Comparative Evaluation of Chronic Rhinosinusitis Patients by Conventional Radiography, Computed Tomography and Diagnostic Nasal Endoscopy (DNE)

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Abstract Chronic rhinosinusitis is a common condition in medical practice. It is defined as inflammation of the mucosa of nose and paranasal sinuses, the fluids within these cavities, and/or the underlying bone that has been present with or without treatment for at least 12 weeks duration. In 1997, a detailed definition of the syndrome was developed by the Rhinosinusitis Task Force of the American Academy of Otolaryngology-Head and Neck Surgery, consisting of the major and minor diagnostic criterias. To study the role of conventional radiography, nasal endoscopy and computed tomography in the early diagnosis of chronic rhinosinusitis. The study was carried out in the Department of Otorhinolaryngology, Saraswati Institute of Medical Sciences. A total of 100 patients with clinical evidence of sinonasal diseases were evaluated with conventional radiography, Nasal endoscopy and computed tomographic evaluation. Out of 100 patients; 58 were male and 42 were female. M:F ratio = 1.38:1. Majority of the patients were being in the age group of 21–30 years (30 %). The most common finding on conventional radiography was opacification of maxillary sinus (42 %) followed mucosal thickening (26 %), haziness of the maxillary sinus (19 %) followed by air-fluid level (13 %). Five basic radiological patterns of sinonasal inflammatory disease are identified among 100 patients. These were (1) Infundibular 16 %, (2) Ostiomeatal unit 32 %, (3) Sphenoidal 8 %, (4) Sinonasal polyposis 28 %, (5) Unclassified 16 %. The sensitivity and specificity of plain film radiography for detecting sinus opacifications was unacceptably low for paranasal sinuses, hence conventional

radiography should not be used as a single diagnostic tool in preoperative evaluation. Nasal endoscopy having sensitivity and specificity almost as good as CT scanning, and being an outpatient procedure may reduce unnecessary diagnostic CT scanning procedures. It allows an unparalleled vision with brilliant illumination of nose and paranasal sinuses. Endoscopic directed procedures have high accuracy due to vision controlled and incomparable guidance in treatment of nasal and nasopharyngeal pathologies. CT scan can be reserved as second level investigation for the subgroup of patients with negative endoscopy who remain symptomatic on follow up.

Keywords Chronic rhinosinusitis · Conventional radiography · Computed tomography · Diagnostic nasal endoscopy (DNE)

Introduction

Chronic rhinosinusitis is a common condition in medical practice. It is defined as inflammation of the mucosa of nose and paranasal sinuses, the fluids within these cavities, and/or the underlying bone that has been present with or without treatment for at least 12 weeks duration. In 1997, a detailed definition of the syndrome was developed by the Rhinosinusitis Task Force of the American Academy of Otolaryngology-Head and Neck Surgery, consisting of the major and minor diagnostic criterias [1, 2]. The impact of chronic rhinosinusitis has been well documented. It affects many people worldwide and its prevalence is rising. Although CRS diagnosis is clinical and symptom based, it is necessary to perform further investigations as Stankiewicz and Chow showed that only 47 % of the patients who were diagnosed with CRS had sinus disease on CT, thus

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leading them to re-evaluate the symptom based definition [3–5].

Objectives

To study the role of conventional radiography, nasal endoscopy and computed tomography in the early diagnosis of chronic rhinosinusitis.

Materials and Methods

The study was carried out in the Department of Otorhinolaryngology, Saraswati Institute of Medical Sciences. A total of 100 Patients with clinical evidence of sinonasal diseases were evaluated with conventional radiography, Nasal endoscopy and computed tomographic evaluation. The study included those patients who were clinically diagnosed as having chronic rhinosinusitis with or without nasal polyposis or having clinical evidence of other sinonasal pathologies in the age group 10–65 years irrespective of sex. Patients with previous alteration of Paranasal sinus anatomy due to facial trauma and previous sinus surgery were excluded. Patients having malignant neoplasms and congenital malformations were excluded from study. Approval for the study was obtained from Institutional Ethical Committee and Institutional Scientific Review Committee. Written informed consent was taken before enrolment of patients into the study.

All the patients were subjected to detailed clinical history particularly for nasal symptoms, general examination and ENT examination. Thereafter, they were subjected to X-ray paranasal sinuses (water's view), computed tomography and diagnostic nasal endoscopy. In the present study, DNE was done under local anaesthesia using 0° and 30° rigid nasal endoscope. Endoscopy was performed using the standard three pass technique to obtain the information regarding purulent secretions, polypoidal mucosa in middle meatus and anatomical variations.

For statistical analysis the data from data collection forms were tabulated in a Microsoft Excel® spreadsheet. Data were then exported to SPSS, version 20.0 for statistical analysis. Chi square and Student's *t* tests were used for statistical analyses. *p* value <0.05 was considered statistically significant.

