

Correlation between computed tomography findings, preoperative nasal endoscopic findings and intra-operative findings in chronic rhinosinusitis with or without polypi

Ali Ahmed El Garem,^a Ahmed El Farouk Abd Elfattah,^a AbdElrahman Younes Ali^b

^aProfessor of Otorhinolaryngology, Faculty of Medicine, Cairo University, ^bLecturer of Otorhinolaryngology, Faculty of Medicine, Cairo University, Egypt

Corresponding author:
AbdElrahman Younes Ali
ALecturer of Otorhinolaryngology, Faculty of Medicine, Cairo University, Egypt
E-mail: abdelrahmanent@gmail.com

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Background: The diagnosis of chronic rhinosinusitis relies on clinical judgment based on a number of subjective symptoms and few findings in physical examination in addition to Computerized Tomography and endoscopy.

Objective: Correlation of findings and preoperative diagnoses detected by nasal endoscopy and computed tomography scan of the nose and paranasal sinuses in patients with chronic rhinosinusitis with or without polyps with operative findings and intraoperative diagnoses to declare the most accurate tool for diagnosis.

Material and Methods: Forty patients with chronic rhinosinusitis. The diagnosis was confirmed by symptoms, nasal endoscopy and CT of the nose and paranasal sinuses. Then patients were subjected to the endoscopic sinus surgery, final diagnosis was confirmed based upon endoscopic surgery.

Data from the nasal endoscope and CT were reported, statically analyzed, and compared to the data obtained from the surgery.

Results: Twenty six patients had a match between the sinuses on the CT and during the FESS, (65%), while 14 patients had a mismatch between their sinuses on the CT and FESS (35%). Out of the 14 patients, 12 had a mismatch in one sinus and 2 had a mismatch in more than one, with the maxillary, anterior ethmoid and the frontal sinuses showing the most degree of mismatch in 4 patients.

The degree of matching between the endoscope/CT to the intraoperative endoscopic findings were 40 % with the endoscope and 50% matching with the CT.

Conclusion: No single procedure can be sufficient in accurately diagnosing chronic rhinosinusitis, and its different classes. Both procedures are required to be performed pre-operatively as they are complementary to each other, for adequate guidance and identification of the important anatomical landmarks of the nose and paranasal sinuses through the endoscopic sinus surgery.

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Introduction

Chronic rhinosinusitis CRS in adults is defined according to the EPOS as presence of two or more symptoms, one of which should be either nasal blockage/ obstruction/ congestion or nasal discharge (anterior/ posterior nasal drip), and maybe facial pain/ pressure, and maybe reduction or loss of smell for a period ≥ 12 weeks. [1] CRS with nasal polypi (CRSwNP) is defined as above with bilateral, endoscopically visualized polyps in middle meatus. CRS without NP (CRSsNP) is defined as above with no visible polyps in middle meatus, if necessary following decongestant. This definition accepts that there is a spectrum of disease in CRS which includes polypoid change in the sinuses and/ or middle meatus but excludes those with polypoid disease presenting in the nasal cavity to avoid overlap. [3]

The diagnosis of CRS relies on clinical judgment based on a number of subjective symptoms and few findings in physical examination. These symptoms and signs are inherently vague and because of the uncertainty associated with the diagnosis of CRS, it is necessary to have data that are more objective about the extent of the disease. [4,5] When combined with sinonasal endoscopy, computed tomography (CT) provides the majority of objective data used to diagnose CRS. It has high sensitivity and provides objective findings

regarding the condition of the nasal mucosa, paranasal sinuses and the presence of fluid or polyps. Furthermore, CT findings are an integral part of several severity staging systems that are used for CRS. However, because studies have failed to correlate these staging systems to disease severity, many authors have advocated the use of CT as a tool in evaluating anatomy and for preoperative planning only. [4]

Aim of work

Correlation of findings and preoperative diagnoses detected by nasal endoscopy and computed tomography scan of the nose and paranasal sinuses in patients with chronic rhinosinusitis with or without polyps with operative findings and intraoperative diagnoses to declare the most accurate tool for diagnosis.

Material and Methods

Subjects

Forty patients were recruited from the ENT outpatient clinic in the Kasr El-Aini hospital, during the period from September 2013 till February 2014, with the age ranging from 12 to 65 years. All patients had CRS according to criteria by EPOS 2012. [5]

The diagnosis was confirmed by symptoms, nasal endoscopy

and CT of the nose and paranasal sinuses. All patients had received a full course of medical treatment with failure of improvement of symptoms for ≥ 12 weeks and they were all indicated for surgery.

