Impact of Anatomical and Radiological Findings for Consideration of Functional Endoscopic Sinus Surgery

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Abstract Endoscopic sinus surgery is being done more accurately and with better diagnosis and planning with the help of high resolution CT scan. It has played an invaluable role in the delineation of the sinonasal pathology and anatomic variations preoperatively. To correlate the CT scan findings with endoscopic findings with respect to anatomical variants and pathology and evaluation of its impact on surgical planning. A prospective study conducted on 300 patients who presented to the ENT outpatient department with sinonasal diseases and underwent Functional endoscopic sinus surgery. There is a need to evaluate and correlate the findings to deduce the extent of relations CT findings have to that of findings observed during endoscopy as they really affect the surgical planning and outcomes.

Keywords Nasal endoscopy · Endoscopic sinus surgery · PNS CT scan

Introduction

Functional endoscopic sinus surgery does not imply “minimalistic” treatment of sinonasal disease with incomplete operations; rather it is a technique to deal with all areas of disease. Even thin membranous bony partitions found in areas adjacent to chronic diseases, that becomes devitalized, can be removed and normal mucosa can be preserved, wherever possible. High-resolution CT imaging

has added, to more accurate diagnosis and, hence, to surgical planning [1]. Its advent in the delineation of the sinonasal pathology and anatomic variations has proven invaluable to the Otolaryngologists in the preoperative planning but CT scan is not always accurate in depicting the disease and anatomical variants. These discrepancies though minor, need further evaluation and correlation of CT findings to that of findings observed during endoscopy and surgery among different individual categories. This study was done to know the impact of anatomical and radiological findings on consideration of functional endoscopic sinus surgery.

Materials and Methods

Objectives

To correlate the CT scan findings with pre and peroperative endoscopic findings and to know the impact of anatomical and radiological findings for consideration of functional endoscopic sinus surgery.

Study Design

It was a prospective study conducted on 300 patients who presented to the ENT outpatient department with sinonasal diseases and underwent Functional endoscopic sinus surgery from September 2002 to 2005. It included a defined inclusion, exclusion and withdrawal criteria.

After pretreatment evaluation consisting of detailed history and examination, all patients were subjected to the diagnostic nasal endoscopic examination under local anesthesia. For this, patient's nasal cavities were packed with 4% Xylocaine and Adrenaline (5:1) soaked and

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squeezed cotton wicks. This was left for 15–20 min in nasal cavities for adequate desensitization and decongestion. Then a systemic endoscopic examination was done in three subsequent passes (Stammberger [1, 2]) and the findings were recorded. This was followed by CT scan as a prerequisite.

Guidelines for computerized topographic examination: With endoscopic diagnosis, almost all patients were subjected to computerized tomography, but before CT scan, all patients underwent optimal (3–4 weeks) medical management to address the problem of acute infection and to shrink and reduce inflammatory and hyperplastic mucosa. For this, a combination of drugs was given according to the pathology in form of antibiotics, antihistaminic, mucolytics, decongestants, anti-inflammatory drugs and steroidal nasal spray.

After adequate medical management, CT scan was done under the following settings:

1. Non contrast scans of nose and paranasal sinuses.
2. Supine position.
3. Mainly coronal cuts with a few axial cuts for sphenoethmoidal recess relations and onodi cells.
4. With a gross slice thickness of 3 mm (but of 1 mm at areas of interest as ostiomeatal complex etc.).
5. Number of cuts according to extent of pathology.
6. Window settings—intermediate windows.

Statistical Methods

All the values were expressed in the terms of mean $\pm$ standard deviation (Mean $\pm$ S.D.), wherever applicable. All the statistical analysis was carried out using statistical package SPSS-11.50.

Observations and Results

Preoperative diagnostic nasal endoscopy was done in all cases. It was observed that 44% patients showed DNS/spur. Regarding uncinat process, 32% patients had prominent uncinat while 12% patients had recessed one. Middle turbinate was hypertrophied in 18% patients while it was paradoxical in 13% patients. Polyps were present in 36% patients bilaterally while 28% patients showed unilateral polyposis (Table 1).

Out of 300 patients in the study group, 225 patients underwent CT scan for nose and paranasal sinuses. Out of 225 patients, 210 (93.33%) patients showed haziness in maxillary sinus, 150 (66.66%) patients in ethmoidal sinus, 117 (52%) patients in frontal sinus and 99 (44%) patients in sphenoidal sinus. Other major findings, which were recorded, are ostiomeatal blockage in 207 (92%) patients

Table 1 Diagnostic nasal endoscopy findings

Findings	No. of cases	Percentage
Aggar Nasi		
Pneumatized	72	24.0
Diseased	24	8.0
Absent	66	32.0
DNS/Spur	132	44.0
Uncinate process		
Prominent	96	32.0
Recessed	36	12.0
Inferior turbinate		
Hypertrophy	45	15.0
Atrophy	9	3.0
Middle turbinate		
Hypertrophy	54	18.0
Paradoxical	39	13.0
Lateralized	15	5.0
Absent	15	5.0
Bulla ethmoidalis		
Prominent	63	21.0
Large	42	14.0
Accessory maxillary ostium		
0	231	77.0
1	54	18.0
>1	9	3.0
Polyps		
Unilateral	84	28.0
Bilateral	108	36.0
Single	90	30.0
Multiple	102	34.0
Sphenoethmoidal recess		
Pus	30	10.0
Polyps	108	36.0
Mucosal disease	36	12.0
Frontal recess		
Pus	45	15.0
Polyps	42	14.0
Mucosal disease	45	15.0

and 105 (46.66%) patients in anterior and posterior units, respectively. DNS or spur was seen in 114 (50.66%) patients. Various other variants were also seen. It is important to note that 27 (12%) patients have shown bony dehiscence, mostly lamina papyracea breach (24 patients) (Table 2).

