THE ROLE OF ANATOMICAL VARIATIONS IN OSTEOMEATAL UNIT IN THE AETIOLOGY OF CHRONIC RHINOSINUSITIS

By

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In The Name of ALLAH

The Most Beneficient

The Most Merciful

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TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

CRS	-	Chronic Rhinosinusitis
CT	-	Computed Tomography
DNS	-	Deviated Nasal Septum
FESS	-	Functional Endoscopic Sinus Surgery
HUSM	-	Hospital Universiti Sains Malaysia
IOEC	-	Infraorbital Ethmoid Cell
OMC	-	Osteomeatal Complex
OMU	-	Osteomeatal Unit
ORL	-	Otorhinolaryngology
pneuUP	-	Pneumatized Uncinate Process
pneuANC	-	Pneumatized Agger Nasi Cell
UP	-	Uncinate Process

ABSTRACT IN BAHASA MELAYU

PENGENALAN

Kerumitan anatomi hidung dan sinus-sinus muka, beserta fungsi bahagian ini yang pelbagai menjadikan bahagian ini suatu kawasan yang amat menarik untuk di kaji dan diselidik secara terperinci, terutamanya di bahagian osteomeatal complex (OMC). Ketidaknormalan secara kongenital dan semulajadi di bahagian ini yang pelbagai, walaupun jarang berlaku, menjadikan ia punca kepayahan semasa melakukan pembedahan. Walau bagaimanapun, peranan variasi anatomi di kawasan ini terhadap pembentukan penyakit sinus masik tidak jelas.

OBJEKTIF

Tujuan kajian ini adalah untuk mengkaji variasi anatomi di kawasa OMC dan menentukan kaitan antara variasi tulang di bahagian ini dengan panyakit sinus, dan juga untuk menentukan variasi utama anatomi di kawasan ini yang mana dapat di kaji melalui CT scan.

METODOLOGI

Satu kajian kes-kontrol telah dilakukan di mana kami telah mengkaji 240 pesakit melalui imej CT scan (CT scan beresolusi tinggi) mereka (120 pesakit merupakan yang

mennghidap penyakit sinus dan 120 orang lagi tanpa penyakit sinus). Imej- imej ini adalah dari sudut pandangan axial dan koronal dangan ketebalan potongan 1.25mm. Data- data telah dianalisa menggunakan ujian 'Pearson Chi Square test'.

KEPUTUSAN

Variasi anatomi yang direkodkan adalah terdiri daripada seperti yang berikut : Concha bullosa 49 kes (40.8%) dikalangan pasakit sinus dan 57 kes (47.5%) dikalangan mereka yang normal, Paradoxical middle turbinate terdapat sebanyak 14 kes (12%) dikalangan pesakit sinus manakala di kalangan mereka yang normal adalah 27 kes (23%), pneumatize uncinate process dijumpai dalam 3 kes (3.3%) dikalangan pesakit sinus dan 3 kes juga dikalangan mereka yang tidak berpenyakit sinus, infraorbital ethmoid cell berlaku sebanyak 61 kes (50.8%) dikalangan pesakit sinus sementara dikalangan mereka tanpa penyakit sinus adalah sebanyak 75 kes (62%), pneumatize agger nasi cell terjadi sebanyak 100 kes (83%) dikalangan pesakit sinus manakala hanya 95 kes (79%) dikalangan mereka yang tanpa penyakit sinus, kebelokan septum hidung pula terdapat sebanyak 67 kes (56%) dikalangan pesakit sinus dan 73 kes (60.8%) di kalangan mereka tanpa penyakit sinus ini dan paling menarik sekali kami juga turut menjumpai septum pneumatization sebanyak 4 kes (3.4%) yang mana kesemuanya dikalangan mereka yang berpenyakit sinus. Walau bagaimanapun, kewujudan satu variasi anatomi sahaja di kawasan OMC tidak ada kaitan dengan pembentukan penyakit CRS kecuali kewujudan variasi paradoxical middle turbinate dan infraorbital ethmoid cell.

