



THE CLINICAL SIGNIFICANCE OF THE ANATOMIC ARRANGEMENT OF FRONTAL AIR SINUSES

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Abstract- The arrangement of air sinuses undergoes a considerable amount of variation which are of immense clinical significance. With increasing demand of sinus surgery a surgeon needs to be familiar with variations of normal sinus anatomy. This is further complicated by the fact that Radiographic procedures involving sinuses is complex because of overlap and extension of sinuses into each other and variation in size and shape of sinuses. The article summarizes some of the abnormalities in frontal sinus and the surgical consequences associated.

Keywords- Frontal sinus, paranasal, Osteomyelitis, mucocele, pneumo sinus

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Introduction

The paranasal air sinuses are formed by the mucus membranes of the middle meatus growing into the cavernous bony tissue while coming in contact with them. These pneumatic cavities are usually paired and are located in Frontal, Maxillary, Ethmoid and sphenoid bones. Each sinus by extension may enter other bones. They are inconsistent in size, shape and type. These sinuses lie in direct proximity to vital structures like orbit and middle cranial fossa. There has been a radical change in surgically managing clinical conditions related to sinuses including frontal sinus. It is of utmost importance to master the normal, abnormal and radiological Anatomy of all sinuses including the frontal sinus. With increasing demand of sinus surgery a surgeon needs to be familiar with variations of normal sinus anatomy. This is further complicated by the fact that Radiographic procedures involving sinuses is complex because of overlap and extension of sinuses into each other and variation in size and shape of sinuses. The article summarizes some of the abnormalities in frontal sinus and the surgical consequences associated.

Material and Methods

In order to know study the paranasal sinuses The calvaria is removed above the level of frontal eminence in an attempt to avoid injury to frontal air sinuses. Subsequently the skin, superficial fascia and deeper muscles of face are dissected out to expose the ostia of paranasal sinuses.

The part is dissected with meticulous care using a pointed angled small scissor, dissection forcep. The rough outline of frontal and

maxillary air sinuses is demarcated in a dark room by transillumination.

In these skulls, brightness obtained by transillumination is mapped out by coloured pencils. A metal cannula is pushed in the corresponding ostia followed by wax impregnation. In order to decalcify the bony framework 5% Nitric acid is used in a big glass container. The injected skull is kept in acid bath to avoid breaking of cast. The specimen is removed and washed under tap water. The softened bones are carefully removed and moulds of sinus cavities obtained. The moulds are studied as far as their dimensions are concerned : anteroposterior depth, height and transverse breadth are concerned via a Vernier Caliper.

The frontal sinus grows and expands into the diploic space of frontal bone from the frontal sinus ostium. Each frontal sinus grows independently of the other. Their growth or lack of it is dependent on the ventilation, drainage and growth of surrounding sinuses and skull base. There can be considerable variation in shape, size and wall thickness of sinuses [1].

Normally The frontal sinuses are present bilaterally but there can be aplasia of either of the frontal air sinus. Inspection of the frontal sinuses can reveal imperfect partitions, varying in height and producing a number of recesses giving the irregular outline. There can be three complete frontal air sinuses with two complete septa. The degree of prominence of superciliary arches is not helpful to indicate the extent or size of frontal air sinuses [2]. Usually there is a difference in symmetry of sinuses of two sides in most of the cases.

Discussion

Inter-individual and intra-individual variations in the size and shape of the frontal sinus have been reported. These can have many clinical implications [3]. The fact that there is a lot of variation in the pattern of sinuses in individuals and every individual has a unique pattern of sinuses is utilized in forensic sciences for identification of the diseases. Based on this fact the Anatomy of sinuses is of particular value just like the identification of individual by finger print or DNA fingerprinting technique.

In case the frontal sinuses get infected and the resolution does not occur by antibiotic therapy especially in case of small sinuses with inadequate drainage and abnormal textures there is a greater chance of infection getting localized and transforming itself into pansinusitis. In 1903, Killian was the first to operate for an infection in the frontal sinus; in 1904, he refined the submucous resection of the nasal septum. Osteoplastic obliteration of the frontal sinus, popularized by Goodale and Montgomery, provided a definitive procedure for recalcitrant frontal sinusitis and mucocoeles. Lately the Open procedures for the paranasal sinuses have been partially replaced by functional endoscopic sinus surgery.

Inflammatory tissue in the ostiomeatal complex, which is in the middle meatus, can obstruct the ostia of the maxillary, anterior ethmoid, and frontal sinuses. Intracranial infections secondary to sinusitis are most frequently associated with frontal sinusitis especially with the sinuses having inadequate drainage due to abnormal anatomy.

