A CORRELATION STUDY OF PARANASAL SINUSES BETWEEN OPERATIVE ENDOSCOPIC FINDINGS IN FESS AND PREOPERATIVE CT SCAN

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ABSTRACT

OBJECTIVES

The aim of the study is correlation of para nasal sinuses between operative endoscopic findings of Functional Endoscopic Sinus Surgery (FESS) and pre-operative Computed Tomography.

STUDY DESIGN

Time bound Cross-sectional study.

METHODOLOGY

A group of 50 patients attending the ENT OPD for sinus related problems at Santhiram General Hospital, Nandyal, were examined and clinically confirmed cases of chronic rhinosinusitis were selected for study. CT scan findings were discussed with consultant radiologist and intrasinus mucosal disease and anatomical variations were noted. Further patients underwent functional endoscopic sinus surgery, during which anatomical variations and intrasinus mucosal disease were noted. Both the findings were tabulated and correlated.

KEYWORDS

Chronic Rhinosinusitis, Computed Tomography, Functional Endoscopic Sinus Surgery, Road Map, Complimentary.

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INTRODUCTION

Medical literature lacks sufficient data that compare pre-operative computed tomography and intra-operative findings during endoscopic surgery of nose and paranasal sinuses. Our concepts of infectious diseases have undergone several major changes during the past century. These changes apply to sinusitis as readily as to the other inflammatory disorders of the nose. Sinusitis in its simplest form is an inflammation of the mucous membranes of the sinuses. Unfortunately, disease may involve other parts of the sinus (Bone) or surrounding structures (Nose, Orbit, Central Nervous System) before the patient seeks help.

A Historical Perspective

In 1879 Nitze credited with the development of a small cystoscope.[1,2] that was subsequently used by Hirschmann in 1901 for visualization of the maxillary sinus via an oro-antral fistula.[3] Several years later in 1925, Maltz coined the term "Sinuscopy" in promoting use of the endoscope for diagnosis.[4,5] Many years later when the surgical microscope became available Heermann published on the use of the microscopy for endonasal procedures in 1958.[6]

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Being a mesothelial organ with the capacity to initiate multiple sites of repair, the peritoneum can simultaneously heal throughout the wound. In case of non-closure peritoneum a spontaneous reperitonealization.[2,3,7] will appear within 48 to 72 hours and complete healing after 5-6 days. 2) Non-closure of the peritoneum contributes to less adhesion.[8,9,10-12] When injured, the peritoneum responds initially by producing a fibrin matrix and proceeds with fibrinolysis to break down the fibrin. Re-approximation of the peritoneal edges with suture material is suspected to result in tissue ischemia, necrosis, foreign body tissue reaction, suppression of fibrinolysis and thus increased risk in adhesion formation. 3) Non-closure of the peritoneum reduces the amount of surgical intervention and saves on valuable operating time and cost.[1,2,3,6,13,14,15,16] The objective of this study was to assess the effects of non-closure and closure of the peritoneum at caesarean section.

MATERIALS AND METHODS

Three hundred pregnant women were included in this study from January 2007 to January 2014. The peritoneum was left open in 150 cases and in 150 it was closed; 50 (Fifty) women in the non-closure group and 50 (Fifty) women in the closure group were undergone repeat cesarean section. Detailed history, examinations and investigations, informed written consent was taken for each patient. They were evaluated intraoperatively subsequently. Substantial technologic improvement in fibre optic design in the early 1950s enabled Harold H. Hopkins of Imperial College London to develop the rod optic endoscope which became available in the early 1960.[7] they greatly enhanced light delivery and optical quality. Further improvement came when Karl Storz from Tuttlingen, Germany, who built endoscopes with angled views from 0 to 30, 45, 70, 90 and 120 degree.

The dramatic changes initiated by the pioneering studies of Messerklinger, in which he demonstrated that each sinus has a predetermined mucocilliary clearance pattern draining towards its natural ostium irrespective of additional openings that may have been created into sinuses.[8] This philosophy of opening the natural ostium of the diseased sinus was popularized by Stammberger.[9] and Kennedy.[10] ESS is now accepted as the surgical management of choice for chronic rhinosinusitis.

Chronic rhinosinusitis is affecting nearly 10-15% of the Indian population and a significant cause of morbidity to the patients.[11] the pathophysiology of sinus disease is mainly related to Patency of ostia, Function of cilia and quality of the nasal secretions the osteomeatal complex is the key area involved in the pathogenesis of chronic rhinosinusitis.[12]

Based on this concept Functional Endoscopic Sinus Surgery (FESS) aims to eliminate disease in the primary site, i.e. the osteomeatal complex and allow resolution of the secondary infection in the larger sinuses.[13] The present study is a time bound cross-sectional study and was done in 50 clinically diagnosed cases of chronic rhinosinusitis, to correlate and evaluate between the CT findings and endoscopic findings in FESS.

