INTERACTIONS BETWEEN MIDDLE EAR AND INNER EAR DISEASES

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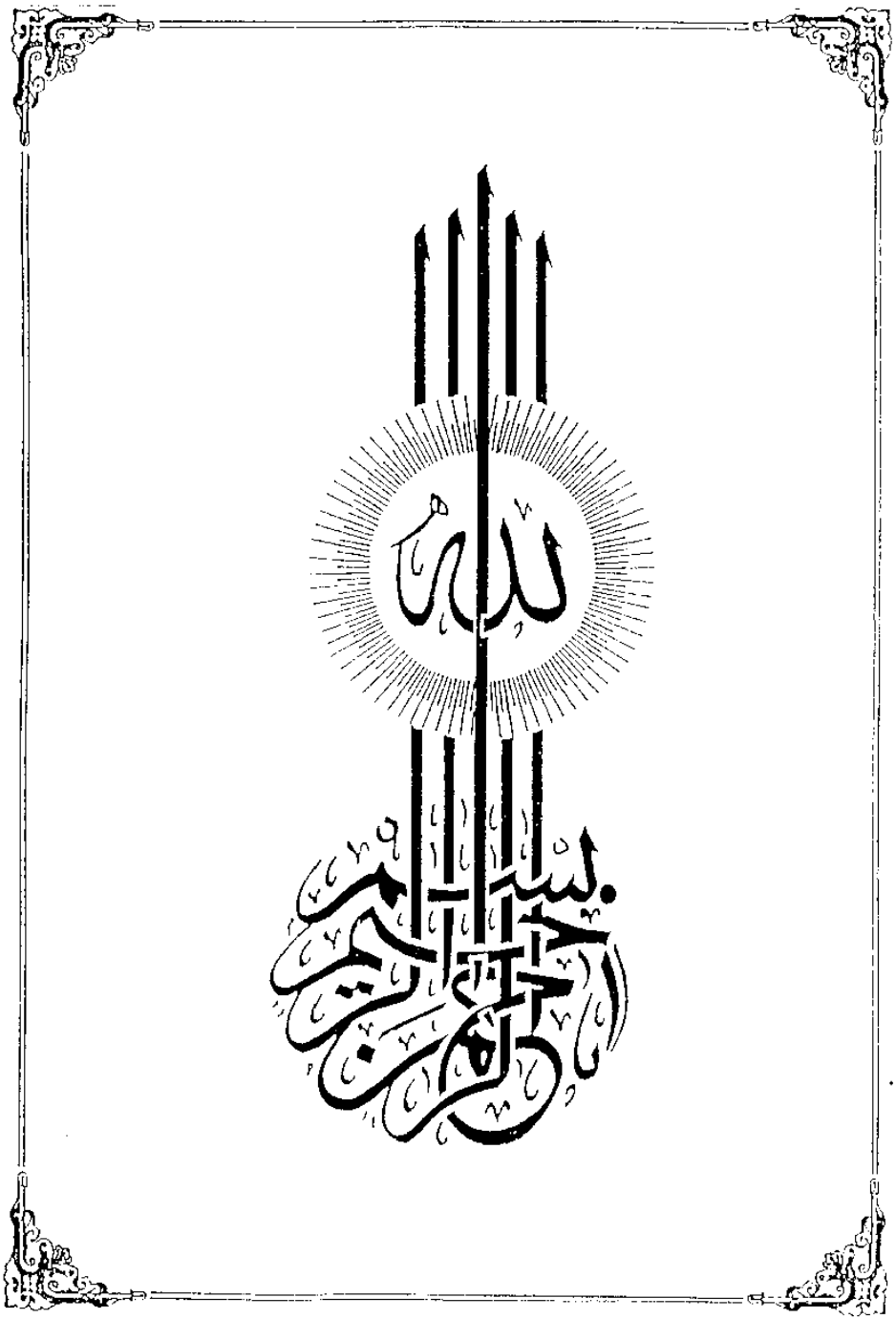

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There is important role between various anatomical parts of the ear and a disease which occure in any of these anatomical sites, and how a disease in one part can interact, cause complications, or manifest clinically on another area (Paparella,1991).