We made two subsets for maxillary and ethmoidal findings. Endoscopic findings were taken as reference while CT scan findings were correlated in percentage of the reference value. Bony dehiscence had a very high correlation between endoscopic and CT finding which was

Table 2 Computerized tomography scan findings

Findings	No. of cases	Percentage
DNS/Spur	114	50.66
Maxillary sinus haziness	210	93.33
Ethmoidal haziness	150	66.66
Frontal haziness	117	52.00
Sphenoidal haziness	99	44.00
Ostiomeatal complex (anterior) block	207	92.00
Ostiomeatal complex (posterior) block	105	46.66
Uncinate process		
Lateralized	45	20.00
Medialized	135	60.00
Pneumatized	12	5.33
Haller cells	18	8.00
Frontal cells	51	22.66
Concha bullosa	48	21.33
Paradoxical middle turbinate	30	13.33
Aggar nasi prominence	75	33.33
Onodi cells	12	5.33
Large bulla ethmoidalis	90	40.00
Bone destruction	15	6.66
Dehiscence		
Lamina papyracea	24	10.66
Skull base	3	1.33
Sphenoid sinus	0	0.00

100% for both maxillary and ethmoidal subset while gross polypoidal changes had a correlation of 98%. Mucosal thickening (90–93%), Aggar nasi (90%), Frontoethmoidal disease (92.8%), DNS (86.3%), Concha bullosa (88.9%), prominent bulla (88.2%) and OMC blockage (87.3%) also showed a considerable correlation while pus/mucopus (60%) in maxillary sinus was a poor correlate (Table 3).

Discussion

Computed tomography over the years has evolved into an essential prerequisite for the assessment of patients undergoing FESS [3] suggested that remarkable anatomic variations of paranasal region and their possible pathologic consequences should be well defined in order to improve success of management strategies, and to avoid potential complications of endoscopic sinonasal surgery. One of the aims of CT PNS is to delineate the extent of the disease and define any anatomical variants that may predispose to disease. The scan serves as a “road map” for the surgeon as he negotiates the potentially hazardous clefts of the paranasal sinus unit. It is a noninvasive, rapid, convenient investigation, which helps in documentation and education. As already mentioned CT scan delineates the extent of

Table 3 Correlation of nasal endoscopic findings with computerized tomography findings

Endoscopic findings	Percentage correlation with CT findings
Maxillary sinus subset	
Mucosal thickening	90.0
Polypoidal change	97.0
Pus/mucopus	60.0
Ethmoidal subset	
Aggar nasi	90.0
Mucosal thickening	93.0
Polypoidal change	98.0
Bulla prominence	88.2
OMC blockage	87.3
Frontoethmoidal disease	92.8
Sphenoethmoidal disease	75.0
Concha bullosa	88.9
Paradoxical turbinate	76.9
Bony dehiscence	100
Others	
DNS/spur	83.3

disease, anatomical and pathological variations far better than other methods. Nasosinus endoscopy and CT scan can be considered complementary techniques for effective demonstration of nasal anatomy and paranasal sinuses, according to Morra et al. [4]. Such statement is added to the theory that the CT scan would be more specific for the assessment of paranasal sinuses, whereas nasosinus endoscopy would have better resolvability to assess nasal fossa, according to Tratado [5].

In the study, we have attempted to correlate the CT findings of patients with endoscopic findings and then to assess its impact in planning of definitive endoscopic sinus surgery. We were able to draw a hypothesis based on these correlations. We made two subsets for maxillary and ethmoidal findings. Endoscopic findings though subjected to individual variations, still were assumed to be correct and were taken as reference, while CT findings were correlated in percentage of this reference value. It was found that there were many instances when certain findings like mucosal thickening was not found during endoscopy but that could be seen on CT scan. Certain parameters like gross polypoidal change (97–98%) and bony dehiscence (100%) showed very good correlation with endoscopic findings while others like presence of pus/mucopus in sinus (60%), paradoxical turbinate (76.9%) and sphenoethmoidal disease (75%) showed poor correlation. Mucosal thickening and polypoidal changes showed 90–98% correlation with that of the CT scan findings which was consistent to that of Jianneto’s correlation of 91.67%. Gross polypoidal

changes in both maxillary and ethmoidal sinus showed very high correlations (97 and 98%), which were better as compared to Jianneto's study, showing a correlation of 94.05 and 91.67%, respectively. Among the bony variants, concha bullosa was presumed in 54 cases during endoscopy while it was observed in 48 cases on CT scans, showing a correlation of 88.88%. Bony dehiscence showed 100% correlation while DNS/spur showed 86.36% correlations with endoscopic findings.

Among the various diagnostic parameters available for preoperative assessment of sinonasal disease, few will disagree with the essence of CT scan because of its ability to depict information i.e. even hidden to endoscope. The ability of high resolution CT scanning to depict accurately the status of structures within the paranasal sinus region represents a major advance in delineating the location and extent of pathology. Now, the development of intraoperative CT navigation system and computer aided surgery has revolutionized the sinus surgery [6].

Despite of all these merits, it has been found that CT is not absolutely accurate in depicting the disease and anatomical variants. These discrepancies though minor, need further evaluation and correlation of CT findings to that of

findings observed during endoscopy and surgery among different individual categories.

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