Exclusion criteria

1. Severe septal deviations, large septal spur.
2. Marked nasal adhesions.
3. Infants, uncooperative or neurotic patients.
4. Nasal and paranasal sinuses tumors.

All patients were subjected to a preoperative assessment protocol that includes history taking where a thorough history of present illness was taken for all the patients, particularly to identify the causes of CRS. This was followed by nasal endoscopic examination using the 4mm 30° rigid nasal endoscope. The nasal cavities were sprayed with a topical decongestant and local anaesthetic. Initially the endoscope passed along the floor of the nose with visualization of the inferior meatus then into the nasopharynx. Next, the endoscope was reinserted between the middle and inferior turbinates, with assessment of the sphenoidal recess, superior turbinate and natural sphenoid ostium. Finally, it was rotated laterally under the middle turbinate into the posterior aspect of the middle meatus, where the bulla ethmoidalis hiatus semilunaris, the infundibular entrance, and the uncinat process were inspected.

Abnormalities of the endoscopic findings such as septal deviations, inferior turbinates hypertrophy, middle turbinates abnormalities, middle meatal polyps, discharge, fungal granulations, superior turbinate, sphenoidal recess, and the nasopharyngeal abnormalities had been reported.

Then CT scan of the nose and paranasal sinuses was done to all the patients, axial and coronal cuts with high resolution and slice thickness of five mm with bone and soft tissue windows. The results were evaluated in details by an expert radiologist reporting sinus abnormalities in the form of how many sinuses were affected, and the severity of the sinus opacification using the Lund-Mackay staging system. [6]

Then patients were subjected to the endoscopic sinus surgery, and final diagnosis was reached based upon surgical endoscopic surgery, because it depends on direct visualization, and in the meantime supported by a good background of preoperative endoscopy and CT scan.

Data from the nasal endoscope and CT were reported, statically analyzed, and compared to the data obtained from the surgery.

Results

A total of 40 cases of chronic rhinosinusitis with or without polyps were chosen in our study, which was formulated during 8 months period, from July 2013 till February 2014. Patients were selected from Kasr-ElAini outpatient clinic of otorhinolaryngology.

Age ranged between 12 till 65 years with a mean of 38.8, with 22 males representing 55% and 18 females of 45%.

Endoscopic examination revealed septal deviation in 18 patients representing 45%, while CT showed the deviation in 22 patients of 55% of the total cases, as for surgery it was found in 24 patients of 60% of the total cases. (Fig. 1).

Out of the forty cases, 22 patients had hypertrophied inferior turbinate of 55%, with 18 patient had normal turbinate by the nasal endoscope, while it was detected in 30 patients of 75% by the CT, with 10 cases only having normal turbinates, and it was hypertrophied in 24 patients of 60%

during the surgery, and 16 patients had normal turbinate of percent 40%.

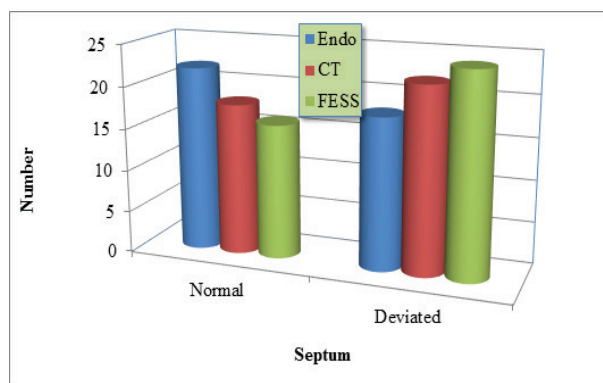


Fig 1 Showing the septum variations in numbers by the three different procedures

In our study, the middle turbinate was included in one of the following criteria, which were:

1. Normal
2. Not seen (endoscope only)
3. Polypoidal
4. Concha bullosa

The average results of the middle turbinate findings on both sides were: 50% of the total patients had a normal middle turbinate by endoscope, 40% had it not seen, in 8% it was concha bullosa and finally 2% was found polypoidal. By CT, 92% of the cases had normal middle turbinate, 2% was not detected by CT, & it was seen as concha bullosa in 6% of the total. By FESS, it was found normal in 54%, polypoidal in 38%, and concha bullosa in 8%. (Fig. 2).