The most important relation of frontal air sinus is the orbit. Fractures of the orbital roof are frequently associated with frontal sinus and nasal ethmoid fractures, and are accompanied by a loss of upward gaze due to involvement of the superior rectus muscle.

A cranial bone may be the site of hematogenous spread of a bacterial infection from another area of the body, but more often it becomes involved by adjacent spread from an infected paranasal sinus, by a penetrating wound, or by an operative infection involving a craniotomy flap. Pott's puffy tumor is such a frontal osteomyelitis, with marked overlying soft tissue swelling that is secondary to frontal sinusitis. Treatment consists of the surgical removal of the infected bone, with simultaneous treatment of any coexisting sinusitis. Appropriate systemic antibiotics are administered, and an adequate margin of normal bone is removed with the specimen to minimize the risk of recurrent infection. A cranioplasty may be performed later for cosmetic and protective reasons and a thorough delineation of borders of frontal sinus is an important prerequisite.

Anatomic variations have a tremendous impact on the direction of drainage, efficiency of mucociliary clearance mechanism and frontal recess morphology [4].

Abnormal anatomy, failure of adequate drainage can result in increased chances of infection of the frontal sinus in the form of Frontal sinusitis which may cause intracranial complications such as meningitis, epidural abscess, subdural empyema, and brain abscess.

Anatomical variations with unusual extension of the frontal sinuses above orbital roof may support the correlation between frontal sinusitis and the possible complications from the orbit and these cases may be considered as 'high risk' cases for orbital complications during a frontal sinusitis. Enlargement of frontal sinus can cause pneumosinus dilatans which is a very rare condition. It can present with headache, frontal bossing, blurred vision or exophthalmos [5,6].

In severe acute frontal sinusitis that fails to respond promptly to systemic antibiotic therapy, the floor of the frontal sinus is trephined through an incision just inferior to the medial part of the eyebrow. An opening of approximately 7 to 8 mm. is made, and a catheter is placed in the sinus to maintain drainage. Trephination is performed in an attempt to prevent the intracranial complications of frontal sinusitis. This is important as variations in Anatomy of frontal sinus can cause a change in techniques of surgery.

In case of trauma which result in the Fractures of the frontal sinus/ sinuses can lead to the development of mucocoeles. Mucocoeles also follow duplication of the mucous membrane. They can gradually enlarge and destroy the part or whole of floor of the frontal sinus; as they expand into the orbital cavity, they produce proptosis and inferior and lateral displacement of the eye. These Mucocoeles and other forms of chronic frontal sinusitis that do not respond to medical management or endoscopic sinus surgery can be managed surgically by an osteoplastic flap approach for obliteration of the frontal sinus. The incision in the bone is made at the periphery of the frontal sinus, and the anterior wall is rotated inferiorly on the hinge of periosteum at the floor of the sinus.

Trauma resulting in Fractures of the upper third of the face may be accompanied either by ocular or central nervous system (CNS) complications or both and can result in facial deformity. The most important and Pertinent facial fractures in this region are those of the supraorbital ridge, orbital roof, frontal sinus, and nasoethmoid or orbital area. Fractures of the orbital roof are frequently associated with frontal sinus and nasoethmoid fractures but may occur as an isolated injury or as an extension of a low frontal skull fracture. The loss of upward gaze in association with this fracture indicates involvement of the superior rectus muscle and possibly superior oblique muscles. Occasionally, a fracture of the orbital roof may be so comminuted as to defy repair, and debridement with primary or delayed bone grafting may be necessary. Comminuted upper and midface fractures are best repaired primarily with immediate bone graft, as delayed grafting is more difficult and has a higher complication rate especially in case of small sinuses with inadequate drainage. A basilar skull fracture should also be suspected when an air-fluid level is seen on the lateral skull film in the frontal, sphenoid, or mastoid sinus [7,8].

In severe cases of trauma associated with fracture of frontal sinuses, a traumatic fistula can develop. Most traumatic cerebrospinal fluid fistulas subside spontaneously if the patient's head is maintained elevated at 30 degrees, but a persistent fistula places the patient at risk for recurrent episodes of meningitis. It should be noted that the leak may be only temporarily closed with brain and then recur. If the leak persists longer than 10 days, craniotomy with reapproximation of the torn dura is indicated.

Conclusion

In view of the fact that the Frontal sinuses occupy an important position in relation to upper part of face, orbit and anterior cranial fossa, any variation in frontal sinus anatomy can affect them. Acute or chronic infections, growths and trauma can effect frontal sinuses with immediate or delayed effect on surrounding structures. As such for a maxillofacial surgeon, ENT Surgeon or a Neurosurgeon a detailed knowledge of Anatomy of frontal sinus is warranted.

Conflict of Interest: None declared.

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