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Original Research Paper

Adequacy of Coronal Ct in Frontal Sinus Surgery

Medical Science

KEYWORDS : computed tomography; coronal; frontal sinus; intraoperative; predictive value.

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ABSTRACT

Since the advent of FESS, attempts have been made to know the best tool to study the surgical anatomy of paranasal sinuses preoperatively. In our institute we undertook a study to know the effectiveness of only coronal CT, in detecting abnormalities in anatomy of frontal sinus and its drainage. The aim of this study is to quantify the level of agreement and accuracy of pre operative true coronal 1mm computed tomography (CT) of Para nasal sinuses (PNS) with intraoperative findings of the frontal recess region in endoscopic sinus surgery.

Introduction:

Since the beginning of endoscopic sinus surgery era, frontal sinus has been a challenge to rhinologist. It has a complex anatomy by virtue of its variable cell patterns in every human being1. Because of its variable anatomy, surgery in this area is difficult. Iatrogenic complications in this area though rare but are potentially catastrophic. Clear understanding of the cellular structure and the drainage pathway of the frontal recess is essential for the success and safety of sinus surgery. A combination of diagnostic endoscopy and radiographic tomographic techniques is essential to accurately define this area2. CT has very much emerged as the gold standard in preoperative diagnosis and allows for accurate patient selection for FESS 3. High definition spiral multi-slice CT scanners, has the ability to image the frontal recess in the axial plane with excellent reconstructions in the coronal and parasagittal planes. For clear understanding of the cellular structure and the drainage pathway of the frontal recess reading the CT scans in all three planes and reconstructing a 3–dimensional picture of the anatomy is necessary4,5,6. Though considered the gold standard, CT taken in all three planes is an expensive proposition and a considerable burden on a majority of our patients.

Improvement in both FESS techniques and CT technology has concurrently expanded the indications for sinus surgery. The key to safe and successful surgery of the frontal sinus is identification of the natural sinus outflow tract with preservation of at least part of the natural ostium.

Materials and methods:

A minimum of 50 patients admitted under the department of ENT in SDM College of Medical Sciences & Hospital, Dharwad were included in this study. These patients who met our inclusion criteria, underwent frontal sinus surgery with dissection of frontal recess from November 2012 to November 2015 . It was a Hospital based cross sectional study .To avoid observational bias, all surgeries were performed by same surgeon.

All Patients undergoing ESS with dissection of frontal recess were included in study. Following patients were excluded from study 1) Patients undergoing ESS without frontal recess dissection. 2) Patients below the age of 10yrs. 3) Patients with malignant tumor involvement of frontal recess and frontal sinus. 4) Cases where ESS was abandoned due to excessive bleed.

All patients selected for the study, underwent preoperative true coronal computed tomography of nose & PNS. The scanning was done on a Siemens somatome 128 slice multidetector CT. Patient was placed in supine position and images taken from the nasion to the posterior extent of sphenoid sinus. Slices taken at 1mm thickness with a shift of 0.7mm to obtain 115 images with exposure of 120 KV, 2.7 sec scan time. The images obtained were loaded onto DICOM (Digital Imaging and Communication in Medicine) and correlated in the operation theatre via PACS (Picture Archiving and Communication System).

Surgical technique: Several approaches to the frontal recess have been described. We used the axillary flap approach which is based on the dissection on the close relationship of the agger nasi with the frontal recess 7.

Correlation : CT was correlated with intraoperative findings for the following parameters, Uncinate process attachment, Agger nasi cell, frontal recess and frontal sinus cells, frontal drainage pathway, anterior ethmoidal artery, frontal sinus and frontal sinus mucosa. The operating surgeon correlated coronal CT PNS with intraoperative findings.

The anatomical boundaries that define the frontal recess, the cells occupying them and the anatomical structures that aid and contribute to its drainage pathway were studied and defined via computed tomography of 1mm coronal sections of the Para nasal sinuses. These findings were correlated with intra operative findings of the respective cases through sensitivity, specificity, positive and negative predictive values.

The parameters included in the study:

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1)Uncinate Process

a)Superior attachment of the uncinate as to the lamina papyracea (lateral), the middle turbinate or the skull base (medial).