MATERIALS AND METHODS

The Time bound cross-sectional study was conducted in the Ear, Nose and Throat Outpatient Department, Santhiram Medical College and General Hospital, Nandyal, from Mar 2012 to Feb 2015. Total numbers of 50 patients were taken in the study. Inclusion Criteria were all clinically confirmed cases of CRS including recurrence cases who had undergone pre-operative CT scan and FESS thereafter and exclusion criteria were conditions which could be treated medically, complicated sinusitis, osteomyelitis, aggressive fungal infection, and infiltrating tumours. Diagnostic validity was used for correlation between Computed Tomography findings and endoscopic findings. Data obtained was analysed according to Cohen's Kappa (k) measure of agreement for agreement and Pearson's correlation (r) for correlation.

The parameters used for correlation were- Deviated Nasal Septum, Inferior Turbinate Hypertrophy, Middle Turbinate abnormalities, Concha Bullosa, Agger Nasi cells, Haller cells, Frontal recess, Infundibulum, Hiatus semilunaris, Uncinate process attachment, Intrasinus mucosal disease of Maxillary, Ethmoids, Frontal and Sphenoid detailed history, clinical examination and routine investigations were done for the patients. They were given pre-operative medical treatment like Antihistamines, Antibiotics, Steroid nasal spray minimum for a period of 2 weeks before taking CT scan and CT scan is taken the day before surgery and they were also treated for if they are suffering from any pre-existing conditions like Nasal allergy, Hypertension, Diabetes mellitus, etc., Consent was taken from all the patients. Pre-operative CT scan findings were discussed with consultant radiologist and intrasinus mucosal disease and anatomical variations were noted. Further patients underwent functional endoscopic sinus surgery, during which anatomical variations and intrasinus mucosal disease were noted. Both the findings were tabulated and correlated.

RESULTS

Descriptive Category	Pearson Correlation (r)	Cohen Kappa's Agreement	Comments
Maxillary sinus	-0.147	0.084	Poor agreement
Anterior ethmoids	0.849	0.763	Good agreement
Posterior ethmoids	0.643	0.803	Very good agreement
Frontal sinus	-0.147	0.016	Poor agreement
Sphenoid sinus	0.451	0.763	Good agreement

Table 1: Correlation between Endoscopic operative findings of intrasinus mucosal disease and CT scan using Pearson(r) correlation and Cohen Kappa's agreement

Descriptive Category	Pearson Correlation (r)	Cohen Kappa's Agreement	Comments
Deviated Nasal Septum	0.342	0.324	Fair agreement
Hypertrophied inferior turbinate	0.596	0.512	Moderate agreement
Middle turbinate abnormalities	1.000	1.000	Very good agreement
Concha bullosa	0.971	0.979	Very good agreement
Uncinate process attachment	1.000	1.000	Very good agreement
Hiatus semilunaris	0.406	0.397	Fair agreement
Infundibulum	0.428	0.373	Fair agreement
Frontal recess	0.690	0.798	Good agreement
Agger nasi cells	0.966	0.920	Very good agreement
Haller cells	1.000	1.000	Very good agreement

Table 2: Correlation between CT scan and Endoscopic operative findings of various anatomical variations using Pearson(r) correlation and Cohen Kappa's agreement

1. Middle turbinate, Concha Bullosa, Uncinate process, Agger Nasi cells, Haller cells and Posterior ethmoids showed very good agreement.
2. Anterior ethmoids, Sphenoid sinus and Frontal recess showed good agreement.
3. Hypertrophied inferior turbinate showed moderate agreement.
4. Deviated septum, Hiatus semilunaris and Infundibulum showed fair agreement.
5. Maxillary sinus and Frontal sinus showed poor agreement.

Cohen Kappa's Statistics	Agreement
<0.20	Poor
<0.40	Fair
<0.60	Moderate
<0.80	Good
To 1.0	Very good

DISCUSSION

Till date very few studies are there on correlation between endoscopy and CT scan in diagnosis of chronic rhinosinusitis on patients, but detailed correlation of per-operative endoscopic findings and pre-operative CT scan findings are not reported.

As the ethnicity has important bearing on anatomical variations and morphological features, this study highlights the importance of developing Indian data which shows deviation from the western frequency of variants. The osteomeatal complex is the key area involved in the pathogenesis of chronic rhinosinusitis.[12] Based on this concept Functional Endoscopic Sinus Surgery (FESS) aims to eliminate disease in the primary site, i.e. the osteomeatal complex and allow resolution of the secondary infection in the larger sinuses.[13] This is the basis for the concept of FESS.

