PEDIATRIC UPPER RESPIRATORY AIRWAY PROBLEMS

ESSAY

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By

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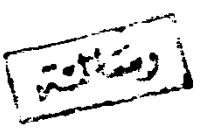

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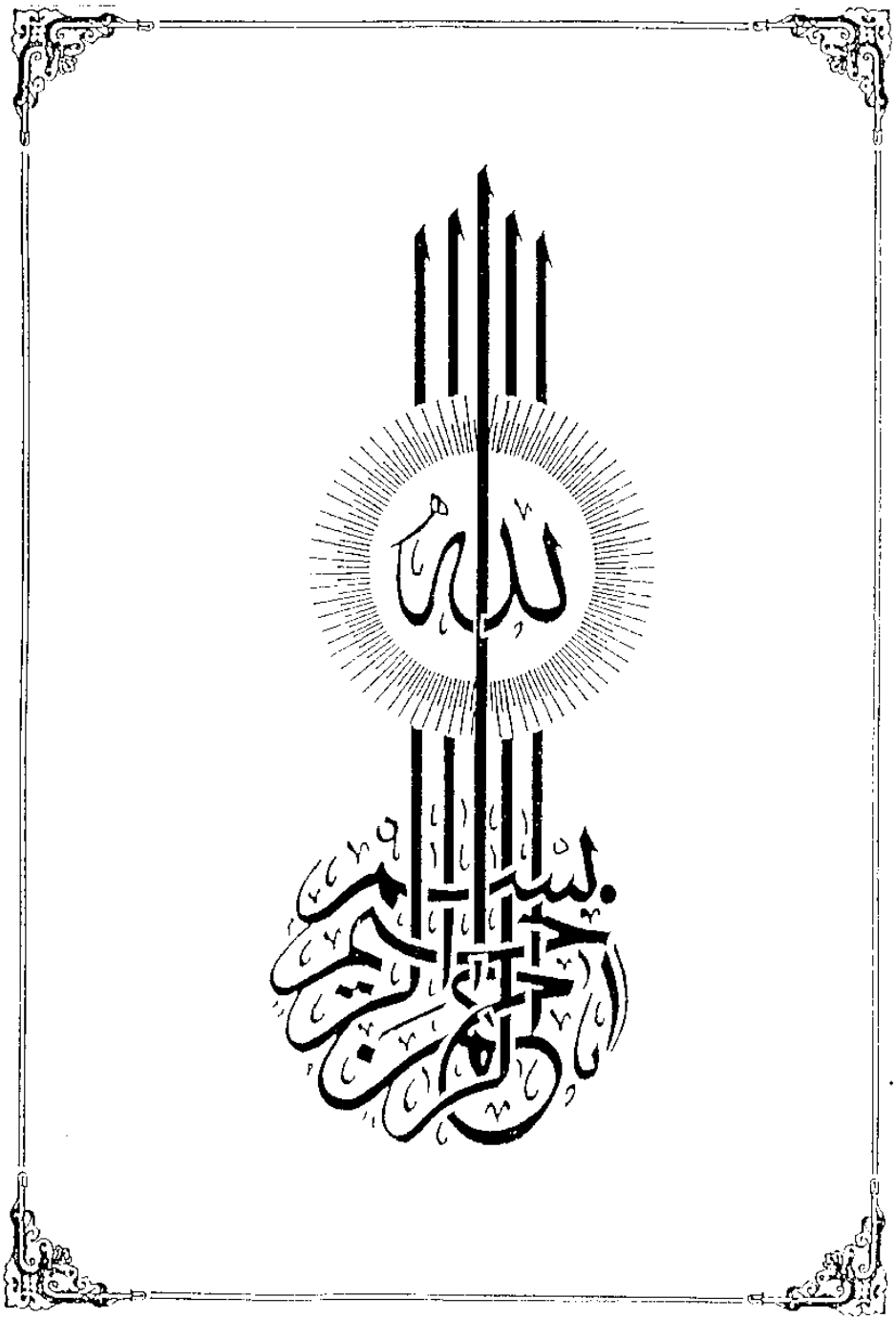

INTRODUCTION

INTROUDCTION

Infants and small children are uniqully susceptible to upper airway problems as a consequence of several anatomic and physiologic factors , and though severity of airway obstruction and rapidity of progression vary depending upon cause and time of presentation. Critical management decisions depend upon rapid assessment of the approximate level of the airway affected and of the degree of respiratory distress.

In this discussion we discuss the most common pediatric upper airway problems. In every case we discuss the aetiology, clinical picture and management Also we discuss methods of assessment of upper airway obstruction.

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E M B R Y O L O G Y

Development of The Nose :-

The nose is formed between the fourth and eighth weeks of intrauterine life and continues to change,even into adult life.

Early in embryologic development, there are five branchial arches at the upper (cephalad) end of the embryo. These arches exist only for a short period of two weeks, and by the time the embryo is six weeks of age, they are largely gone. The region just anterior to the forebrain becomes the frontonasal process. The face, including the nose and jaws, develops from the frontonasal process and the first branchial arch. The first arch bifurcates into two processes-the maxillary and the mandibular.

The development of the nose is the first step in the development of the face. The nasofrontal process elongates downward and narrows. At the lateral portions of the leading margin of the nasofrontal process,secondary processes (right and left median nasal) develop.Meanwhile, the maxillary and mandibular processes grow medially. The lateral maxillary processes also develop secondary (lateral nasal) processes. Between these and the medial nasal processes, pits form, which later become the anterior nares. The frontonasal, lateral and median nasal and maxillary

Development of The Palatine Tonsil :-

The tonsil derives from entoderm and mesoderm, the former giving rise to the epithelial elements, and the latter to mesenchyme, which differentiates to produce all the remaining tonsillar structures.