ABSTRACT

INTRODUCTION

The complexities of the nose and paranasal sinuses anatomy, as well as their multiple functions make the sinuses an interesting and rewarding topic of study especially at the region of osteomeatal complex (OMC). Congenital anomaly in this region, though rare, may create technical difficulties during surgery. However, the role of anatomical variations in pathogenesis of sinusitis is still unclear.

OBJECTIVE

The aims of the study was to look into the anatomical variations in the osteomeatal complex in chronic rhinosinusitis patients, to determine the association between bony anatomical variations in osteomeatal complex with chronic rhinosinusitis (CRS) and to determine the main anatomical variations in the osteomeatal complex which are usually depicted by computed tomography (CT) and nasoendoscopy in patients with CRS and normal patients without CRS.

METHODOLOGY

A case control study was done in which we had reviewed the CT scan of paranasal sinuses (HRCT) images of 240 individuals, 120 cases of CRS and another 120 patients without CRS problem. Their paranasal sinuses CT scan obtained 1.25mm thicknesses in

axial and coronal planes with high resolution technique were reviewed. The data were analysed using Pearson Chi Square test.

RESULT

The anatomical variations recorded were: Concha bullosa in 49 cases (40.8%) among the CRS and 57 cases (47.5%) among patients without CRS, Paradoxical middle turbinate in 14 cases (12.0%) of CRS and 27 (23.0%) in patients without CRS, pneumatized uncinate process were found in 3 cases (3.3%) of CRS cases while in patients without CRS 3 cases (3.3%) as well, Haller's cells (infraorbital ethmoid cell) in 61 (51.0%) cases of CRS while 75 cases (62.0%) cases of patients without CRS, pneumatized agger nasai cell 100 (83.0%) in CRS and 95 (79.0%) in patients without CRS, deviated nasal septum in 67 cases (56.0%) of CRS while in patients without CRS 73 (60.8%) cases and lastly pneumatized septum seen in 4 (3.3%) cases of CRS and none in patients without CRS. However the presence of single anatomical variation itself does not have significant association with the genesis of CRS except for paradoxical middle turbinate and infraorbital ethmoid cell.

CONCLUSION

The most common anatomical variation in osteomeatal complex in CRS patients are pneumatized agger nasi cell , followed by haller's cell, DNS, right concha bullosa, left concha bullosa, paradoxical middle turbinate, pneumatize uncinate process and lastly

septum pneumatization. And the single occurence of an anatomical variant itself does not establish the genesis of the CRS disease except for paradoxical middle turbinate and infraorbital ethmoid cell.

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

1.1 ANATOMY OF THE NOSE AND PARANASAL SINUSES

The complexities of the nose and paranasal sinuses anatomy, as well as their multiple functions make the sinuses an interesting and rewarding topic of study. There are a total of four paired sinuses. They include the frontal, ethmoid, maxillary and sphenoid sinuses as shown in figure 1.1 below. Depending upon their common draining areas and functions, they are divided into anterior and posterior groups of sinuses. Anterior group of the sinuses comprised of maxillary, frontal and anterior ethmoidal air cells. While posterior group of the sinuses comprised of sphenoid sinus and posterior ethmoidal air cells. These sinuses are essentially mucosa-lined airspaces within the bones of the face and skull. The anterior group of sinuses drain into the middle meatus while posterior ethmoid sinus drain into the superior meatus and sphenoid sinus drain into the sphenoethmoidal recess.