In the present study, among study group (50 patients) the most common group was CRS without nasal polyposis (74%); CRS with bilateral nasal polyposis (12%): CRS with unilateral nasal polyposis (6%) and the least groups are CRS with fungal ball and CRS with allergic fungal sinusitis (4%). Till now, there is no study data on comparative incidence of types CRS. The incidence of CRS with Nasal Polyps is found to be 4% in general population and 25-30% of total CRS cases.[14]

In the present study, 20-40 years age group was most common and males (60%) and females (40%). In this study, nasal discharge (100%), nasal obstruction (92%), headache (92%) were the most common presenting symptoms, followed by sneezing (52%), facial pain (30%) and impaired smell (12%).

In this study 40% of cases were suffering from Allergic rhinitis, showing a strong association of allergy in CRS. According to Ashok Shah et al. study.[15] on CT PNS, sinusitis was present in more than two-thirds of the 189 patients with allergic rhinitis in groups 2 and 3 (136/189). According to Bousquet J et al.[16] the epidemiological studies have shown that 25- 50% of the patients with allergic rhinosinusitis have asthma and 70% of asthmatics have chronic allergic rhinosinusitis.

In the present study, most common anatomical variation was deviated nasal septum (84%) and can be compared with Perez Pinas et al.[17] (80%) study and Charusingh et al.[18] (66.6%) study, Ashok K Gupta et al.[19] (72.4%), but more than Asruddin et al.[20] (38%) study. Sheetal D et al.[21] showed moderate correlation. In our study, DNS showed fair agreement, (k=0.324). Septal deviation and spurs can cause severe headaches and other functional disturbances and predispose the patient to recurrent acute sinusitis or CRS.

Inferior turbinate hypertrophy was seen in 24%- Rt and 22% - Lt. It showed moderate agreement, (k= 0.512) in which CT and endoscopic findings did not go in hand. Inferior turbinate hypertrophy was observed in most of the allergic chronic sinusitis cases. Sheetal D et al. study showed poor correlation.

Among the intrasinus mucosal disease, Maxillary sinus (k=0.084) and Frontal (k=0.016) disease showed poor agreement, Anterior ethmoid (k=0.763) and Sphenoid (k=0.763) disease showed good agreement, whereas Posterior ethmoids (k=0.803) showed very good agreement. In our study maxillary, anterior ethmoid, posterior ethmoid, frontal, and sphenoid were diseased in 92%, 74%, 36%, 8%, 18% and 94%, 78%, 38%, 10%, 18% cases on right and left sides in CT scan, whereas they showed 18%, 74%, 20%, 0%, 2% and 22%, 68%, 24%, 0%, 2% cases on right and left side in endoscopy during FESS. In Sheetal D et al. maxillary sinus showed not a good correlation, whereas anterior ethmoids and posterior ethmoid showed excellent correlation.

According to Bolger et al. maxillary sinus disease was observed in 77.7% cases, posterior ethmoids in 38.6%, frontal in 36.6% and sphenoid sinus in 25.4%. Maru et al. reported maxillary sinus disease in 70.4% cases, posterior ethmoids in 52.4%, frontal sinus disease in 48.3% and sphenoid sinus disease in 40.8% cases. Maxillary sinus hypoplasia was seen in 2% cases both on right and left side both on CT scan and revealed during FESS. Complication of orbital emphysema was encountered during uncinectomy in FESS on right side because of this anatomical variation and the uncinate process lying in opposition with the lamina papyracea, in spite of extreme care during FESS.

Frontal sinus was hypoplastic in 4% cases both on right and left sides. It can be compared with Sheetal D et al.[21] study, Frontal sinus hypoplasia in 2% on right side, and Hyperplasia with 8% cases on right side.

Sphenoid sinus was asymmetrically pneumatized in (94%) cases. Anterior clinoid process pneumatization was 4% - Rt and 2% - Lt and was bilateral in 2% cases. Posterior clinoid process was normal in all the cases. Root of pterygoid process got pneumatized in 2% cases on both sides. In one case there was pneumatosis dilatans with hyperpneumatization of lateral process of pterygoid. It can be compared with Sheetal D et al. study findings of Anterior clinoid process pneumatization in 2% cases on right and 4% cases on left, Root of pterygoid process pneumatization in 4% cases on right and 2% cases on left side. Till date, very few studies on this finding.

