by the sphenopalatine artery. The sphenopalatine is the terminal branch of internal maxillary artery. Before the era of nasal endoscopy, the severe posterior epistaxis, which is failed from the posterior nasal packing, can be treated by internal maxillary artery ligation through the CWL approach. Nowadays, the sphenopalatine artery can be directly ligated or clipped by endoscopic approach.[17,18] (figure 9). This procedure requires less operative time and provides less tissue trauma comparing to the CWL approach.



Figure 9. Clipping the right sphenopalatine artery in the posterior epistaxis case.

2.2. Non-rhinologic condition

2.2.1. Obstruction of nasolacrimal system

Lacrimal system consists of the lacrimal punctum, canaliculus, lacrimal sac and lacrimal duct. The duct drains tear into the inferior meatus. Location of lacrimal drainage obstruction commonly occurs below the level of sac. Dacryocystorhinostomy (DCR) is the procedure for the treatment of obstructive of lacrimal system at that level. DCR can be bone via the incision around the medial canthus region. Then, the cavity of sac is entered. The medial (nasal surface) of sac is drained into the nasal cavity.

By using the endoscope approach, intranasal cavity can be examined and corrected if that particular structure may contribute to the obstruction. The intranasal specific area of lacrimal sac is called "AggerNasi" area is approached. The medial side of sac is entered after the Ag-

gerNasi bone work is done by drill or ronguer.(figure 10). The next step is to marsupialise the lac and make the sac stay widely open into the nasal cavity. Endoscopic DCR provides many advantages such as: ability to correct intranasal anatomy, less bony drilling, and no scarring.[19,20]



Figure 10. Endoscopic DCR. The transilluminated area is the AggerNasi area.

2.2.2. Cerebrospinal fluid repair

The etiologies of cerebrospinal fluid (CSF) leakage are either traumatic or non-traumatic cause. Most of the traumatic from accidental cause heal spontaneously after a few weeks of conservative treatments.

For the indicated cases of CSF leak, the external approach via bi-coronal incisions with utilization of various materials, such as fascia, can be done with excellent result.[21,22] Endoscopic approach to the anterior skull base is an alternative method, especially for the single-lesion leakage or the same-stage repair with the intranasal resection of tumor.[23] Many choices of repairing material is used, for instance: autologous fat graft, nasal mucosa, cartilage from septum or auricle, and allografts. (figure 11). Metaanalysis study reveals the comparable result with the external approach.[24]

2.2.3. Orbital/optic nerve decompression

Proptosis from thyroid hyperfunction is treated initially by prednisolone and immunosuppressive drugs. Surgical approach reserves for the refractory case, which can be done by removal of the bony wall of orbital. Theoretically, the selective on particular wall can be chosen, depending on the surgeon's preference and the degree of proptosis.

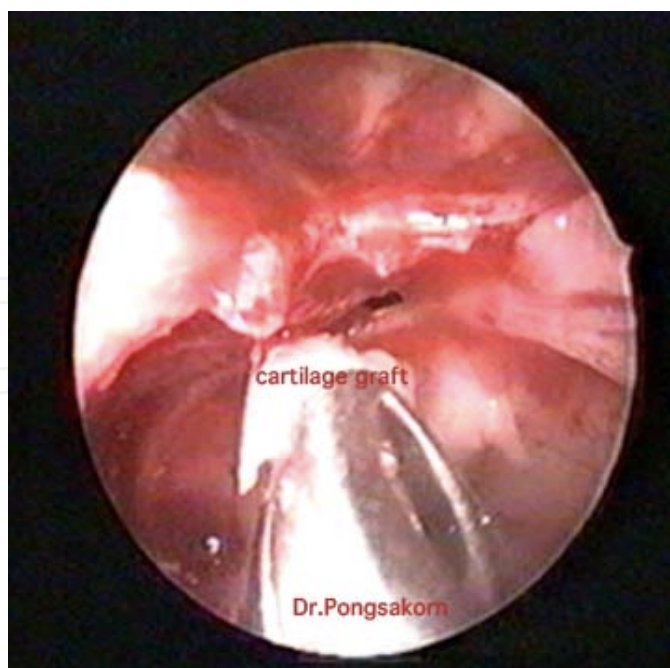


Figure 11. Endoscopic CSF leak repair. The cartilaginous free-graft is inserted to repair the skull base defect.



Figure 12. Endoscopic orbital decompression. The lamina papyracea is dissected from the periorbital by curettage.

Endoscopic medial wall decompression is commonly done, allowing the orbital content expands into the ethmoid cavity.[25,26] The first step of medial wall decompression is to do the ethmoidectomy with/without middle meatal antrostomy. Lamina papyracea is exposed and the surgeon can estimate the area of bony area to match with the degree of patient's

proptosis. Then, the bony decompression is done with minimally disturbance of orbital content. The hyperplastic orbital content protrudes into the ethmoid cavity (figure 12), which will make the proptosis improves. When more space is needed, the additional inferior orbital wall is performed in the same setting. In this 'infero-medial wall decompression', the orbital content gains more space into the maxillary & ethmoid cavities.

For the blunt traumatic injury of optic nerve, rhinologic surgeon can use the endoscope to decompress the medial&interior wall of orbital apex. This procedure provides more space for the compressed optic nerve.

3. Conclusion

Endoscope can be utilized in various conditions in rhinology&allergy. It provides both diagnostic and therapeutic value. The surgical treatment with endoscopic approach can be done in the inflammatory condition and the others conditions such as tumor resection, CSF leakage repair, DCR, orbital decompression, vascular ligation in epistaxis.

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