POSTOPERATIVE CHEST COMPLICATIONS

An Essay
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General Surgery

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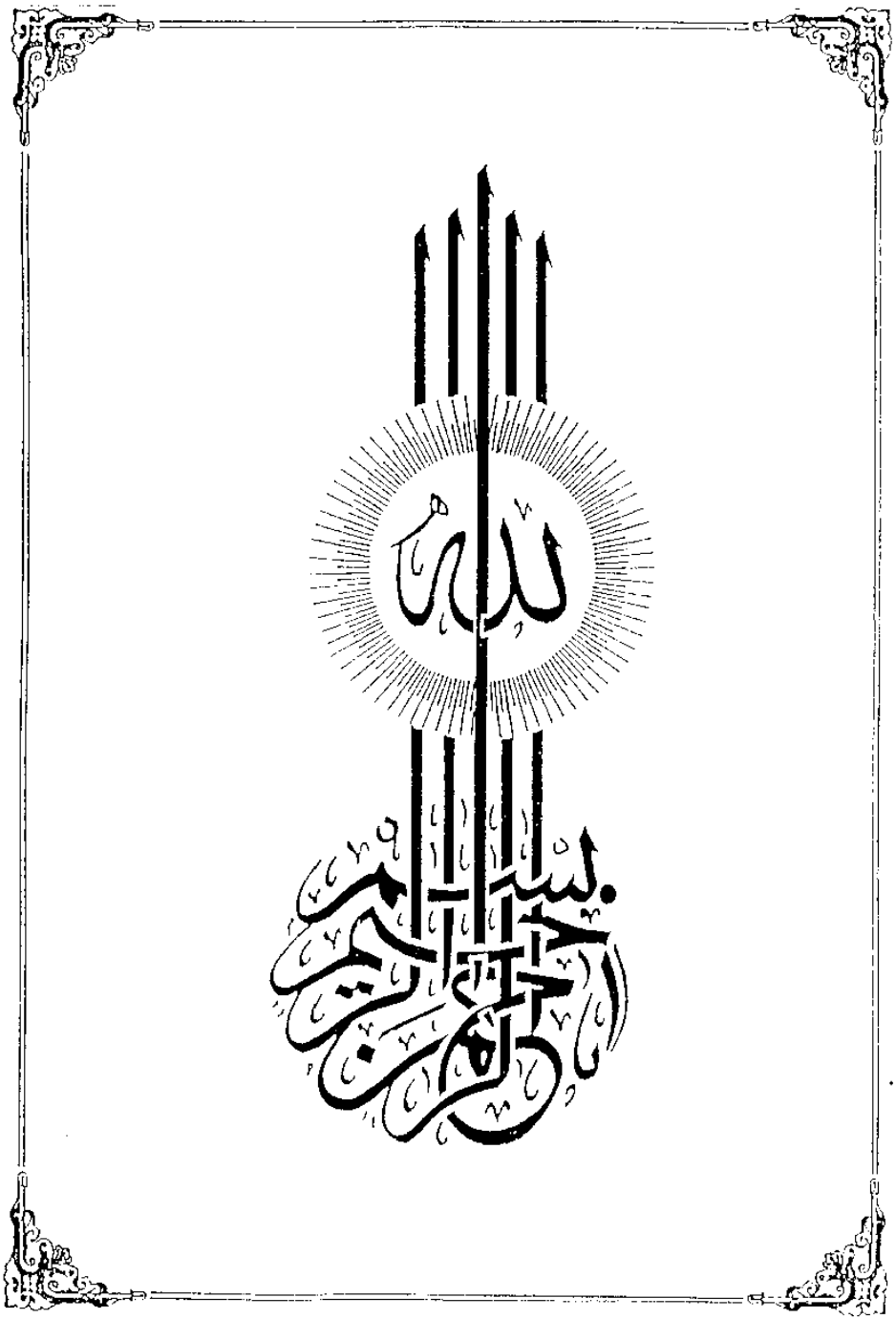
DEDICATED TO

My Father

and

My Mother

For leading me into intellectual pursuits.



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CONTENTS

INTRODUCTION

Postoperative chest complications as a group constitutes the most common of all complications occurring in the postoperative period and it may lead to a serious outcome if not recognised and managed properly.

This essay discusses these complications in some detail to demonstrate its pathogenesis methods of prophylaxis and treatment to enable the surgeon to be alert and acquainted with these possible complications and how he can detect, prevent and manage it properly.