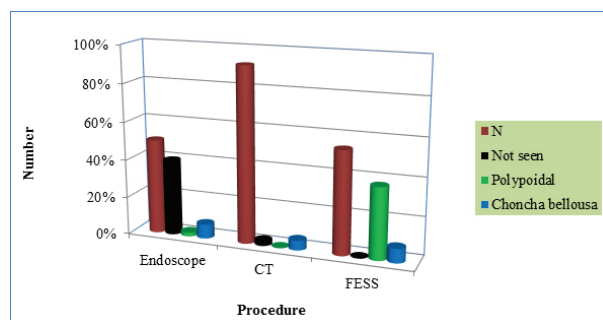


Fig 2 Showing average of percent of each finding of both sides of the middle turbinate by the three different procedures

In our study, the middle meatus was included in one of the following criteria, which were:

1. Normal
2. Not seen
3. Discharge
4. Polyps
5. Opacified

Findings of the middle meatus by endoscope revealed that most of the cases had polyps in their middle meati of 72%, 15% of the total patients had a normal meatus, 10% was full of discharge, and finally 3% had it not seen. By CT, 82% had opacified middle meatus, and 18% of the cases had normal middle meatus. By FESS, it was found that it included polyps in 76%, normal in 18%, and full of discharge in 8%. (Fig. 3).

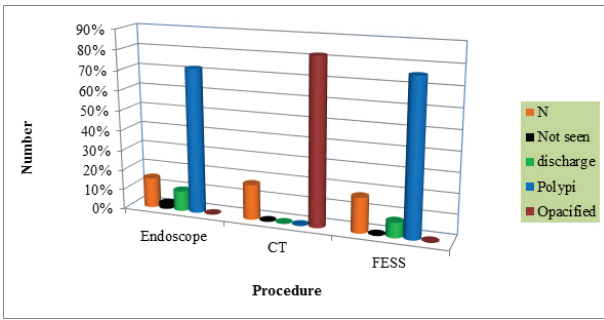


Fig 3 Showing average of percentages of each finding of both sides of the middle meatus by the three different procedures

As for the superior turbinate, it was normal in 8 cases of 20% by nasal endoscope, and not seen in the rest of the patients of 32 cases of 80%. As for CT, it was found normal in all cases and with same result during surgery.

In our study, the sphenoethmoidal recess was included in one of the following criteria, which were: 1) Normal, 2) not seen, 3) discharge, 4) polyps, 5) opacified. The sphenoethmoidal recess was found by endoscope to be not easily visualized as detected in 75% of the cases, followed by being normal in 23% and finally was seen discharging in 2% of the cases. By CT, 72% had an opacified sphenoethmoidal recess whereas 28% of the cases had it normal. By FESS, it was found normal in 38%, full of polyps in 35%, and full of discharge in 27%.

In our study, we commented on the nasopharynx if it was found normal or it contained adenoid tissue, and we found that 30 patients had adenoid of 75% by all three procedures, making no such difference between using either endoscope or CT when judging the nasopharynx.

By CT the lamina papyracea was found normal in 32 cases of 80% of the total cases, and 8 cases had it dehiscent representing 20% of the patients. During the FESS, 30 patients had normal lamina papyracea of 75% and the remaining 10 cases had it dehiscent.

It was found in our study that 36 cases both by CT and FESS revealed having an intact ICA of 90% and only 4 cases had dehiscent ICA of 10% of the cases.

It was found that 26 patients had a match between the sinuses on the CT and during the FESS, representing 65% of the total cases, with 14 patients showing a mismatch between their sinuses on the CT and FESS of 35%. Out of the 14 patients, 12 had a mismatch in one sinus and 2 had a mismatch in more than one, with the maxillary, anterior ethmoid and the frontal sinuses showing the most degree of mismatch in 4 patients. (Fig. 4).