The pillars of the fauces develop from the second and third branchial arches, the mesenchyme of which extends into the soft palate, while the primitive tonsil fossa is located in the second pharyngeal pouch between the arches.

The development of the tonsil fossa provides the framework for the tonsil, and, because the entoderm appears earlier than the mesoderm, the epithelial covering of the primitive tonsil is the first structure to be recognized. The mesenchyme makes its appearance beneath the epithelium.

Initially, the epithelium consists of a single layer of cuboidal cells, but with the growth of the foetus the epithelium deepens to contain five layers.

During the third month of foetal life the crypts appear as protrusions from the surface epithelium gorwing into the mesenchyme. These are at first solid ingrowths

which branch and later canalize by disintegration of their centres. This crypt formation continues untill birth, and is more marked in the upper part of the tonsil than the lower.

Lymphocytes develop from the mesoderm about the sixteenth week of foetal life, and slowly accumulate around the crypts. This infiltration continues throughout the remainder of prenatal life, and migration into the epithelium, which is marked at full term, is greatly accelerated in the succeeding weeks.

At birth the tonsil is a very small structure , difficult to identify. As a result of lymphocytic proliferation, and especially in the presence of infection, it enlarges rapidly in the first few months of life . (Birrell, 1960).[2]

Development of The Adenoids :-

This develops in much the same way as the palatine tonsil. A series of ridges of undifferentiated mesenchyme appears in early foetal life below the entoderm which lines the primitive nasopharynx, and which forms a layer of pseudostratified columnar epithelium.

Lymphocytes develop in the mesenchyme, and continue to proliferate in much the same way as occurs in the palatine tonsil. Should this proliferation be greatly accelerated before birth, the baby will be born with a relatively large pad of adenoids. (Birrell, 1960).[2]

Development of Larynx :-

The larynx develops during that very vital period between the fourth and tenth weeks of fetal life.Very soon after conception (at the 3 mm. stage) a longitudinal groove forms down the middle of the floor of the lower portion of the primitive pharynx, giving rise to a ventral tubular outgrowth, which is the anlage of the entire respiratory tract. The primitive glottis develops from the entoderm of the upper end of the laryngotracheal tube. During the fourth week the third and fourth branchial arches fuse to produce the epiglottis, which appears as a transverse ridge just below the tongue and above the primitive glottis (the hypobranchial eminence). Two lateral elevations on either side of primitive glottis arise from

the fourth and fifth branhcial arches to form the arytenoids. About the seventh or eighth week the epiglottis and these two lateral arytenoid swellings join to form a T-shaped primitive glottis at the upper end of the laryngeal groove. Epithelium then grows completely across and closes the entire lumen. By the tenth week this lumen has been re-established, but failure to recanalize completely at this time results in atresia or formation of a web.

The glottic opening now has lost its T-shape and becomes more oval, and the lateral recesses on each side give rise to the ventricles of the larynx. At about the tenth week the vocal cords develop from the caudal margins of the lateral ventricles, and later elastic tissue is produced in the cords. Most of the cartilages of the larynx develop from condensation of mesenchyme. The cartilages of the epiglottis is of the elastic type, but does not appear until much later, probably about the fourth or fifth month. This may account for the frequent hypoplasia or hypogenesis as seen in the "exaggerated (or flabby) infantile" larynx. The laryngeal muscles develop from the mesenchyme of the fourth branchial arches.

The larynx grows craniad and even reache the nasopharynx by the fifth month. Therefore, the larynx is very high throughout fetal life, and even for several months after birth, constantly descending with growth from C_4 at birth to C_6 in adult life.(Ferguson, 1970).[3]

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P H Y S I O L O G Y

Respiratory Functions of The Nose :-

I- Nasal Airway:

The nose is the natural course of respiration and is vital for neonates in the first weeks of life.Furthermore, in childhood the nasal vestibule is relatively shorter , and the anterior nares point slightly more forwards than in adult, so that the nasal airway should be easier in the child (Birrell, 1960) [2].

The nasal cavity is a 1-5 mm slit with a narrow inlet and wide outlet for the air. The internal ostium acts as a nozzle directing some of the inspired air almost vertically against the olfactory region.

During quiet breathing between 5 and 10 per cent of the inspired air pass through the olfactory slit . This fraction becomes larger, up to a maximum of 20 per cent on sniffing (Douek, 1979) [4].

Respiratory pressures in the nose and paranasal sinuses are of the order of $\pm$5 mm water, both on inspiration and expiration.

The normal air current during quiet breathing are laminar as well as turbulent. Turbulence occurs especially just behined the narrow ostium (Ingelstedt and Toremalm

1960, 1961). It increases with air velocity(muscular work, partial nasal obstruction), irregularity of the mucosal configuration (septal spurs) and with an abnormal wide nasal cross-sectional area (atrophic rhinitis,partial maxillectomy). (Neils, 1979).[5]

The nose acts as a variable resistor and may account for as much as 40 percent of the total airway resistance. The efficiency of the nose as an airway is dependent upon the downwards direction of the nares, the small inlet and large outlet, the shape and size of the nasal cavity, the streamlined nasal turbinates and the flow velocity. This simple but accurate relationship may be stated:-

$$R = K(PLV/D^4)$$

In this equation R = resistance , K = constant ,
P = gas density, L = tube length,
V = velocity of flow and D= tube diameter.

Another factor that affects the diameter of the nasal vault is the nasal cycle. The upper respiratory tract is a twisting, curving, closed conduit of varying section and irregular circumference stretching from the nares to the glottis. Its nasal portion is divided from nares to choanae by a wall, the nasal septum.