ANAESTHESIA AND PULMONARY CIRCULATION

ESSAY

Submitted in Partial Fulfilment Of Master Degree

In Anaesthesia

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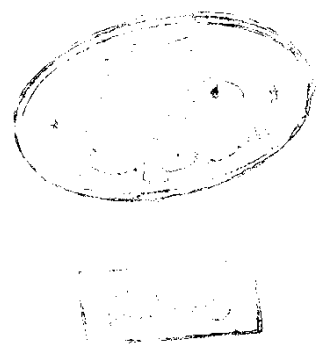

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AC KNOW LEDG EMENT

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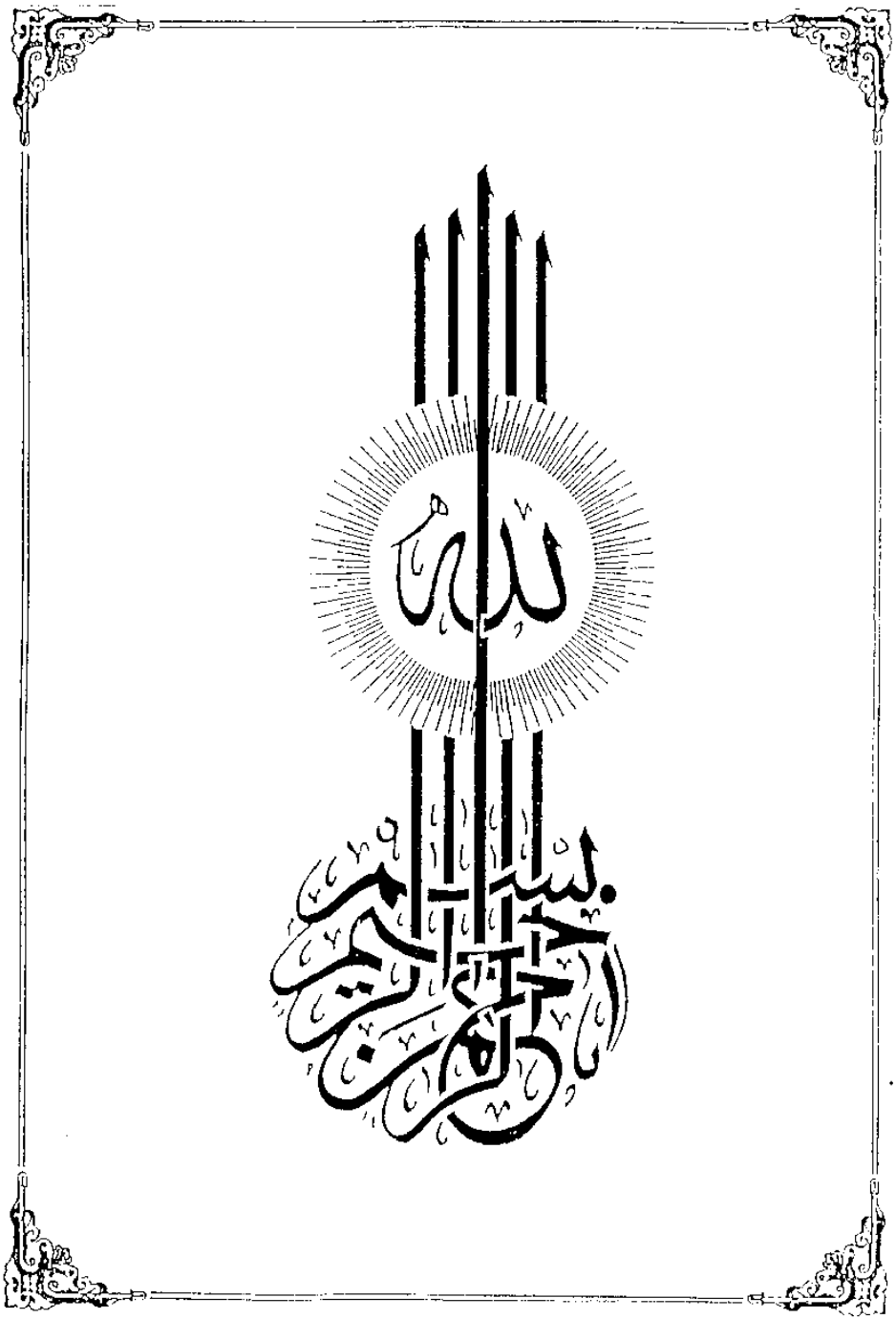

C O N T E N T S

INTRODUCTION

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A few decades ago , the pulmonary circulation was often discussed within the context of being a passive conduct that simply connected the right and left hearts and whose principle function was to unload CO2 and take up O2 without consideration for the efficiency of that process . In recent years , the major advances in understanding the pulmonary circulation have, to a large extent ,created an awareness of the physical and chemical interactions of the pulmonary circulation with the alveoli and airways , and of how these interactions affect the efficiency of the gas exchange process.

The pulmonary circulation is in series with the systemic circulation , it recieves the mixed venous blood from the right ventricle , and thus it is the only arterial circuit in man that carries desaturated blood in his extra-uterine life .

The flow of blood through pulmonary circulation is approximately equal to the flow through the whole of systemic circulation . It therefore varries from about 6 l/min. under resting conditions to as much as 25 l/min. in severe exercise, Although the flow rates are similar in the two systems , the

pressures are greatly different, pulmonary arterial pressures being approximately one-sixth of the systemic . The pulmonary vascular resistance is thus much less than that of systemic circulation. Therefore, pulmonary circulation is characteristically a low-pressure, low-resistance system. The pulmonary artery pressure is about 24/9 mm Hg and the mean pressure is about 15 mm Hg . The volume of blood in pulmonary vesseles at any time is about 1 liter , of which less than 100 ml is in the capillaries.