It appeared from the results of the CT & operative procedure that the anterior ethmoid sinus was the most commonly affected sinus with 34 cases by CT and 36 cases with FESS (+2), followed by the posterior ethmoid sinus with 34 cases by CT and 32 cases with FESS (-2), then the maxillary sinus with also 34 cases by the CT and 30 cases by the FESS (-4), then the frontal sinus with 26 cases by the CT and 22 cases by the FESS (-4), and finally the sphenoid sinus with 26 cases with the CT and 20 cases during the FESS (-6). (Table 1)

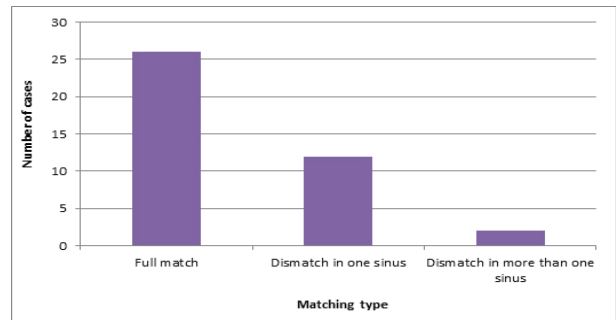


Fig 4 Showing the degree of matching between CT scan and ESS regarding the sinuses

Table 1. Showing the involvement of various sinuses detected by CT & ESS

Sinus	CT		Operative	
	Number	Percent	Number	Percent
Maxillary	34	85%	30	75%
Anterior ethmoid	34	85%	36	90%
Posterior ethmoid	34	85%	32	80%
Frontal	26	65%	22	55%
Sphenoid	26	65%	20	50%

Provisional diagnosis is reached by the pre-operative nasal endoscope, and by CT, and correlated with the final diagnosis which is fulfilled by the surgery. It was found that CRS without polyps was diagnosed by the endoscope in 12 cases and by CT in 6 cases, but the final diagnosis was reached by the FESS in only 2 cases. On diagnosing allergic polyps, it was found that endoscopic diagnosis was in 22 cases, 18 cases diagnosed by the CT and finally they were 16 cases diagnosed by the FESS. When trying to reach diagnosis for the allergic fungal sinusitis, it was detected by endoscope in 6 cases, 8 cases by the CT and 10 cases by the FESS. In cases of fungal ball, nothing was diagnosed by the endoscope, 2 cases by the CT and finally it was detected in 4 cases by the FESS. In our last criterion (chronic indolent fungal sinusitis) also nothing was detected by the endoscope, 6 cases were seen by the CT, however 8 cases were diagnosed by the FESS. (Fig. 5).

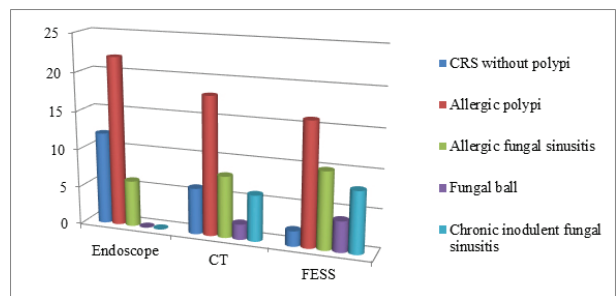


Fig 5 Showing the different percentages of the different diagnoses in our study

The degree of matching between the endoscope / CT to the operative diagnoses were that the endoscope showed a 40% matching with the FESS whereas the CT showed a 50% matching with the FESS regarding the diagnosis.

Discussion

Sinusitis or rhinosinusitis is inflammation of the paranasal sinuses. It can be due to infection, allergy, or autoimmune issues. It is a common condition in medical practice, which affects many people worldwide and its prevalence is rising.

Although CRS diagnosis is clinical and symptom-based, it was necessary to perform complementary exams in order to confirm diagnosis and also to indicate severity and origin of the disease. So CT scan and nasal endoscopy were performed. They also helped to identify anatomical abnormalities.

In our study, septal deviation was detected in 18 cases (45%) by the endoscope and 22 cases (55%) by the CT and 24 cases (60%) by operation. Zojaji et al., 2008 showed similar results which revealed septal deviation in 28 cases (55%) by CT and 31 (61%) by the operation out of 51 cases enrolled in his study. [5] Shahizon et al., 2008 revealed similar results with septal deviation by endoscope in 10 cases (42%) and by CT in 16 cases (67%) out of 24 cases enrolled in this study. [9,10]

Considering inferior turbinate, it was found hypertrophied in 22 cases (55%) by nasal endoscopy, 30 cases (75%) by the CT and in operation it was hypertrophied in 24 cases (60%). This overestimation of hypertrophied inferior turbinate by the CT than in endoscope & operation because it was hidden within the polyps, giving a false sensation of hypertrophy. However Zojaji et al., 2008 revealed that the total number of patients with hypertrophied inferior turbinates was 36 (71%) by CT and 34 (67%) during operation, in the 51 cases enrolled in his study. [5] In contrast also to our study, Duarte et al., 2005 revealed hypertrophied inferior turbinate in 16 (80%) out of 20 patients by nasal endoscopy and only 9 cases (45%) by the CT. [9,11]