2)Presence or abscence of Ager nasi cell.

3)Frontal Sinus Cells: the presence or absence of the Kuhn type of frontal cell.

4)Medial or Lateral Frontal sinus drainage pathway .

5) Presence or absence of Anterior Ethmoidal artery.

6)Frontal Sinus mucosa which is categorized as either thick or normal.

Observations:

1) Uncinate process attachment

In this study CT showed 84% of cases had uncinate process attached to lamina papyracea and 16% medially (skull base and middle turbinate).This was in accordance with the previous studies8,9.Coronal CT scan was able to correlate with intraoperative finding with positive predictive value of 88.89% and negative predictive value of 100%.Which proves adequacy of only coronal CT in pre operative diagnosis.

2) Agger nasi cell.

In this study, CT showed Agger nasi in 88% of cases, which correlates with other studies8,9,10,11. The positive predictive value is 97.78% and negative predictive value is 100%.Which upheld are hypothesis.

3) Frontal sinus cells

In this study coronal CT correlated with intraoperative findings accurately ,with negative predictive value of 90 to 100%. The sensitivity index for type 3 cell was lower; this was because of inability to identify the cell intraoperatively. This observation is similar to the previous studies10.

4) Frontal sinus drainage pathway

In this study 84% of patients had medially draining frontal sinus12. This is the commonest type of drainage noticed .This parameter was accurately identified by coronal CT with predictive value of 100%.

5) Anterior ethmoidal artery

Coronal CT scan was very accurate in identifying anterior ethmoid artery. The lower negative predictive value can be attributed to inability to identify it during surgery. Its identification preoperatively minimized the risk of intraoperative bleeding and complication associated with it.

6) Frontal sinus mucosa

In most of our cases there was thickening of frontal recess or sinus mucosa. For which frontal sinus was explored. Coronal CT showed good correlation between preop CT and intraoperative finding .

Discussion:

Surgery of the frontal sinus is said to a challenge to most endoscopic sinus surgeons13. The frontal recess has a complex and unpredictable anatomy .Because of its range of anatomical configurations. It lies behind the frontal beak between superior portion of the middle turbinate and the lamina papyracea14 .To best understand the anatomy of frontal sinus Pluridirectional tomography and computed tomography (CT) are used 15.CT is the perfect tool for imaging of paranasal sinus because of its ability to depict accurately fine bony architecture of nose and paranasal sinus drainage pathways 16, 17. Thus it has become a prerequisite for FESS. Preoperatively routinely CT scan is being done, which serves as an important guiding light during surgery18.Previously it was believed that coronal CT was sufficient in providing the anatomical details during surgery19.

According to Peter-John Wormald,surgery of the frontal recess and frontal sinus should only be performed if the surgeon has a clear understanding of the cellular structure and the drainage pathway of the frontal recess. Such an understanding comes with the ability to read the CT scans in all three planes and to reconstruct a 3–dimensional picture of the anatomy 4,5,6. In recent times virtual endoscopy is being used for frontal outflow tract mapping in performing minimal invasive surgery of frontal sinus11.

In our study all the parameters necessary for surgery of frontal sinus surgery were considered and studied on 1mm coronal CT scan. These parameters were correlated intraoperatively. All the surgeries were performed by same surgeon. Our study showed that most of the parameters had sensitivity of 90 to 100%, except for the type 3 frontal Kuhn cell .which was over diagnosed on CT. The other reason for this is inability to locate Kuhn type 3 cell during surgery.

Based on our observation, we conclude that coronal CT is adequate for frontal sinus surgery. In our study we did not encounter any intraoperative complication, nor did we abandon surgery because of limited CT scan. In Indian scenario , limited CT scan of PNS has a lesser financial burden on an individual's income. It depicts preoperative anatomy with utmost accuracy and strong predictive value. This makes it a excellent and adequate tool for preoperative evaluation for frontal sinus surgery.

Conclusion:

Preoperative coronal CT scan is adequate in diagnosing anatomical variations ,which can alter the outcome of surgery. It can also help in anticipating the intraoperative difficulties and thus prevent the complications. It is financially viable for most of our Indian population.

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