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A computed tomographic analysis of frontal recess cells in association with the development of frontal sinusitis

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ABSTRACT

Objective: This study was done to determine frontal recess anatomy cell variations and its association with frontal sinusitis. The incidence of frontal recess cells in the population, the presence of frontal recess cell variations in chronic rhinosinusitis and non-chronic rhinosinusitis and the association of frontal recess cell variation in the development of frontal sinusitis were also assessed.
Methods: This was an observational, retrospective cross-sectional study of computed tomography (CT) scan of paranasal sinus that had been performed on patients in Hospital Universiti Sains Malaysia and Hospital Sultanah Bahiyah done from January 2009 until December 2016. The presence of frontal recess cells variation was compared with other populations.
Results: A total of 312 sides from 156 patients' CT scan images were analyzed. Left and right sinuses were considered individually. A total of 63 sides showed evidence of frontal sinusitis, 37 were male and 26 were female, whereas 249 sides were clear from frontal sinus disease. It was not much difference in mean age for frontal sinusitis patient (46.51 ± 14.00) and patients without frontal sinusitis (48.73 ± 16.44). The percentage was almost equal for CRS and non-CRS groups regardless of side and gender. In our study, the frontal recess cell such as agger nasi cell was found in almost all patients 98.1%, frontal ethmoidal cell type 1, type 2, type 3 and type 4 comprised of 28.8%, 31.1%, 14.4% and 0% respectively. Whereas, suprabullar cell can be seen in 40.3%, supraorbital ethmoid cells 16.7%, frontal bullar cell 33.0% and inter-frontal sinus septal cells 10.8%. There was a statistically significant association between the presence of frontal bullar cell and the development of frontal sinusitis (p value < 0.001).
Conclusion: The frontal recess cells variation in Malaysian subjects were almost similar to those reported in other Asian populations such as Japanese, Taiwanese, Chinese and Korean. Our study found that frontal bullar cells had a significant association with the development of frontal sinusitis than other frontal recess cells. The understanding of the frontal recess anatomical structures was very important as this would lead to a successful treatment of CRS and at the same time it helped the surgeon to have a better plan of endoscopic sinus surgery to prevent the disease recurrence and surgical complication.

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1. Introduction

Chronic rhinosinusitis is an inflammatory disorder of the nose and the paranasal sinuses. The diagnosis of chronic rhinosinusitis is made based on European position paper on rhinosinusitis and nasal polyps 2012 [1]. Anything that disturbed the drainage pathway of the paranasal sinus can lead to the development of rhinosinusitis. Therefore, it is very important to have adequate ventilation and drainage for healthy normal functioning sinuses. Normal draining sinuses needs a patent sinus ostium connecting the sinuses to the nasal cavity.

The mucociliary system plays a vital role in draining the mucus produced within the sinuses into the nasal cavity. In the frontal sinus, the mucus is transported to its ostium located inferiorly [2]. Usually acute frontal sinusitis heals fast and chronic frontal sinusitis is less frequent as compared to maxillary sinusitis because of the high position of the maxillary sinus ostium, resulting in less favorable drainage. The width and course of the frontonasal recess, be it straight or curved, depends on the size and number of the anterior ethmoidal cells, some of which develop into the frontal sinus and are then called 'frontal cells' or 'frontal bulla' [2].

Kuhn proposed that there is various type of cells that surround the frontal recess (Fig. 1). There are agger nasi cells (ANC), supraorbital ethmoidal cells (SOEC), frontoethmoidal cells type 1, type 2, type 3 and type 4 (FC1, FC2, FC3, FC4), frontal bullar cells (FBC), supra bulla cells (SBC) and interfrontal sinus septal cell (IFSSC) [3].

