

# What is ARDS- basic introduction

Dr A.N. Thomas Jan 2013.

This presentation should be viewed  
on a computer with the sound ON!

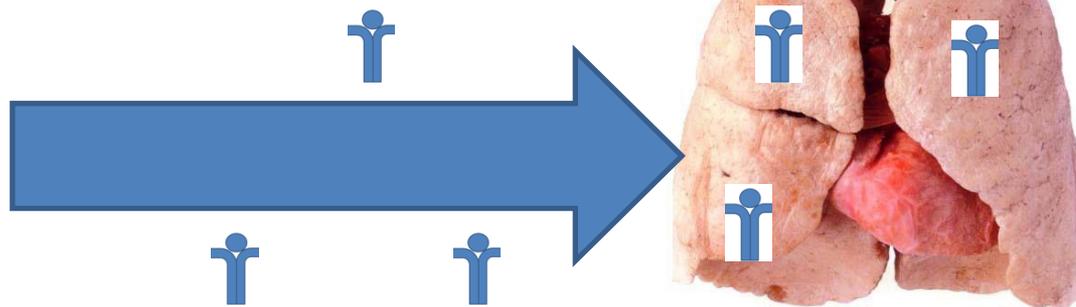
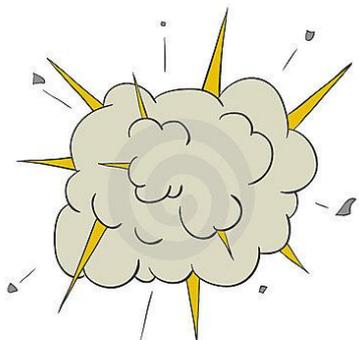
# Wound healing requires an inflammatory response from the body



Local inflammatory response causes redness and swelling

The inflammatory reaction eventually allows the wound to heal

With significant wounds some of the inflammatory mediators spill out into the blood stream- blood returning from the body all goes through the lungs



Why does the body allow this to happen?



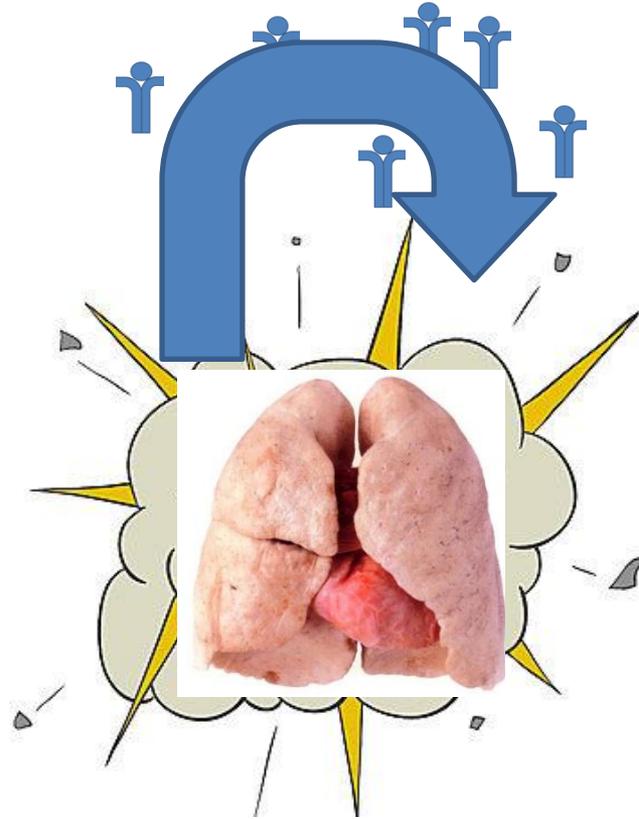
# What changed to allow us to recognise ARDS in the 1960s?