The essay begins with discussion of some important anatomical& physiological informations of significance for our subject and a lot of no significance for the subject is omitted.

The important complications are then discussed separately begining with pulmonary aspiration of gastaric contents and its serious effects then pneumothorax, hypoxemia, hypercapnia, pneumonia, lung abscess atelectasis, acute tracheobronchitis and finally pulmonary embolism every one of these complications has its own pathogenesis, clinical manifestations, preventive measures and treatment.

At the end of the essay surgery and anesthesia in patients with respiratory diseases are discussed to illustrate some precautions necessary for avoidance of complications in those susceptible patients.

ANATOMY OF THE CHEST

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I- The skeleton of the chest

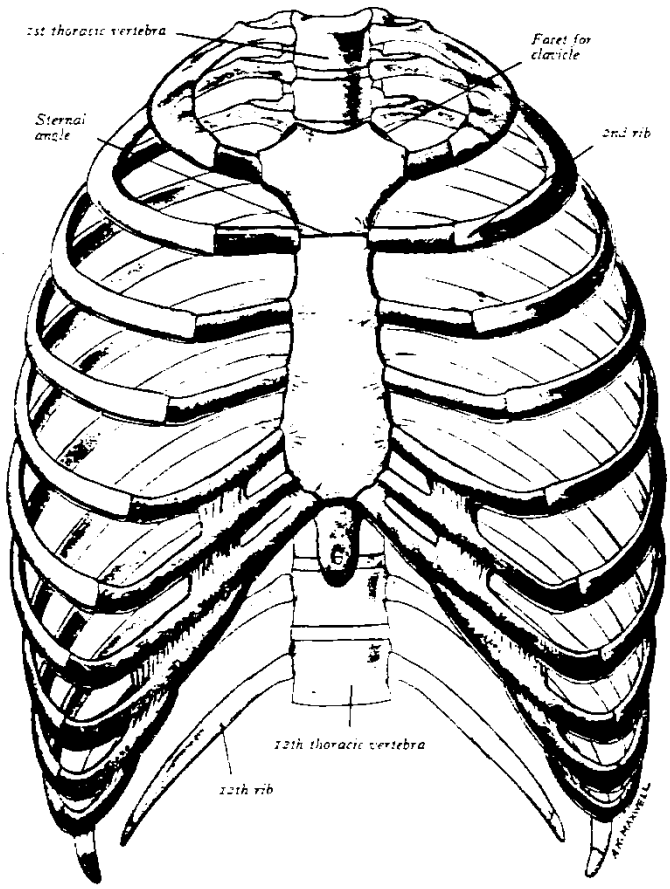

Fig. (1): *The skeleton of the thorax*

It is an osseocartilagenous framework within which are the principal organs of respiration and circulation. It is conical in shape narrow above and broad below, flattened from before backwards, and longer behind than in front. It is reniforms on the harizontal section on account of the forward projection of the vertebral bodies.

Posteriorly *the thoracic skeleton includes the twelve thoracic vertebrae and the posterior parts of the ribs. At each side of the vertebral column there is a wide and deep groove in consequence of the lateral and backwards direction which the ribs follow from their vertebral extremities to their angless.* ***Anteriorly*** *are the sternum, the anterior ends of the ribs and the costal cartilages and this aspect is flattened or slightly convex.* ***Laterally,*** *the thorax is convex, and is formed by the ribs. The ribs and castal cartilages are separated from each other by the intercostal spaces, eleven in number, which are occupied by the intercostal muscles and membranes.*

The ***inlet*** *of the thorax is reniform in shape, its anteroposterior diameter is about 5 cm, its transverse about 10 cm. Its plane slopes downwards and forwards, and it is bounded by the first thoracic vertebra behind, the superior border of the manubrium sterni in front.*

The ***outlet*** *is bounded by the twelfth ribs at the sides, and in front by the cartilages of the tenth, ninth, eighth and seventh ribs, which ascend on each side and form an angle, termed the infrasternal angle. The outlet is wider transversly than from before backwards, and slopes obliquely downwards and backwards, it is closed by the diaphragm, which forms the floor of the thoracic cavity.*

Like any other part of the skeleton, the thorax displays variation in dimensions and proportions which are partly individual and also linked to age, sex and race. In the newly born the transverse diameter is relatively less,

but a change to adult proportions occurs when the child begins to walk. In the female the capacity is less, absolutely and proportionately, the sternum is relatively shorter and the thoracic inlet more oblique, the suprasternal notch being level with the third thoracic vertebra, rather than the second, as in the male. The upper ribs are also more movable in females permitting comparatively greater expansion of the upper thorax. In tall and thin individuals the thoracic skeleton usually shows similar proportions, as also in short and braod.