The incidence of concha bullosa in this study was 14% - Rt and 28% - Lt and Rt both in CT scan and FESS showing very good agreement (k=0.979). Bolger et al.[22] have reported 53.6%, Maru et al.[23] 42.6%, Perez Pinas et al. 23.6% and Sheetal D et al. reported. In this study conches bullosa have showed very good agreement. In our study, bulbar cells were 2%-Rt and 6% - Lt, lamellar cells were 6% - right and 6% - left, true concha cells were 6% - Rt and 16% - Lt, whereas in Bolger et al. study 46.2% were lamellar cells, 31.2% were bulbar cells, and 15.7% were true concha cells. Another middle turbinate variation in our study is paradoxical middle turbinate, which was same on CT and FESS showing very good agreement (k=1.000).

Paradoxical middle turbinate refers to the concavity of the turbinate medially, contrary to the normal convexity medially. This causes obstruction of the OMC leading to sinusitis. In the present study paradoxical turbinate is seen in 2% and 4% cases on right and left in CT scan and is same in FESS. Sheetal D et al. reported 17% on right and 8% on left on CT scan and 8% on right and 4% on left in FESS. Perez Pinas et al. reported 10% cases on CT scan. Till date very few studies on this point and more studies need to be evaluated on this point. Endoscopic evaluation of uncinate process variations in literature ranges from 0.4%-15%. In our study, uncinate process attachment showed very good agreement (k=1.000). In Sheetal D et al. study also it showed excellent correlation. More studies need to be evaluated on this point.

Assessment of hiatus semilunaris and infundibulum showed fair agreement (k=0.397 and 0.373, respectively) between CT and FESS. But during FESS good correlation was between diseases at hiatus semilunaris and infundibulum and mucosal disease in maxillary sinus. In Sheetal D et al. study showed poor correlation of Hiatus semilunaris and infundiblum between CT and FESS. More studies need to be evaluated on this point.

In our study frontal recess showed good agreement (k=0.798) between CT scan and FESS. In Sheetal D et al. study, it showed poor correlation. More studies need to be evaluated on this point. Agger nasi cells may block the frontal recess depending upon the degree of pneumatization thus identification on the CT scan is in cases of frontal sinusitis surgery. In the present study, Agger nasi showed very good agreement between CT scan and FESS (k=0.920). In Sheetal D et al. study Agger nasi Cells showed excellent correlation. More studies need to be evaluated on this point.

Haller cells (Infraorbital cells) are an extension of ethmoid air cells present in inferomedial wall of the orbit or roof of the maxilla and obstruct the infundibulum leading to sinusitis. Haller cells showed very good agreement in the present study (k= 1.000). In Sheetal D et al. it showed poor correlation. More studies need to be evaluated on this point. The anatomical variation in the incidence is 4.17% reported by Baradaranfar MH et al.[24] and 45.9% by Bolger et al.

CONCLUSION

In patients clinically diagnosed to have chronic rhinosinusitis and who underwent pre-operative CT scan of PNS followed by Functional Endoscopic Sinus Surgery.

1. Clinical examination can only evaluate the structural abnormality of nasal septum and inferior turbinate. It is inadequate to identify other structural abnormalities like Concha bullosa, Paradoxical middle turbinate, Haller cells, Onodi cells, Osteomeatal complex and Agger nasi cells.
2. Deviated nasal septum is better evaluated during FESS than on CT, but CT scan report on deviated nasal septum is still acceptable.
3. Inferior turbinate hypertrophy is best evaluated during FESS.
4. Identification of middle turbinate structural abnormalities is better assessed during FESS.
5. Concha bullosa and its distribution are better evaluated on both on FESS and CT scan.
6. Osteomeatal complex block due to gross anatomical variations is an indicator of intrasinus mucosal disease.
7. Uncinate process attachment variations is best assessed on CT scan.
8. Agger nasi cells are better assessed on CT scan but FESS are also acceptable.
9. Endoscopy is superior to CT scan in assessing the mucosal changes like Oedema, Polyps, congestion and visualization of Accessory Maxillary ostium, Sphenoid sinus ostium, Sphenoethmoidal recess.
10. CT scan is superior to Endoscopy in assessing anatomical variations like Onodi cells, Haller cells, Concha, Optic nerve dehiscence, Olfactory fossa depth, Vomer pneumatization, Frontal hypoplasia and Maxillary sinus hypoplasia, Internal Carotid artery course, Sphenoid sinus pneumatization.
11. CT scan is mandatory as pre-operative work up in undergoing FESS as it guides like a "Road Map" on which to operate and to prevent per-operative and post-operative complications.
12. Endoscopy and CT scan are "Complimentary" in the assessment of various anatomical variations in Osteomeatal complex and intra-sinus mucosal disease.

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