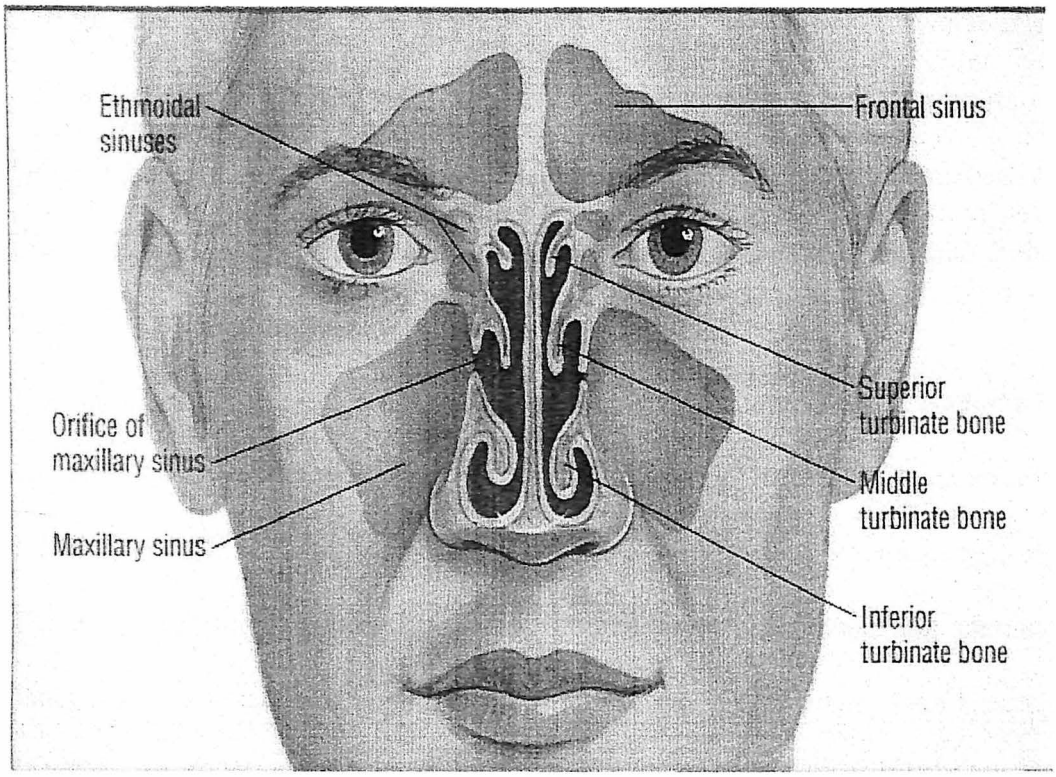

Figure 1.1: The anatomical position of paranasal sinuses in adult.
(Adapted from Elsevier Ltd. Drake at al: Gray's anatomy for Student)

Their development begins in the intrauterine life, but results in only two clinically-relevant sinuses by birth--the maxillary and ethmoid sinuses. The development of the lateral nasal wall begins with two outgrowths. The first outgrowth is the maxilloturbinal which will eventually become the inferior turbinate. Subsequently, another mound of mesenchyme forms which is the ethmoturbinal, destined to become the middle, superior, and supreme turbinates by subdividing into the second and third ethmoturbinals. This growth is followed by the development of the agger nasi cells, uncinate process, and ethmoid infundibulum. The sinuses then begin to develop. The resultant system of cavities, depressions, ostia, and processes is a complex system of structures which must be understood in detail, to make surgical management of sinus disease safe and effective.

The nose is part of the upper portion of the upper respiratory tract and it consists of external nose and nasal cavity, from which the paranasal sinuses originate and extend (Alan Kerr et al, 1997). Nasal cavity is divided into right and left nasal cavities by the nasal septum. Each cavity consists of lateral nasal wall, medial nasal wall, floor, roof and anterior nare and posterior choana.