Each rib possesses its own range and direction of movement, contributing to the combined respiratory excursions of the thorax. Each rib may be regarded as a lever, the fulcrum of which is situated immediately lateral to its costo-transverse articulation, so that when the shaft of the rib is elevated the neck is depressed, and vice versa, because of the large difference in length of the arms of this lever a slight movement at the vertebral end of the rib is much magnified at the anterior extremity.

The anterior ends of the ribs are lower than the posterior, and therefore, when the shaft of the rib is elevated, they rise in a forward direction. Again, the middle of the shaft of the rib lies in a plane below that passing through the two extremities, so that when the shaft is elevated relatively to its ends it is at the same time carried outwards from the median plane, further, each rib forms the segment of a curve which is greater than that of the rib immediately above. Therefore, the elevation of a rib increases the transverse diameter of the thorax in the plane to which it is raised. The

modifications of the rib movements at their vertebral ends is easily understood if the articulations of the ribs with the vertbral column is known. This can be divided into two, one connecting the heads of ribs with the bodies of vertebrae, the other, the costotransverse joints, uniting the necks and tubercles of ribs with transverse processes. The head of ribs are so closely connected to bodies of the vertebrae by the radiate and intra-articulr ligaments that only slight gliding movments of the articular surfaces on one another can take place. Similarly, the strong ligaments binding the necks and tubercles of the ribs to the transverse processes limit the movement of the costotransverse joints to slight gliding, guided by the shape and direction of the articular surfaces. (Fig. 2).

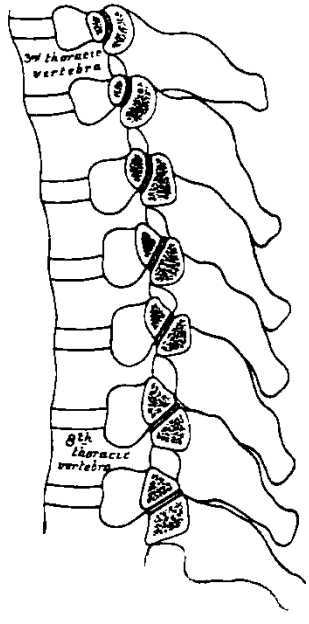

Fig. (2): *A section through the costoransverse joints from the third to ninth.*

The articular surfaces on the tubercles of the upper six ribs are oval in shape and convex from above downwards, they fit into corresponding concavities on the anterior surfaces of the transverse processes, so that upward and downward movements of the tubercles are associated with rotation of the rib-neck on its long axis. On the seventh to tenth ribs the articular surfaces of the tubercles ar almost flat, and face obliquely downwards, medially and backwards. The surfaces with which they articulate are on the upper aspects of the transverse processes, when therefore, the tubercles are drawn up they are at the same time carried backwards and medially. The joints of the head of the ribs and the costotransverse joints move simulatenously and in the same direction, the total effect being that the neck of the rib moves as if a single joint, of which two articulations form the ends. In the upper six ribs the neck of the rib moves but slightly upwards and downwards its chief movement is one of rotation round its own long axis, rotation downwards of the front of the neck of the rib being associated with depression, rotation upwards with elevation of the anterior end of the rib and its costal cartilage. In the seventh to tenth ribs the neck of the rib moves upwards, backwards and medially, or downwards, forwards and laterally, with resultant increase or diminution of the infrasternal angle, a small degree of rotation accompanies these movements. Further modifications result from the attachments of their anterior extremities, and it is convenient therefore to consider separately the movements of the ribs in three groups, vertebrosternal, vertebrochondral and vertebral.