Results

Out of 100 patients; 58 were male and 42 were female. M:F ratio = 1.38:1. Majority of the patients were being in the age group of 21–30 years (30 %) (Figs. 1, 2).

Fig. 1 Sex distribution of the patients

Fig. 2 Age distribution of the patients

The most common symptom was nasal obstruction (89 %) followed by nasal discharge (81 %), PND (42 %), sneezing (36 %), headache (34 %), nasal polyp (30 %) and ear discharge/heaviness (25 %) (Fig. 3).

The most common finding on anterior rhinoscopy was deviated nasal septum (70 %) and next were nasal discharge (67 %), turbinate hypertrophy (48 %) followed by polyps (30 %).

The most common finding on conventional radiography was opacification of maxillary sinus (42 %) followed by mucosal thickening (26 %), haziness of the maxillary sinus (19 %) followed by air-fluid level (13 %) (Fig. 4).

The most common anatomical variations detected on nasal endoscopy was deviated nasal septum (80 %) followed by concha bullosa (46 %) and paradoxical middle turbinate (24 %), prominent bulla ethmoidalis was found in (32 %) and agger nasi in (36 %) patients (Fig. 5).

The findings detected on computed tomography were deviated nasal septum in 76 %, concha bullosa in 48 %, uncinate process variation in 38 %, prominent bulla ethmoidalis and agger nasi both 30 % each, paradoxical middle turbinate in 21 % patients (Fig. 6).

Five basic radiological patterns of sinonasal inflammatory disease are identified among 100 patients. These were (1) Infundibular 16 %, (2) Ostiomeatal unit 32 %, (3) Sphenothmoidal 8 %, (4) Sinonasal polyposis 28 %, (5) Unclassified 16 % (Fig. 7, Case Nos. 1, 2, 3).

Fig. 3 Most common primary presenting symptoms of the patients **Fig. 4** Finding on conventional radiography **Fig. 5** Anatomical variations detected on nasal endoscopy **Fig. 6** Anatomical variations detected on computed tomography **Fig. 7** Radiological patterns of sinonasal inflammatory disease on CT scan

Discussion

The present study showed that sinonasal pathology has a higher preponderance in male patients and is commonly seen in the age group of 20–30 years. 30 % patients had prolonged history of 2–5 years and 20 % had symptoms persisting for more than 5 years. In the study conducted by Kirtane et al. [6] there were 48 (61.5 %) males and 30 (38.4 %) females and male to female ratio was 1.6:1.

In the study conducted by Kirtane et al. [6], the commonest complaint was nasal discharge seen in 61 % patients, followed by nasal obstruction in 59 % patients. In the study conducted by Aminnu Bakari et al. the nasal discharge (97.4 %) was the most common presenting complaints followed by nasal obstruction (94.7 %) [7].

With CT scanning as gold standard the mean sensitivity for diagnosis of any abnormality in the maxillary sinus by conventional radiography was 57.8 %, specificity 50 %, positive predictive value 91.2 % and negative predictive value 11.6 %. Chi square value was 0.222, with degree of freedom 1 and *p* value was 0.637.

Case No. 1 Endoscopic, X-ray and CT paranasal sinus (coronal view). Photograph showing right sided antrochoanal polyp

Case No. 2 Endoscopic, X-ray and CT paranasal sinus (coronal view). Photograph showing inverted papilloma left side

Case No. 3 Endoscopic, X-ray and CT paranasal sinus (coronal view). Photograph showing deviated nasal septum with spur

The mean sensitivity was 67.7 %, specificity 87.6 %, accuracy 78.6 %, positive predictive value 82.5 % and negative predictive value 76.9 %. in another study by Konen et al. [8] (Table 1).

Plain radiographs are relevant only when they show features of fluid level: findings of haziness and opacity are of less diagnostic value as stated by Kolo [9]. The shortage

of water's view technique could be ascribed to anatomical causes such as: hypoplastic sinus, orbital floor fissure, superior orbital fissure and zygomatic recess which could appear as false clouding and opacification and false mucosal thickening and technical causes. They are insufficient to evaluate anterior ethmoid cells, frontal recess and 2/3 superior part of nasal cavity according to our findings and similar studies. Due to the super-positioning of the structures and problems experienced for ideal positioning, imaging is usually suboptimal and extension of soft tissue mass and bone destructions are not clearly visualized.

The mean sensitivity for diagnosis of deviated nasal septum by nasal endoscopy was 96.8 %, specificity 89.18 %, positive predictive value 93.84 % and negative predictive value 94.24 %. The Chi square value was 75.8, with degree of freedom 1 and p value was <0.001 . The mean sensitivity for diagnosis of concha bullosa was 93.18 %, specificity 99 %, positive predictive value 99.93 % and negative predictive value 94.91 %. The Chi square value was 88.4, with degree of freedom 1 and p value was <0.001 . The mean sensitivity for diagnosis of polyps was 97.14 %, specificity 92.3 %, positive predictive value 87.17 % and negative predictive value 98.36 %. The Chi square value was 76.5, with degree of freedom 1 and p value was <0.001 .