When dealing with the middle turbinate results, it can be detected that the high prevalence of normal middle turbinate finding by the CT is probably because that it can be detected within the polyps radiographically (better in the bone window) better than endoscopically, and also because that the CT cannot detect that the middle turbinate being polypoidal, revealing it as a normal variant and hence the high percent (92%), unlike during the operation in which 38% of the cases showed a polypoidal middle turbinate. This previous incidence is nearly similar to the incidence of the middle turbinate that was not detected endoscopically (40%) probably because it was hidden within the polyps. The low incidence of the polypoidal middle turbinate detected by the endoscope is probably because it was not easily identified from within the polyp. The study showed nearly similar results regarding the concha bullosa by the three different procedures.

Zojaji et al., 2008 revealed in his study that 8 cases (16%) had a polypoidal middle turbinate by both the endoscope and during the operation, unlike to our study. Also he noticed the concha bullosa in 7 cases (14%) by the CT and found that only 4 cases (8%) had it during the operation. Shahizon et al., 2008 also in contrast with our study revealed that 45% of his cases (40 patients) had concha bullosa detected by CT and only 25% had it detected by nasal endoscope. Sheetal et al., 2011 showed that 38% of his cases (45 patients) had concha bullosa on the CT and nearly 36% of the cases had it during the operation, with near agreement with our results. [9-11]

It was found in our study, that there was a close relation between the middle meatus being normal by the different procedures. Endoscopy revealed that 72%

of the cases had polyps and 10% had discharge in their middle meati with close relation to the operative findings, unlike by the CT which showed high prevalence of opacity criterion in our study (82%), this is probably because that what seems to appear as polyp or discharge by the endoscope, will only be visualized as opacity on the CT.

Shahizon et al., 2008 showed a high degree of agreement with our results concerning the non-specificity of the CT in differentiating between discharges or polyps with 60% of the 40 cases had opacity on the CT, however endoscopically it was found that only 25% of the cases had polyps in the middle meatus, and the rest had discharge. [9] Zojaji et al., 2008 revealed that 84% of the 51 cases showed opacity on the CT (not differentiating between polyps or discharge), and actually during the operation 86% had a pathology, 25% only of which were polyps, and the rest were discharge. [10]

Regarding the superior turbinate, it was found that only 8 cases (20%) were detected endoscopically, and the rest were not detected, unlike the CT and during the operation in which the superior turbinate was detected in all the cases. This is probably due to the difficulty of reaching it in the presence of polyps, edema and discharge, also because of the uncooperation of some cases.

Regarding the sphenoidal recess, it was found that in most of the cases (75%) it was difficult to visualize it endoscopically, as it was difficult to reach for it because of its position and if it was associated with polyps, edema or discharge, and also because of the uncooperativeness of some cases. Again due to the un-specificity of the CT, it showed that 72% of the cases had opacified sphenoidal recess, but it was actually 35% of the cases had polyps and 27% had discharge during the operation. Sheetal et al., 2011 revealed that 22% of his 45 cases had discharge at their sphenoidal recess, and 15% had polyps, with contrast with our results. [12]

In our study, we took a look over the nasopharynx, and revealed that adenoid tissue was detected in the nasopharynx of 10 cases of 25%, as seen by endoscope and CT, and was confirmed by the surgery. The lamina papyracea was dehiscence in 8 cases representing 20% as detected by the CT and was found by surgery that 10 cases of 25% had a dehiscence lamina. Also dehiscence of the internal carotid artery was detected in 4 cases as detected by CT and confirmed by the surgery.

Sheetal et al., 2011 revealed that 2% of his cases had internal carotid artery dehiscence, indicating a high level of agreement with our study. [12]

Results of maxillary sinus findings in our study showed that half of the 27% of the cases that scored 1 on the Lund-Mackay score system were discharge, and it was found that 10% of the cases despite being polyps and fungal granulations, yet they also scored 1 on the Lund-Mackay scoring system. However, more than half of the cases scored 2, with the majority of the cases were polyps (33%), and yet also 15% of these cases (who scored 2) were discharge, and this is probably due to the non-specificity of the CT in differentiating between the polyps and discharge. Also it was found that 10% of the cases were fungal granulations, and they were equally distributed between scores of 1 & 2, and this is probably because of the degree of the pathology on the CT.

