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مسئولية عن محتوى هذه الرسالة.

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Removal of Chest Drains in Post Coronary Artery Bypass Graft Patients: Do Various Phases of Respiration Make a Difference?

Thesis

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By

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INTRODUCTION

The early management of the postoperative open heart surgery patient can be viewed as an extension of the intra operative care the patient received [1]. There is a continuous decline in mortality and morbidity in cardiac surgery despite increases in patient age, comorbid conditions, and procedure complexity. Much of this success can be attributed to advances in critical care. In addition to many other aspects special efforts are directed towards circulatory and respiratory stabilization[2], and here comes the importance of mediastinal and pleural drains as they must be closely observed to ensure vital stabilization of the patient in addition to monitoring systems, so, it is important to keep them patent[3]. Draining the pleural cavity has been initially described by Hippocrates.[4] In 1876, Hewitt was the first to use a completely closed intercostal drainage system[5], but it was not until World War II that tube thoracostomy became common in the treatment of injured patients.[6]The use of chest tubes postoperatively for thoracic procedures was not common until reported by Lilienthal in 1922[7].

It's also important to remove pleural drain in the right time to avoid possible undetected mediastinal bleeding or fluid re-accumulation in open pleura which may result from premature removal. And to avoid infection, prolonged exposure to pain and prolonged mechanical irritation which may result from their prolonged stay [8].

When time comes they must be removed in the right way i.e. in sterile conditions and for pleural drainage. The phase of respiratory cycle needs to be put in consideration. Proper removal is critical to reduce the risk of post drain removal pneumothorax. The focus is to prevent air from re-entering the pleural space by minimizing the exposure of the thoracostomy site to the atmosphere [9]. There has been some debate regarding the optimal timing of thoracostomy tube (TT) removal in relation to the respiratory cycle. Some propose removing the tube at the end of maximal inspiration because the lung has been fully expanded creating the smallest space between the visceral and parietal pleurae [10]. However, when removing the thoracostomy tube during inspiration the patient can potentially suck air into the pleural space through the open thoracostomy site. Others recommend TT removal at the end expiration while performing Valsalva maneuver when the pressure difference between the atmosphere and the thoracic cavity is the least, reducing the potentiality of air moving through the thoracostomy site [11]. When removing the tube during expiration pain may cause the patient to inadvertently inhale and draw air in to the pleural space. One study of thoracostomy tube removal that randomized the patients to removal at the end of inspiration versus removal at the end of expiration, both while performing Valsalva maneuver, demonstrated that the rate of post drain removal pneumothorax between the two groups was similar (8% versus 6%)[12]. Given that no method has shown to be superior in preventing pneumothorax, but quick removal of the pleural drain while maintaining occlusion of the thoracostomy site helps in prevention of post drain removal pneumothorax during removal procedure[9].

In this study we tried to find out if there is optimal timing of pleural drain removal during different phases of respiration to allow the least possible pneumothorax to happen, we also focused on patients post Coronary Artery Bypass Grafting (CABG) surgery and we have assessed and followed up the patients pre and post removal through chest X-ray.

Aim of the Study

This a comparative study between various times for removal of left pleural drain in (end-inspiratory, end-expiratory and during Valsalva maneuver in both expiration and inspiration) in post coronary artery bypass graft surgery concerning efficiency and complications.

HISTOLOGY

Proper understanding of histology of pleura helps us to understand how cellular and lymphatic design, in addition to mechanical factors that will be mentioned later, facilitates the pleural space negativity which is cornerstone element in its physiological function. Normal pleura appears to be semi-transparent smooth glistening membranes lining the chest wall and covering the intra-thoracic structures. Microscopic examination of the pleura with light microscope reveals five layers; mesothelial cells layer, thin connective tissue layer, superficial elastic layer, loose connective tissue layer and deep fibro-elastic layer.[(13)]

The mesothelial cells layer is the first layer. The diameter of mesothelial cells ranges from 16.4 microns (plus or minus 6.8) to 41microns (plus or minus 9.5). The thickness of this layer ranges from less than one micron to more than 4 microns. The shape of mesothelial cells is either flat or cuboidal depending upon its place in the pleura but they become rounded in shape when they are dislodged. The mesothelial cells are tightly adherent to each other in apical parts of the pleura but in other regions they seem overlapping upon each other without being really attached. This overlapping disappears when pleura stretches in inspiration because their junctional complexes are loose. The cellular junctional complexes make the mesothelial cells layer leaky like the endothelial layer of small venules but junctional complexes are more tight in visceral pleura making it more resistant to leakage.[14]