The lateral wall of nasal cavity is certainly the most complex and important anatomic structure from both clinical and surgical standpoints. The lateral nasal wall consists of inferior, middle and superior turbinates with their respective meatuses. The middle meatus is the most important meatus; it presents several important elements for the airflow and drainage pathways from the anterior group of sinuses (Alan Kerr et al, 1997). It has two dimensional opening – the semilunar hiatus, which receives the main drainage pathways from the anterior group of sinuses (Richard & Jonathan,2002). The drainage to this fissure is from the frontal sinus, through the frontal recessus, the maxillary sinus through the infundibulum, and anterior ethmoidal air cells directly through the main ostium. The semilunar hiatus and surrounding structures together compose the osteomeatel complex. One believes that the obstruction of this narrow region is the key factor in the development of chronic sinusitis. The middle turbinate and then other osseous projections from the lateral wall or from the middle meatus toward the nasal cavity are generally parts of the ethmoid bone and responsible for the anatomical structure of this complex and important region.

1.2 OSTEOMEATAL COMPLEX

The terminology of osteomeatal complex or osteomeatal unit (figure 1.2) was first describe by Nauman et al. in 1965, it is the functional term for anterior group of sinuses drainage system and is defined as region situated lateral to anterior 2/3 of middle turbinate. This includes agger nasi, uncinate process, bulla ethmoidalis, remaining anterior ethmoidal cells, Hiatus semilunaris, frontal recess and osteum of maxillary sinus.

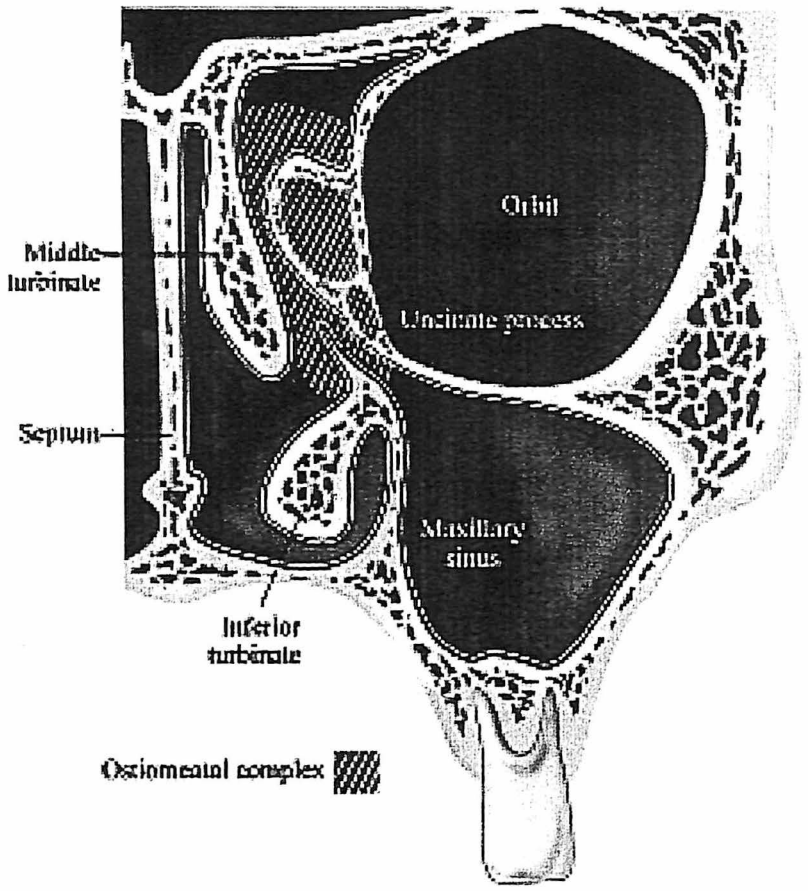

Figure 1.2: Illustated picture of left nasal cavity, orbit and paranasal sinus. Shaded area showing the osteomeatal region. (Adapted from Microsscopic Surgery for The Paranasal Sinuses by A.C. Stam, 2000)