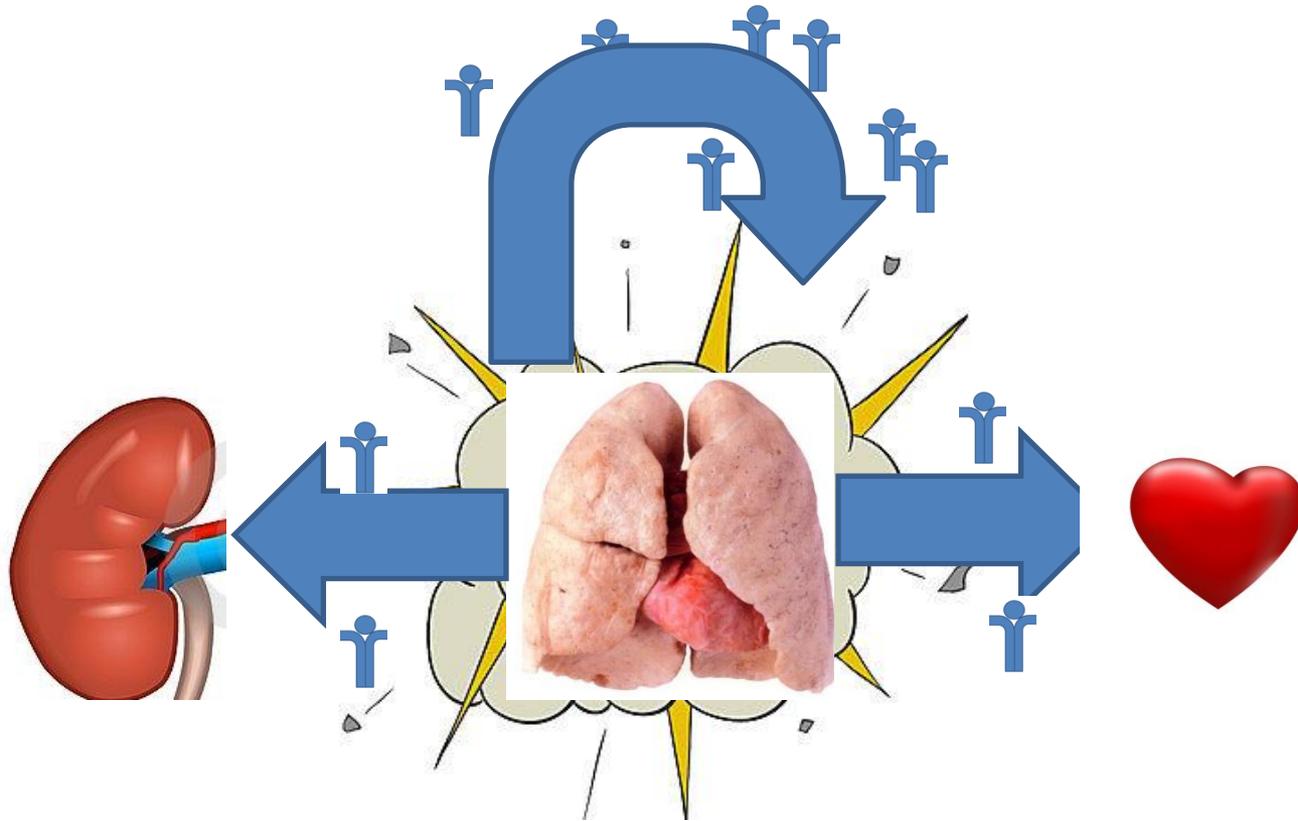
# What types of injury can cause this?

- Outside of the lung:
  - Septicaemia
  - Major trauma
  - Pancreatitis
  - Fat embolus
  - Amniotic fluid embolus
  - Other
- Inside the lung:
  - Pneumonia- viral or bacterial
  - Aspiration pneumonitis
  - Inhalational injury from smoke or other toxic substances
  - Drowning
  - Other

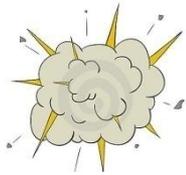
Inflammatory mediators can also be released by a lung injury like aspiration pneumonia and go on to cause ARDS



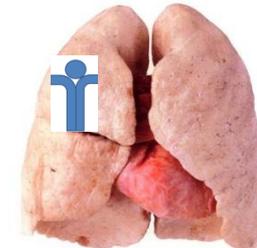
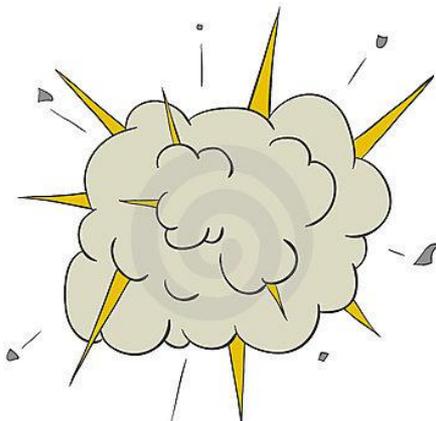
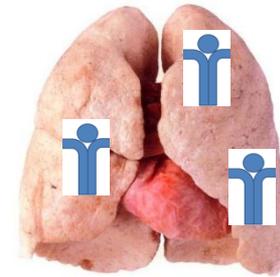
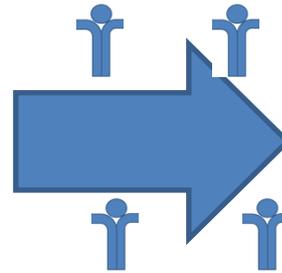
Inflammatory mediators can also spill out from the lung and damage other organs leading to multiple organ dysfunction and death- even if the initial problem was in another organ!