ANATOMY

ANATOMY OF PULMONARY CIRCULATION

Pulmonary Trunk:-

The pulmonary trunk conveys deoxygenated blood from the right ventricle of the heart to the lungs. It is about 5 cm. in length and 3 cm. in diameter, and arises from the base of the right ventrical, then it runs upwards and backwards, at first in front of ascending aorta, and then to its left side. In the concavity of aortic arch it divides, at the level of fifth thoracic vertebra, into right and left pulmonary arteries which are of nearly equal size . (Last,1979)

Right pulmonary artery:-

The right artery is slightly longer and wider than the left , it runs horizontally to the right , behind the ascending aorta, superior vena cava and upper right pulmonary vein, and in front of the oesphagus and right bronchus , to the root of right lung, where it devides into two branches, one for each lobe of the lung. Above, it is connected to the concavity of aortic arch by ligamentum arteriosum.

Left Pulmonary Artery:-

Alittle shorter and smaller than the right, it runs horizontally in front of the descending aorta and left bronchus to the root of left lung, where it divides into two branches, one for each lobe of the lung.

Above, it is connected to the concavity of the aortic arch by ligamentum arteriosum.

Pulmonary Vascular Bed :-

Each pulmonary artery then branches successively like the system of airways,and pulmonary arteries accompany segmental and subsegmental bronchi down to terminal bronchioles, then they divide to form the capillary bed in alveolar walls. The pulmonary bed is so arranged that it is very efficient in gas exchange. Pulmonary capillaries form plexuses which lie immediately beneath lining epithelium in the walls and septa of alveoli and air sacules .

Pulmonary vessels are.very thin and distensible therefore pulmonary arterial tree has a very large compliance, averaging 4 ml. per mm Hg. , which is almost equal to that of the entire systemic arterial tree . This large compliance allows.the pulmonary

arteries to accomodate stroke volume output of right ventricle. (Warwick,1979.)

Pulmonary Veins:-

Two from each lung, arise from pulmonary capillaries the radicals coalescing into larger branches which run through the substancesof the lung, mostly independently of pulmonary arteries and bronchi. Finally they open into left atrium of the heart conveying oxygenated blood to be distributed to all parts of the body by left ventricle.

Bronchial Arteries;-

Supply blood for nutrition of the lung, they are derived from the upper posterior (aortic) intercostal arteries. They carry about 1-2 percent of cardiac output and their blood is oygenated blood. (Warwick, 1979) .

SOME ANOMALIES OF ANAESTHETIC IMPORTANCE

I- Unilateral Absence Of Pulmonary Artery :-

Congenital unilateral absence of a pulmonary artery usually occurs in association with other cardiac lesion , isolated unilateral absence in rare. Frequently in such condition, there are no clinical findings, and the dis-order may be first recognized by a characterstic pattern of chest x-ray finding. (Joan , 1983) .

Without associated cardiac abnormalities, clinical symptoms , if present are usually non-specific, like history hemoptysis reccurent pulmonary infection, pain in the chest, dyspnea on exertion, or sometimes cyanosis. Clinical signs are generally unremarkable with the excepation of decreased breath sounds on the involved side. (Schneeweiss, 1983) .

X- ray finding : Are cardiac and mediastinal displacement absence of pulmonary arterial shadow, smaller hemithorax, elevation of the hemidiaphragm , and paucity of vascular marking, all on the involved side. On the oppsite side, there is hyperinflation and herniation of the lung across the midline.

There is newer radiographic technique which offers safety and easy performance, it is digital subtraction angiography, which has been used to evaluate pulmonary

arterial circulation; it demonstrated the main pulmonary artery, right and left pulmonary arteries and smaller branches .(Buonocore,1983)

This technique also offers good diagnosis of pulmonary embolism, and evaluation of congenital heart diseases . (Ludwing,1983)

Other investigations: ECG ; arterial blood gases, bronchoscopic and bronchographic findings are likewise normal. Routine tests of pulmonary functions are usually normal or show mild restrictive defects. After the case is suggested by chest x-ray it is confirmed by angiogram or nuclear scaninng which shows mormal ventilation scams bilaterally with complete absence of perfusion on the involved side.

Anaesthetic applications:-

In patients with unilateral pulmonary artery, hemodynamic studies demonstrate normal pulmonary arterial pressure at rest and exaggerated rise in presence of exercise. Large communications can develop between systemic circulation and pulmonary bed, and nutrition of the abnormally vascularized lung is well preserved by bronchial arteries , through which up to one-third of left ventricular output may flow without any workload on the left ventricle. (Joan, 1983).

Patients with unilateral absence of a pulmonary artery enjoy good health , but these patients develop unilateral pulmonary oedema in the other hyperperfused lung if they are subjected to high-altitude or any other cause of hypoxia during anaesthesia . The cause of this oedema is the uneven vasoconstriction induced by hypoxia . (Hackett , 1980) .

II- Origin Of Pulmonary Artery From Aorta :-

Origin of pulmonary artery from aorta is usually associated with other anomaly , the most common is patents ducts arteriosus (PDA) or Fallot 's tetralogy mortality of this malformation without operation is extremely high . The surgery is done in infancy , mostly by the use of deep hypothermic circulatory arrest , but unfortunately there is also a high surgical mortiaity . (Patricia , 1983) .

III- Occult Pulmonary Artery :-

Sometimes , the distal portion and intrapulmonary vessels of the called absent pulmonary are in fact present, thus the artery is usually occult rather than absent.