The Mechanical Cause of Loculated Pleural Effusion

Nikhil Mishra

ABSTRACT

In this research, we are going to deal with the probable mechanism behind the loculated pleural effusions using the Law of Viscous fluids against rough surfaces/walls.

The idea of the research is to form a firm ground regarding the mechanism of pleural effusion.

Keywords: NA

Classification: DDC Code: 833.6 LCC Code: PZ7.W996

Language: English

Great Britain Journals Press

LJP Copyright ID: 392844

London Journal of Medical and Health Research

Volume 23 | Issue 1 | Compilation 1.0

The Mechanical Cause of Loculated Pleural Effusion

Nikhil Mishra

ABSTRACT

In this research, we are going to deal with the probable mechanism behind the loculated pleural effusions using the Law of Viscous fluids against rough surfaces/walls.

The idea of the research is to form a firm ground regarding the mechanism of pleural effusion.

I. INTRODUCTION

As we know by now pleural effusions are caused due to a particularly large number of underlying pathologies such as pneumonia which accounts to almost 53% of cases, Tuberculosis, congestive heart failures, Cirrhosis and a lot more. The point of discussion of this research is particularly prognosis or empyema which if may left behind after the chest tube drainage can sure shot lead to loculated pleural effusion which can either be transformed into malignancy and have a poorer malignancy or further re- occurrence of disease or some either fatal infections.

Regarding locular effusion, the most uncommon or unorthodox behavior of the fluid is what that draws the major attention by forming atypical shapes that are observable on CT's, radiographs and USG which is still needed to be understood.

Classification of effusion

For this we have classified effusion on the basis of pleural fluid positivity , and gram strain positivity and also ph.

effusion
(on the basis of gram strain positivity and pleural fluid positivity

LOCULATED EFFUSION. Normal pleural effusion

When Ph is <7.2.

jgWhen ph is not measurable

complex parapneumonic effusion. Empyema.

Complex parapneumonic effusion and empyema both are the fluids/liquids that contains a good amount of (more than usual) of leukocytes.

Hence, makes the fluid grainy or to be said viscous/turbid which is also verified when drained out theough chest tubes as they are straw colored may be haemorrhagic but surely turbid.

In the pleural cavity, as suggested, there are mesothelium cells which are responsible for surfactant secretion and certain lymphatics which help in the generating a negative pressure during rest.

Presence of certain cells on the parenchyma of the lungs or the chest walls, it is really hard to consider the walls of these surfaces (constituting to the pleural cavity) as "ideally smooth surfaces."

According to the wall laws for viscous fluid near rough wall surfaces , we should consider the the wall law of first order which is the Dirichlet law that states , a fluid satisfies a "no slip" boundary conditions under the homogenized surface. Also, we should take in the consideration of the type of the fluid associated with law or experiment.

Case 1

Presence of any non-viscous liquid/fluid like water (may or may not be macroscopically clear) or Tansudates.

- As these are non viscous liquids/fluids and are less denser, these doesn't correspond to the law and hence will now follow "no slip" boundaries or rather will follow "slip" boundaries.

hence are least likely to develop into Loculated pleural effusion.

(a) This is the cxr of pleural effusion caused by transudate showing no special pattern of fluid. Hence a normal pattern is obtained.

(a)

(b)