For the anterior ethmoid sinus, it was found that 78% of the cases scored 2 on the Lund-Mackay scoring system, with about 60% of these cases were having polyps and approximately the remaining cases had fungal granulations, and this is accepted as the ethmoid sinus is known to be the commonest sinus to be affected by polyps. Also it is noted from the results that 13% of the cases scored 1, with nearly equal distribution among the various categories.

As for the posterior ethmoid sinus, results showed nearly similar results as the anterior ethmoid, where 65% of the cases showed a score of 2 on the Lund-Mackay score system with 50% were polyps, and only 15% were fungal granulations. Also it was noted that 15% showed a score of 1 with almost all of them were polyps. Finally about 20% of the cases showed normal posterior ethmoid with a score of 0.

According to the frontal sinus findings, it was found that 33% of the cases had polyps with all of the cases showed a score of 2, also it was detected that 42% had a normal frontal sinus, yet some of which had a score of 1 or 2 on the CT.

Finally the sphenoid sinus, results revealed that 26% of the cases had polyps with scores of 2 in 18% and 1 in 8%. 16% of the cases had discharge in their sphenoid with equal distribution between the scores of 1 & 2, also noticed that 14% of the cases had fungal granulations, with the CT unable to distinguish between polyps, discharge and fungal granulations due to the lack of the sensitivity of CT.

It was found that in 26 cases representing 65% that there was a match between the sinus involvement on the CT and during the operation, with 14 cases (35%) showed a mismatch between both procedures. Also it was noted that in our study that the anterior ethmoid sinus was the most commonly affected in 90%, followed by the posterior ethmoid in 80%, then the maxillary in 75%, then the frontal and sphenoid with 55% and 50% respectively, with nearly equal data obtained from the CT.

According to Sheetal et al., 2011, reported that the maxillary sinus was the most commonly affected sinus in his study by CT in 51% of the 45 cases, followed by the anterior ethmoid in 38%, then the posterior ethmoid in 30%, finally the frontal and sphenoid sinuses in 27% and 17% respectively. His results were confirmed intra-operatively with the maxillary sinus was the most commonly affected sinus with 43%, then the anterior ethmoid with 37%, followed by posterior ethmoid sinus in 31%, and finally the frontal and sphenoid with 25% and 15% respectively. Also Zojaji et al., 2008 mentioned that the maxillary sinus was the most affected sinus in 82%, followed by the ethmoids in 55%, then the sphenoid with 25%, and finally the frontal sinus in 20% out of the 51 cases. [9,12]

It was found from our results that many cases were diagnosed as CRS without polyps by the endoscope (about 30%) and yet only 5% were actually diagnosed as CRS without polyps intra-operatively, probably due to that in some cases severe edema and discharge obscured the view, as well as small polyps within the middle meatus, and fungal balls maybe have been missed by endoscope and so were diagnosed as CRS without polyps.

There was an overestimation for the diagnosis of allergic polyps by the endoscope (55%) mainly, when actually it was detected in 40% of the cases, and this is probably due to the fact that many of these polyps showed the bluish glistening feature of allergic polyps by the endoscope, making an assumption that the diagnosis would be most likely allergic polyps, and at the same time there was an underestimation of allergic fungal sinusitis by the endoscope (15%) mainly, when the actual results were 25% of the cases, due to missed fungal mud detection during the endoscope.

Also there is to a lesser degree a mismatch between the CT and the operation regarding the allergic polyps and allergic fungal sinusitis, and this is probably due to the decrease sensitivity of the CT in detecting the fungal mottling, and also an inexperienced radiologist commenting on the data.

There is a poor correlation between the endoscope and the operative results when diagnosing chronic indolent

fungal sinusitis, and this probably due to that the fungal granulation tissue and debris being masked by the polyps, giving an inaccurate diagnosis and hence the high percent of the cases diagnosed as allergic polyps by the endoscope.

There was a better correlation between the CT and the operative results regarding the chronic indolent fungal sinusitis and this is probably because that the indolent fungal sinusitis appears on the CT with high incidence of erosion of the surrounding bony septation as the lamina papyracea, internal carotid artery bony septation as hence a better diagnosis can be established.