Some ear manifestations can indicate the occurance of coexisiting pathology in the middle and or inner ear, as in cases of congenital anomalies or trauma, while on the other hand some ear manifestations can indicate the progression of the pathology from one part to the other as in case of middle ear inflammation, granuloma, and neoplastic conditions of both middle and inner ear.

Also some pathological conditions of one part can lead to another pathology that affect the other part as in perilymphatic fistulas and, endolymphatic hydrops. While some ear diseases can originate from one part and manifest primarily on the other part as in case of otosclerosis.

Another way of interaction, is the effect of surgical procedure on the middle or inner ear that can lead to damage and/or changes of the anatomy of the other part as in case of cochlear implant.

Accordingly, we categorized these diseases under groups as; congenital anomalies, inflammations, graulomas and related conditions, neoplasms, trauma, and miscellaneous conditions as; otosclerosis, perilymphatic fistulas, endolymphatic hydrops, ototoxicity, and cochlear implants.

The aim of our essay is to study and clarify these interactions between the middle and the inner ear, as our understanding of these interactions will improve, our ability to diagnose and proper managment of patients with otologic diseases (paparella,1991)..

EMBRYOLOGY OF THE EAR

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The ear, more than any other structure demonestrates the phylogeny of the human, consisting of a primitive endorgan of balance, a more developed auditory sensor, and a sound conduction mechanism. The inner ear is the first organ in the body to be developed, it reaches adult size and configuration by midterm. On the other hand external and middle ear, are not completly formed at birth, and the temporal bone continus to grow and change in form till the age of puberty (Austin,1985).

EMBRYOLOGY OF THE INNER EAR

The otic labyrinth begins to differentiate by the end of the third week with apperance of the auditory placodes. By the forth week the plocode becomes invaginated to form a pit, the mouth of the pit becomes closed to form the auditory vesicle (otocyst) (Austin,1985).

The vesicle sinks below the surface ectoderm to rest in the mesoderm. The tubotympanic recess then intervens between the vesicle and the surface ectoderm, and the ultimate gross relations of the three parts of the ear are established (Mawson and Ludman,1979).

The vesicle elongates and the wall becomes folded to define the three major divisions of the auditory vesicles, the endolymphatic duct and sac, the utricle with its semicircular ducts and the saccule with the cochlear duct. This differentiation begins from the sixth week of the interuterine life, and completed by the ninth week (Austin,1985).

The semicirculer canals arise from the dorsal part of the vesicel as three disc-like evaginations that appear in the right-angled disposition of the canals, then their centres absorb to become the three semicircular canals by the seventh week (Mawson and Ludman,1979). The cochlear duct arise at the sixth week as a short evagination from the saccule, it begins to coil at the eighth week and by the tenth to eleventh week it has formed nearly 2 1/2 - 2 3/4 turns. The cochlear duct remains joined to the saccule by relative

slender ductus reuniens and it continues to grow in size until midterm but does not increase in the number of turns(Austin,1985).

By the end of the first month, the inner ear exihibts only an endolymphatic space. In the latter part of the third foetal month the first perilymphatic space appears just within the oval window in the vestibule, and it is called the cisterna perilymphatica. The scala vestibuli appears as an extension of this cisterna. The second space appears from just below the round window, this well be the scala tympani(Ballantyne,1979).

The perilymphatic space has three principal prolongations into the surrounding otic capsule, the periotic duct or the cochlear aqueduct, the fissula antefenestram and the fissula postfenestram. The periotic duct extends from the scala tympani near the round window region to the subarachnoid space, it is not lined by epithelium and hence not a true duct, but it contains little fluid and connective tissue(Austin,1985).

The fissula antefenestram appear in the ninth week as a strip of precartilage in the lateral wall of the cartilaginous otic capsule immediatly anterior to the oval window. In the course of the next three weeks, the extension of periotic tissue stretches as a connective tissue ribbon from the vestibule to the middle ear. Vertically the ribbon extends from the scala vestibuli to the tympanic cavity, near the cochleariform process. The fissula continues to grow untill midfeatel life (about 21 weeks), at which time the ossification of the otic capsule is nearly complete(Gulya,1990).