This is the USG of pleural effusion caused by transudates

Case 2A

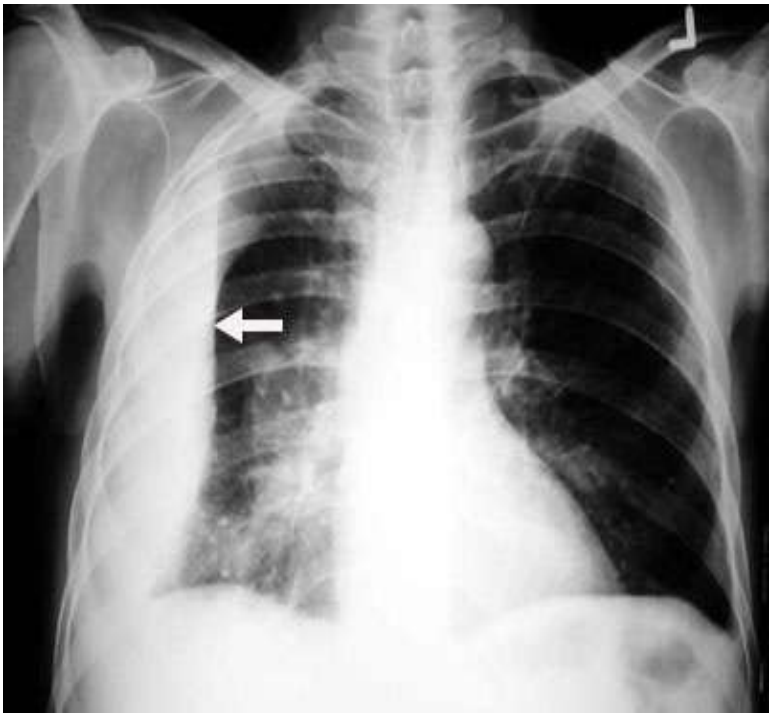
Presence of parapneumonic fluid or empyema (viscous liquids) or exudates in Normal healthy pleural cavity.

- As these fluids clearly follow the wall law of first order and are coherent to all the conditions of rough surfaced walls are likely to have a Loculated approach.
- According the law when the edges of the fluid comes into the contact of the parenchyma of the lung surface and the chest wall they tend to have a "no slip" movement.

During inspiration and expiration, due to the compensatory movement of the chest wall in response to the lungs, the surface area between them tend to change frequently, these fluids when present inside the cavity have a pulsating affect due to frequent change in the surface area caused by inspiration and expiration and hence splash/rise to a certain height on either side of the wall. As these fluids show no slip movement they tend to 'adhere' to the surface they reached by pulsation and hence carry on there journey from there for the next pulsation.

- As these pulsation that are generated as a change in surface area is not that determining macroscopically, small gradual movements are made by these fluids over the time.

When a typical amount of fluid (say 40-60ml) is accumulated , pleural effusion starts showing its classical symptom of dyspnoea. As the pulsation continues , the shortness of breath here is the positive feedback for the localization to happen as the shortness of breath increases the repetition of pulsation and demise the time interval between two consecutive pulsation, the frequency of pulsation increases hence giving the fluid to localize in much better conditions than before but using the same principle as before.



(a) Cxr of loculated pleural effusion showing the unique pattern

(b) USG of loculated pleural effusion showing the unique pattern

Case 2B

Presence of parapneumonic fluid or empyema (viscous fluids) in a non healthy pleural cavity.
Lets consider 2 cases under this case.

Case 2B (i)

Lung/chest wall parenchymal damage due to certain pathology resulting in the depletion /irregularity of the surfaces.

- Due to the unevenness/irregularities which is incremental in this condition, the localization is most likely to happen. For the viscous fluids to adhere to the wall, one of the most primary cause is the type of surface and the level of roughness it offers. Here, as the roughness is increased quite significantly and also as the symptom dyspnoea is followed , it provides the most premium condition for the fluids to localize and hence the rise of the fluid in the definite shape is more significantly observed macroscopically.

Case 2B (ii)

Lack of mesothelium cells/ improper functioning of the cells.

- As these cells are responsible for the secretion of the surfactant which actually provides cushioning to the lungs, have some immediate effect on making the surfaces relatively smoother.

Due to improper functioning of cells/lack of these cells, relatively much lesser surfactant is present leading to the further roughness of the surfaces and hence leading to the condition that is same followed as CASE 2B(i).

Case 3

Presence of fluids in the fibrotic pouches created in the parenchyma due to the tear of lesions.

- Sometimes due to the tear of fibrotic lesions in the parenchyma, some slits and pouches are created. Deposition of these fluids in the pouches process a loculated pleural effusion. Though presence of parapneumonic fluid increase the morbidity ratio as it is quite infectious by nature, degrades the prognosis quite a few times.

Cxr of loculated pleural effusion (trapped) in pouch created

Note :-

The laws of viscous fluid near rough wall is technically applicable to the parts of flow that are close to the walls that is <20% of the height of flow. During the course of research this consideration was taken into account.

- Patients on diuretics can be misjudged as exudates instead for transudates. So , proper history taking is advisory.

Investigation

- Investigation should be carried out according to the recent guidelines.