The level of agreement between diagnostic nasal endoscopy and CT is almost perfect for deviated nasal septum, turbinate hypertrophy, concha bullosa, medially bent uncinat process and polyp (0.829, 0.925, 0.821, 0.922,

0.821 and 0.833 respectively); substantial for paradoxical middle turbinate (0.736) and slight for bulla ethmoidalis. This observation was found to be statistically significant (Table 2).

According to Kasapoglu et al. [10], computed tomography and nasal endoscopy are supplementary to each other in preoperative evaluation of patients with chronic sinusitis. Anatomic variations such as medially deviated uncinat processus, concha bullosa, and paradoxical middle turbinate located at the middle meatus can easily be identified with nasal endoscopy but information on their anatomic details and expansion of the sinus disease can not be obtained. On the other hand, CT scanning allows describing anatomic details and expansion of the sinus diseases.

Sonkens et al. [11] observed five basic radiologic mucociliary patterns of sinus disease—(1) Infundibular 26 %, (2) Ostiomeatal unit 25 %, (3) Sphenoethmoidal recess 6 %, (4) Sinonasal polypoid 10 %, (5) Sporadic or Unclassified 24 %. In the present study also similar five pattern were identified (1) Ostiomeatal unit 32 %, (2) Infundibular 16 %, (3) Sinonasal polypoid 28 %, (4) Sphenoethmoidal 8 %, (5) Unclassified 16 %. However we found osteomeatal unit pattern in majority in 32 (32 %) cases.

In this study, it was found that the Ostiomeatal complex area was involved in most of the patients thus emphasizing the concept of 'Ostiomeatal complex and ethmoid being the key factor in the causation of chronic recurrent sinusitis'. Removal of disease in ostiomeatal complex region is the basic principle of functional endoscopic sinus surgery.

Table 1 Comparison of X-ray PNS in various studies

Study	Konen et al. (%)	Nicolaas et al.	Rudolf et al.	Our study (%)
Sensitivity	67.7	83.3 %	52.2 %	57.8
Specificity	87.6	69.2 %	86.7 %	50
PPV	82.5	83.3 %	–	91.2
NPV	76.9	–	–	11.6

Conclusion

The sensitivity and specificity of plain film radiography for detecting sinus opacifications was unacceptably low for paranasal sinuses, hence conventional radiography should not be used as a single diagnostic tool in preoperative evaluation.

Table 2 Level of agreement between diagnostic nasal endoscopy and computed tomography in patients with sinonasal diseases

Finding	Endoscopy positive		Endoscopy negative		κ	p
	CT positive	CT negative	CT positive	CT negative		
Deviated nasal septum	61	4	2	33	0.829	<0.05
Inferior turbinate hypertrophy	48	2	1	49	0.925	<0.05
Middle turbinate hypertrophy	40	6	1	53	0.821	<0.05
Concha bullosa	41	1	2	56	0.922	<0.05
Paradoxical middle turbinate	23	6	1	70	0.736	<0.05
Uncinate process medially bent	18	2	1	79	0.821	<0.05
Bulla ethmoidalis	40	8	27	25	0.143	<0.05
Polyp	34	5	1	60	0.833	<0.05

Nasal endoscopy having sensitivity and specificity almost as good as CT scanning, and being an outpatient procedure may reduce unnecessary diagnostic CT scanning procedures. It allows an unparalleled vision with brilliant illumination of nose and paranasal sinuses. The radiation dose to the patient is not negligible in standard CT of the sinuses, therefore Nasal endoscopy should be promoted and thereby reducing unnecessary radiation exposure to the patients.

Nasal endoscopy has the ability to detect small localized disease in the nasal cavity, which can be missed even by computed tomography. Diagnostic nasal endoscopy can prove to be a better diagnostic modality compared to CT scan when conditions like middle meatal secretions, condition of mucosa, polyps are looked for. In pathological benign nasal mass histopathological is essential for its diagnosis where diagnostic nasal endoscopy can prove useful in taking precise biopsy.

Endoscopic directed procedures have high accuracy due to vision controlled and incomparable guidance in treatment of nasal and nasopharyngeal pathologies. CT scan can be reserved as second level investigation for the subgroup of patients with negative endoscopy who remain symptomatic on follow up.

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Compliance with Ethical Standards

Conflict of interest Mohit Srivastava declares that he has no conflict of interest. Sushant Tyagi declares that he has no conflict of interest.

Ethical Approval This article does not contain any studies with human participants performed by any of the authors. This article does

not contain any studies with animals performed by any of the authors. This article does not contain any studies with human participants or animals performed by any of authors.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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