Vertebrosternal ribs: *(Fig. 3-A)*

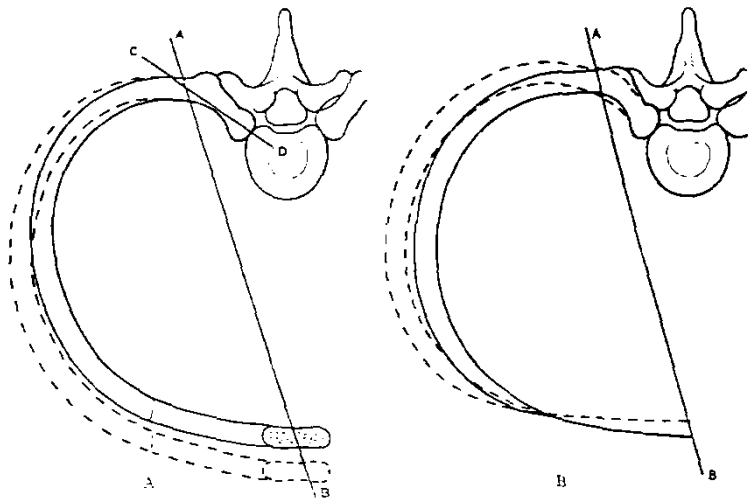

***Fig. (3** A, B):*

A- *A diagram showing the axes of movement (AB and CD) of a vertebrosternal rib. The interrupted lines indicated the position of rib in inspiration*

B- *A diagram showing the axes of movements (AB) of a vertebrochondral rib.The interrupted lines indicate the position of the rib in inspiration.*

The first rib moves little, except in deep respiration. Its movements occurs about an oblique axis through the neck, the shaft is displaced upwards and laterally in inspiration and the under surface comes to face more directly downwards. This movement is impossible if the costal cartilage is calcified, as it sometimes is, the first rib on each side and the manubrium sterni then moves as a single unit about a transverse axis through the costotransverse joints. Movement of the second rib is slight also in quiet respiration. Elevation of the third to sixth ribs raises and thrusts forwards their anterior extremities, the greater part of the movement being effected by the rotation of their necks backwards. The thrust of the anterior exremities carries forwards and upwards the body of the sternum, which moves on the joint between it and the manubrium, and thus the anteroposterior thoracic diameter is increased.

This movement, however, is soon arrested, and the elevating force is then expended in raising the middle part of the shaft of the rib and everting its lower border, at the same time the costochondral angle is opened out. By these movements a considerable increase in the transverse diameter of the thorax is effected.

Vertebrochondral ribs: *(Fig. 3-B)*

The seventh rib is included with this group, as it conforms more closely to their type of motion. While the movmeents of these ribs assist in enlarging the thorax for respiratory purposes, they are also concerned in increasing the upper abdominal space for viscera displaced by the action of the diaphragm, although relaxation of the abdominal wall can account at least in part for this. The costal cartilages articulate with one another, so that each pushes up that above it, the final thrust being directed to pushing forwards and upwards lower end of the body of the sternum. The amount of elevation of the anterior extremities is limited on account of the very slight rotation of the necks of these ribs. Elevation of the shaft is accompanied by an outward and backward movement, the outward movement everts the anterior end of the rib and opens up the infrasternal angle, while the backward movement pulls back the anterior extremity and counteracts the forward thrust due to its elevation, this latter is most noticeable in the lower ribs, which are the shortest. The total result is a considerable increase in the transverse and a diminution in the median anteroposterior diameter of the upper part of the abdomen, at the same time, however the lateral anteroposterior diameters of the abdomen are increased.

Vertebral ribs. *Since these ribs have free anterior exremities and only costovertebral articulations with no intra-articular ligaments, they are capable of slight movements in all directions. When the other ribs are elevated these are depressed and fixed by the quadratus lumborum muscles to form fixed points of action for the diaphragm, the muscles responsible for these movements will be discussed.*

II- The Muscles of the Thorax

This group of muscles Figs. (4, 5, 6) consists of muscles which connect adjoining ribs (intercostales, externi, enterni, et intimi), span several ribs between attachments (subcostales), connect ribs to sternum (Transversus thoracic), or ribs to vertebrae (Levatores costarum, serratus posterior superior et inferior) and the diaphragm. They are all concerned in the movements of ribs and hence with respiration.

The intercostales *(Fig. 4) are thin superimposed layers of muscle and tendinous fibres occupaying the itnercostal spaces. They are named from their surface relations - the intercostales externi are the most superficial and the intercostales intimi are the innermost.*

The intercostales externi *are eleven in number on each side: Their attachments extend from the tubercles of the ribs almost to the cartilage of the ribs in front where each is repalced by an aponeurotic layer named external intercostal*