The fissula postfenestram, is evagination of periotic tissue from the vestibule into the otic capsule posterior to the oval window, it undergoes a developmental sequence similar to that of the fissula antefenestram. The fissula post fenestram is seen first in the featus of tenth weeks as an area of differentiating precartilage, it can be distinguished as a zone of connective tissue, which becomes surrounded by the bone of the otic capsule (Gulya,1990).

At eight weeks, the mesoderm surrounding the auditory vesicle

becomes converted into a cartilagenous capsule. In this cartilage the scala tympani and scala vestibuli gradually extend along each side of the cochlear duct until they approximate and fuse at the tip with formation of an opening known as, the helicotrema(Mawson and Ludman,1979).

Ossification of the capsule proceeds from fourteen centers which appear at succeeding intervals, enlarge and fuse with each other. The modiolus develops as a membrane bone . Ossification is generally completed by the twenty fifth week(Austin,1985).

The neuroepithelial structures are basically similar in type, but they become modified in form according to their function. Each of the end-organs consistes of hair cells, supporting cells, and an overlying gelatinous substance where hairs are embeded. The vestibular end-organs are differntiated before the cochlear end-organ. The macula of the utricle and saccule begin differntiation at the seventh week and are differentiated by the twelfth week. The crista of the semicircular canals start development with the macula. The epithelium of the cochlear duct develop first at the basal turn at about eight weeks to be follwed by the middle and apical turns. At the fifth month the organ of corti is fully formed (Ballantyne,1979).

EMBRYOLOGY OF THE MIDDLE EAR

Mesodermal condensations developed in the side wall of the primitive pharynx to form the branchial arches and they grow around towards each other ventrally where they fuse in the midline. In this way a series of horseshoe-shaped arches come to support the pharynx, the fourth and fifth pouches open by a common grove into the pharynx. Thus there are four pouches separating six arches (McMinn,1990).

The tubotympanic recess develops from the first pharyngeal pouch to approach the surface between the first and second arches. The lining membrane of the auditory tube and lower tympanum to level of the chorda tympani is converted from tubotympanic recess (Mawson and Ludman,1979).

The malleus and incus are derived from Meckel's cartilage, which is the cartilage of the first arch. The stapes is derived from Reichert's cartilage, which is the cartilage of the second arch. Ossification begins in the long process of incus in the fifteenth week and spread up the body. The malleus is ossified two weeks later, and the stapes after another week (Austin,1985).

ANATOMY OF THE EAR

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ANATOMY OF THE MIDDLE EAR CLEFT

The middle ear cleft consists of, the Eustachian tube, the tympanic cavity, the aditus, the mastoid antrum, and the pneumatic system of the temporal bone .

THE EUSTACHIAN (PHARYNGOTYMPANIC) TUBE :

The eustachian tube desends dowenward medially and anteriory from the anterior wall of the tympanum to the nasopharynx at an angle of about 45 degree with the sagittal plane and 30 degree with the horizontal one, it is about 37 mm long, the upper (tympanic) third is osseous while the lower (pharyngeal)two third is cartilaginous. A constriction exists at the junction of its lateral bony wall and medial cartilaginous portion, known as the isthmus. The cartilage of the tube is elastic except at the isthmus, where it becomes hyaline. In the bony part of the tube the mucous membrane is low coulmnar ciliated epithelium and firmly bound to the periosteum. At the lower end the cartilage of the tube lies directly under the mucosa of the nasopharynx, forming an elevation behined the pharyngeal orifice of the tube known as the tubal elevation, which situated behined and at the same level of the posterior end of the inferior turbinate. The lining of the cartilagnous tube is pseudostratified coulmnar cells. Near the pharyngeal orifice there are goblet cells and tubuloacinar glands that secrete mucus into the tubal lumen. Surrounding the pharengeal orifice is a ring of lymphoid tissue known as the tubal tonsil. The tube is more horizontal and relatively wider and shorter in the infant than in the adult (Donaldoson and Duckert,1991).