1. Uncinate process

The ucinate process is a curved, boomerang shaped structure (as shown in figure 1.2 below) and is composed of mucosa, periosteum and a thin bony lamina. It is the anterior most boundaries of the middle meatus, at the medial wall of the maxillary sinus, and forms the anterior boundaries of hiatus semilunaris and the infundibulum. The uncinate process varies in size and in its point of insertion. Usually, laterally it attached to the lamina papyracea, anteriorly and far superiorly it attached to lamina papyracea, skull base or middle turbinate and inferiorly and far posteriorly it attached to the ethmoid process of inferior turbinate. And it has free medial border. This free edge of the uncinate process is very important from a surgical point of view. Sometimes it lies almost in coronal plane covering the ethmoid bulla but, in other cases, it can be very small and may lie adjacent to the lamina papyracea (A.C. Stam et al, 2000). The superior attachment of uncinate process decides the opening of the frontal recess. Majority of cases (86%) – forms a superior blind recess known as recessus terminalis. Fourteen percent attaches to middle turbinate or skull base, so if this happened the frontal recess will open into the ethmoidal infundibulum (Lund V.J et al, 1994).

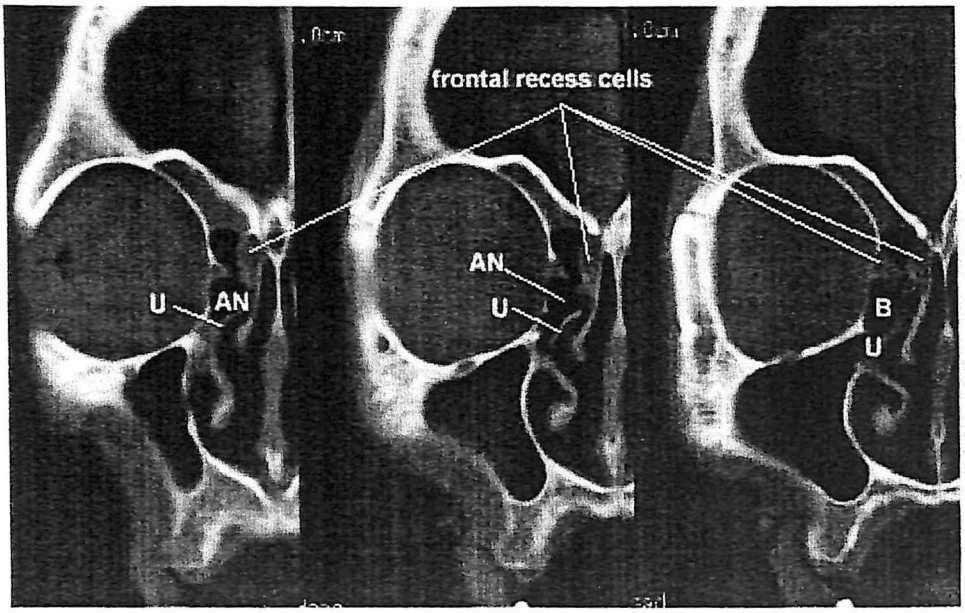

Figure 1.3: CT scan of PNS (coronal view) showing the uncinate (U), agger nasi cell (AN) and ethmoid bulla (B). (Adapted from Anatomic Variation of the Paranasal Sinuses: CT Examination for Endoscopic Sinus Surgery by Halil A et al, 1999)

2. Anterior ethmoid cell (Agger Nasi)

The agger nasi cells (as shown in Figure 1.3 above and figure 1.4 below) are the most anterior ethmoid cells and are located above and anterior to the uncinate process (A.C. Stam et al, 2000). The agger nasi is the anterior limit of the frontal recess, thus large agger nasi cells can impinge on the frontal recess. Endoscopically viewed, the agger nasi appears as a prominence superior to the insertion of the middle turbinate.