Frontal sinus is regarded as one of the sinuses that are difficult to approach as it is located higher than the other paranasal sinus and is surrounded by complex cell structures with a very narrow drainage pathway. It is vital for surgeons to have a high-quality CT scan of PNS to assess the anatomy and drainage pathway of the frontal sinus before proceeding with surgery [4]. CT scan also shows the surgeon the extent of the pathology, the aggressiveness of the disease state, and involvement of the adjacent vital structures, thus reducing the risk of potential complications during surgery [5].

There have been multiple studies using cadaveric as well as studies on CT evaluation of the frontal recess anatomy cell variations [4]. Most of the literature published on the anatomical variants of the frontal recess anatomy have been conducted on Caucasian, Middle-eastern and Chinese populations. In view of the critical importance of the various landmarks as well as the scarcity of information on Malaysian population, this study was conducted to explore the frontal recess cell variations in Malaysian patients. To date, there is no available literature on Malaysian population regarding the various cells which encroach on the frontal recess and its association in the genesis of CRS with or without nasal polyps.

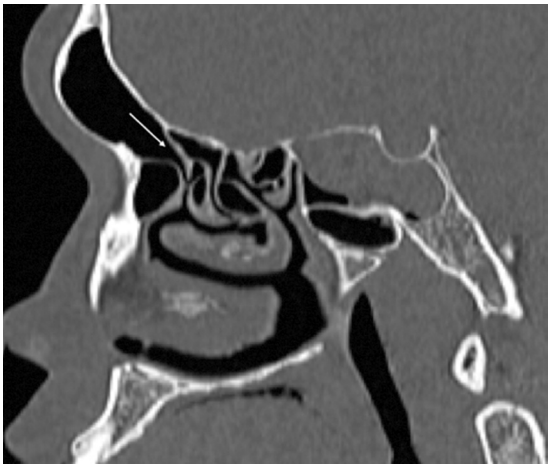

Fig. 1. Normal frontal recess anatomy. Sagittal CT image shows the right frontal recess (arrow).

2. Methods

This is an observational, retrospective cross-sectional study of contrast-enhanced computed tomography of PNS (CECT PNS) that had been performed on patients in Hospital Universiti Sains Malaysia (HUSM) and Hospital Sultanah Bahiyah (HSB). This study was conducted from January 2009 until December 2016.

The study population was Malaysians 18 years and older. The source population is patients who attended Otorhinolaryngology (ORL) clinic in both hospitals. The patients had clinical and endoscopic findings suggestive of CRS and underwent CECT PNS at radiology department. Patients from the emergency department who underwent CT brain until cervical, including paranasal sinus or reconstructed paranasal sinus for other indications without past medical history of CRS were also recruited as our control group.

Both hospitals used Siemens SOMATOM CT scanner with 1.25 mm-thick-axial, coronal and sagittal cuts. CT scan in HUSM used Siemens SOMATOM definition AS+ 128 slice, 64 detectors (2009). In HSB, CT scan images were obtained via Siemens SOMATOM emotion-6 6 slice. There is difference in number of slices per one rotation, but the quality of the images is still the same which is 1.25 mm cut in all three planes. The reconstructed multiplanar slices can also be reconstructed to 1.25 mm thickness in axial–coronal–sagittal cut. The CT scans were done following their respective protocols in the hospitals.

Data was retrieved from medical record unit and manually from the CT scan registry book available in the record and filing office of the diagnostic imaging department or from the PACS online. The online PACS-IW system was accessed to trace the type of CT scan that every patient had undergone. The CT scans of paranasal sinuses were retrieved and saved into a DVD-R. These images were subsequently transferred into the OSIRIX 64-bit DICOM Viewer imaging software on a MacBook Pro laptop.

Interpretation and review of the CT PNS in axial, coronal and sagittal planes will be done by one radiologist and one ORL specialist together. Each of them will see all the cases from both hospitals, with any disagreements resolved by consensus. All data obtained were entered in the study proforma. All data obtained were transferred into the Statistical Package for Social Sciences (SPSS) software version 22.0.

3. Result

A total of 312 sides from 156 patients' CT scan images were analyzed. Left and right sinuses were considered individually.

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