Conclusion

In conclusion, it appeared from the results that there was a great degree of correlation between the CT with the operative findings regarding many of the findings such as the septal deviation, superior turbinate, sphenoethmoidal recess, lamina papyracea, internal carotid artery dehiscence, and only 10% mismatching between the sinuses by the CT and operation, and finally a better correlation with the diagnoses than the endoscope.

Regarding the endoscope, there was a great deal of agreement with the operative findings including the inferior turbinate, concha bullosa, a better specificity than the CT on the middle meatus findings, and finally a lesser agreement with the operative diagnoses then with the CT.

So in conclusion, it can be found from our study that no single procedure can be sufficient in accurately diagnosing CRS, and its different classes, and that both procedures are required to be performed pre-operatively as they are complementary to each other, for adequate guidance and identification of the important anatomical landmarks of the nose and paranasal sinuses through the ESS.

References

1. Fokkens W, Lund V, Bachert C, Clement P, Hellings P, Holmstrom M, et al. European position paper on rhinosinusitis and nasal polyps. *Rhinol Suppl.* 2005;18:1-87.
2. Fokkens W, Lund V, Mullol J. European Position Paper on Rhinosinusitis and Nasal Polyps Group European position paper on rhinosinusitis and nasal polyps 2007. *Rhinol Suppl.* 2007;20:1-136.
3. Benninger MS, Ferguson BJ, Hadley JA, Hamilos DL, Jacobs M, Kennedy DW, Lanza DC, Marple BF, Osguthrope JD, Stankiewicz JA, Anon J, Denvey J, Emanuel I, Levine H. Adult chronic rhinosinusitis: definitions, diagnosis, epidemiology, and pathophysiology. *Otolaryngol Head Neck Surg.* 2003;129:S1-S32.
4. Duarte AF, Soler Rde C, Zavarezzi F. Nasal endoscopy associated with paranasal sinus computerized tomography scan in the diagnosis of chronic nasal obstruction. *Rev Bras Otorrinolaringol (Engl Ed).* 2005;71:361-3.
5. Fokkens WJ, Lund VJ, Mullol J, Bachert C, Alobid I, Baroody F, Cohen N, Cervin A, Douglas R, Gevaert P, Georgalas C, Goossens H, Harvey R, Hellings P, Hopkins C, Jones N, Joos G, Kalogjera L, Kern B, Kowalski M, Price D, Riechelmann H, Schlosser R, Senior B, Thomas M, Toskala E, Voegels R, Wang de Y, Wormald PJ. EPOS 2012: European position paper on rhinosinusitis and nasal polyps 2012. A summary for otorhinolaryngologists. *Rhinology.* 2012;50:1-12. doi: 10.4193/Rhino50E2.
6. Lund VJ, Kennedy DW. Staging for rhinosinusitis. *Otolaryngol Head Neck Surg.* 1997;117:S35-S40.

7. Jones NS. CT of the paranasal sinuses: a review of the correlation with clinical, surgical and histopathological findings. *Clin Otolaryngol Allied Sci.* 2002;27:11-7.
8. Zinreich SJ. Rhinosinusitis: radiologic diagnosis. *Otolaryngol Head Neck Surg.* 1997;117:S27-34.
9. R. Zojaji R., Mirzadeh M, Naghibi S.: Comparative Evaluation of Preoperative CT Scan and Intraoperative Endoscopic Sinus Surgery Findings in Patients with Chronic Rhinosinusitis,-head and neck imaging. *Iran J Radiol.* 2008;5.
10. Shahizon MM, Suraya A, Rozman Z, et al. Correlation of computed tomography and nasal endoscopic findings in chronic rhinosinusitis. *Med J Malaysia.* 2008.
11. Duarte AF, Soler Rde C, Zavarezzi F. Nasal endoscopy associated with paranasal sinus computerized tomography scan in the diagnosis of chronic nasal obstruction. *Rev Bras Otorrinolaringol (Engl Ed)* 2005;71:361-3.
12. Sheetal, D., Devan, P.P., Manjunath, P., Martin, P., Satish Kumar K., Sreekantha, Satisha T.G., Manjunatha Goud, B.K., 2011. Computer tomography paranasal sinuses – do we really require before functional endoscopic sinus surgery? *Journal of Clinical and Diagnostic Research.* 5:179-181.