The most characteristic feature of mesothelial cells is presence of microvilli on its pleural surface giving it a brush appearance. These microvilli range from 0.5 micron to 3 microns in length and about 0.1 micron and their density ranges from few to more than 600 per 100 cubic micrometer. In general the number of microvilli is larger in visceral pleura than in parietal pleura for the same region, but the inferior parts of visceral pleura in addition to the anterior and inferior parts of mediastinal parietal pleura show the largest density of microvilli over mesothelial cells. Their function is suggested to be supporting the hyaluronic rich glycoprotein meshwork which decreases the friction between the lung and the chest wall. Hyaluronic acid is secreted by mesothelial cells and sub-pleural mesenchymal cells.[13]

The nucleus of mesothelial cells is ovoid with prominent nucleolus and its cytoplasm contains well developed organelles including apparent mitochondria, golgi apparatus, smooth& rough endoplasmic reticula, poly ribosomes and glycogen granules. The mesothelial cells have numerous pinocytes on both pleural and basal surfaces. When detached, mesothelial cells can transform into macrophages which are capable of engulfing particles by phagocytosis. Macrophages in the pleural space are also derived from peripheral blood mono-nuclear cells and from alveolar macrophages. Some evidences show that mesothelial cells can also transform to myofibroblasts.(15)

The mesothelial layer is very delicate thus, when irritated, the cells shrink but the cellular bridges between mesothelial cells keep the layer continuous. When interrupted, the continuity of mesothelial cells is restored via mitosis of surrounding cells and migration of other cells. The mesothelial cells rest on basement membrane which resembles the beginning of the next layer. (14)

The second layer is the thin connective tissue layer that contains the basement membrane. The third layer is the superficial elastic layer. the boundaries between these two layer is imprecise.(14)

The forth layer is composed of loose connective tissue layer which contains nerve fibers, capillaries and lymphatics. It is also rich in collagen and elastic fibers. in visceral pleura there are other layers of elastic fibers that helps in elastic recoil of the lung and it also guards against over inflation of the lung. This layer serves as a plane in cases of pleurectomy.(16)

The fifth layer is the deep fibroelastic layer which is tightly adherent to subpleural structure, and in case of visceral pleura, it is tightly adherent and tightly attached to inter alveolar septula which allows better distribution of mechanical forces in even manner. The fifth layer in the parietal pleura forms the endothoracic fascia.(15)

Communication between pleural space and lymphatics (13)

The pleural cavity is directly connected with subpleural lymphatics through stomatas, membrane ciribriformis, lacunae and lyphatic channels.

Stomatas which are ovoid or round openings in parietal pleura about six microns in diameter. They are abundant in postero-inferior part of pleural space and they are found only in parietal pleura.(16) membrane ciribriformis present beneath the parts of pleura that lie around the stomata and they are tangled communicating connective tissue bundles covered by mesothelium on pleural surface and lies beneath it the lymphatic endothelium.

Lacunae are globular parts of lymphatic channels which lie beneath membrana ciribriformis and open by stomata on pleural surface and drain in to the ordinary lymphatic channels through a guarding valve.

The respiratory movements play a role in lymphatic suction. during inspiration, stomata widen and particles are engulfed into the lacuna or pushed by the inflating lung. In the expiration, the stomata narrow and lacunae are pushed which squeezes the particles into the lymphatics channels through the valves which guard against back flow in next inspiration.

Regional differences of the plura[13]

Visceral superior parts which are more fixed and less mobile is thin and the mesothelium is composed of flat cells with scattered microvilli thus the apical visceral pleura is more susceptible to bullae formation. Visceral inferior parts, which are more mobile, are thick and their mesothelium is formed of cuboidal cells with numerous microvilli.

Parietal pleura over ribs contains flat mesothelial cells with scattered microvilli, its layers are thin and the fibroelastic layer is fused with perichondium or periosteum while the parietal pleura that covers loose structures above or below the ribs and the pleura of the recesses contain cuboidal mesothelial cells with numerous microvilli and their deep fibroelastic layer is unclear.

The parietal pleura that covers muscles or the diaphragm shows intermediate characteristics between the