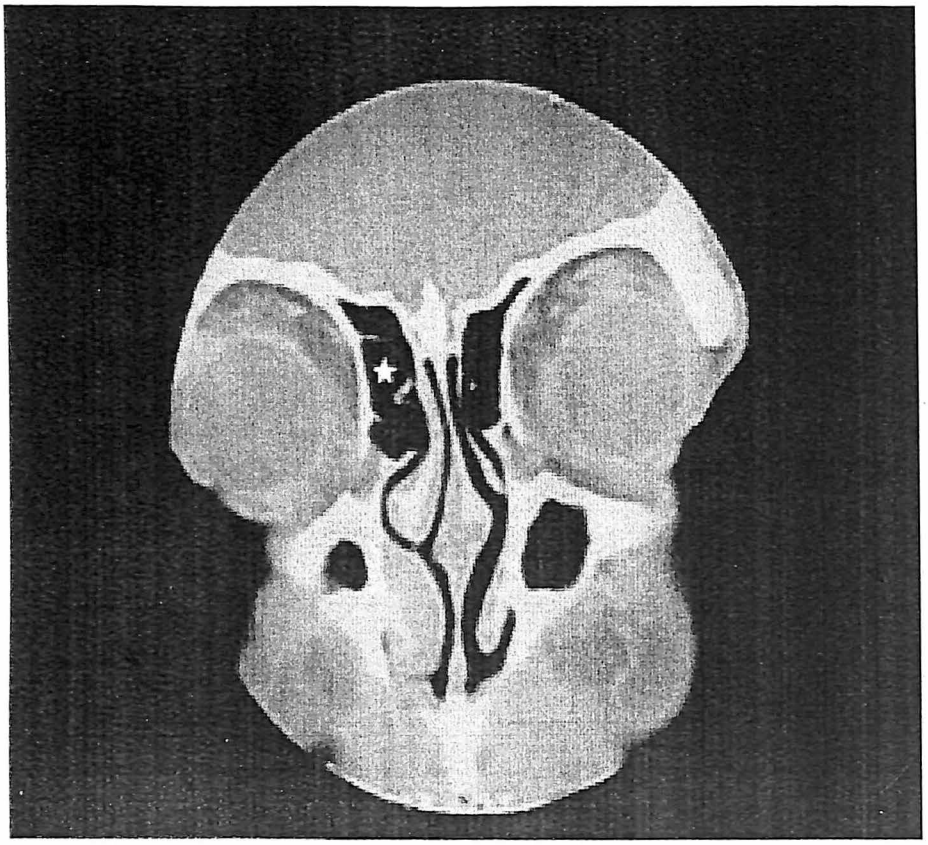

Figure 1.4: CT scan coronal view of PNS showing right agger nasi cell as indicates by the star (☆). (Adapted from Anatomic Variation of the Paranasal Sinuses: CT Examination for Endoscopic Sinus Surgery by Halil A et al, 1999)

3. Bulla ethmoidalis

The ethmoid bulla is a differentiation of the ethmoid cell and is the largest and most regular of the anterior ethmoid cells (as shown in figure 1.3 above). It is located at the level of middle meatus, superior to the inferior hiatus semilunaris, and forms the posterior wall of the frontal recess, serving as protection for the skull base in surgical procedures. It has its own drainage ostium and drains directly into the hiatus semilunaris or into the

adjacent ethmoid cells. It is considered an important anatomical landmark in intranasal ethmoidectomies and in surgeries of the frontal recess and middle meatus. It varies in size; normally it has a suprabullar cells between it and skull base however an extensive aeration caused suprabullar cells get into a suprabullar recess, where if a posterior extension obstructs the retrobullar recess. In cases with extensive aeration its roof lodges the anterior ethmoid artery. These recesses can be accessed through the superior hiatus semilunaris. A large ethmoid bulla usually adversely affects the drainage and ventilation of the related paranasal sinuses (A.C. Stam et al, 2000).

4. Hiatus semilunaris

The hiatus semilunaris (as shown in figure 1.5 below) is a two-dimensional space lying between the posterior edge of the uncinate process and the anterior surface of the ethmoidal bulla, it lead to 3 dimentional ethmoid infundibulum, its anterior portion vertically inserted along the anterior skull base. The ethmoidal infundibulum is reached from the middle meatus by passing through the hiatus semilunaris (Alan Kerr et al, 1997).