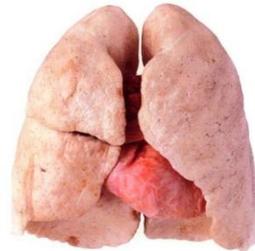
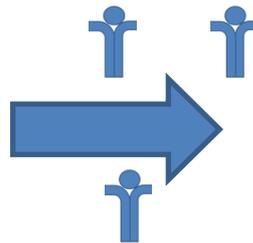
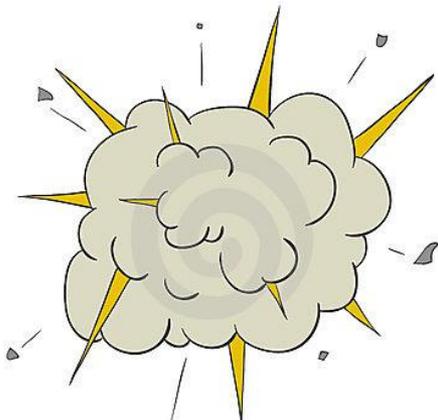
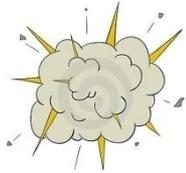
# The size of the injury does not on its own determine the degree of lung injury



**With:**  
**Wrong genetic  
make up or  
Second hit or  
Ethanol abuse**



The outcome will also be determined by the condition of the lungs before the insult or other injuries to the lung



# What are the processes involved in causing lung damage? 1. the normal lung.

Type 2 alveolar cells produce surfactant which coats inner surface of alveolus.

Alveolus full of air and occasional white cell to fight infection and remove particles

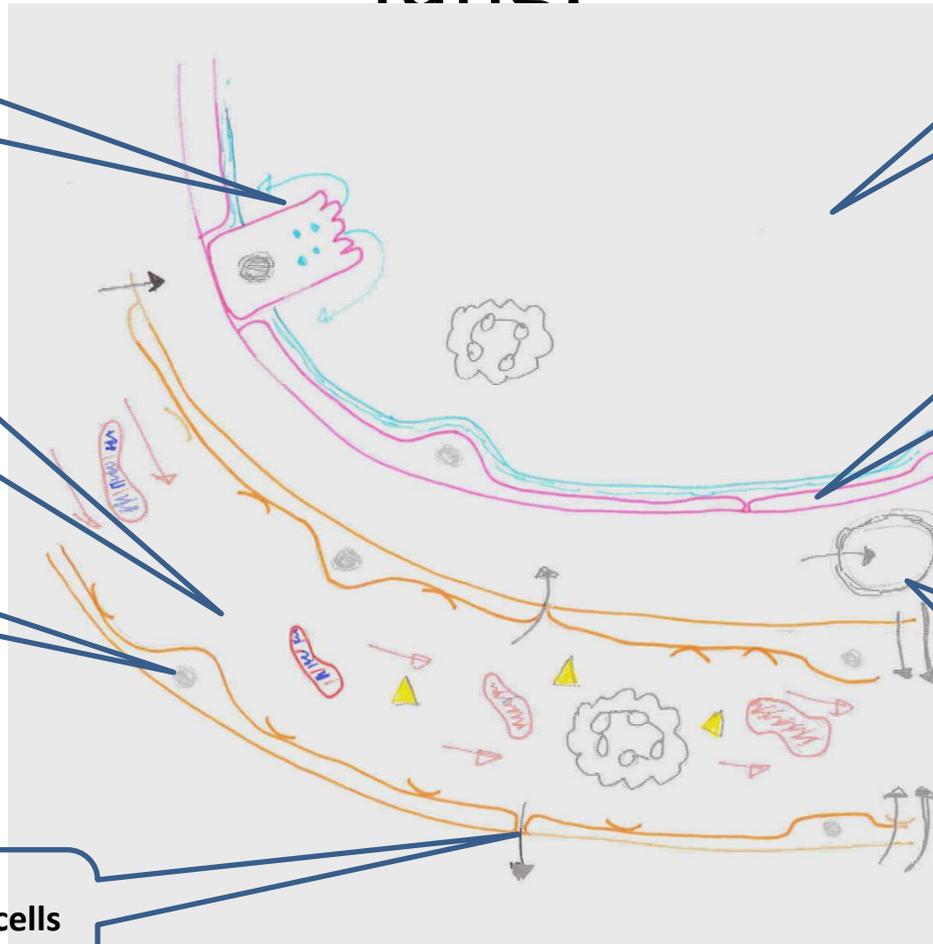
Red cells, white cells and platelets pass over the capillary cells with out sticking; red cells collect oxygen

Very thin type 1 alveolar cells covered with surfactant allow gas transfer

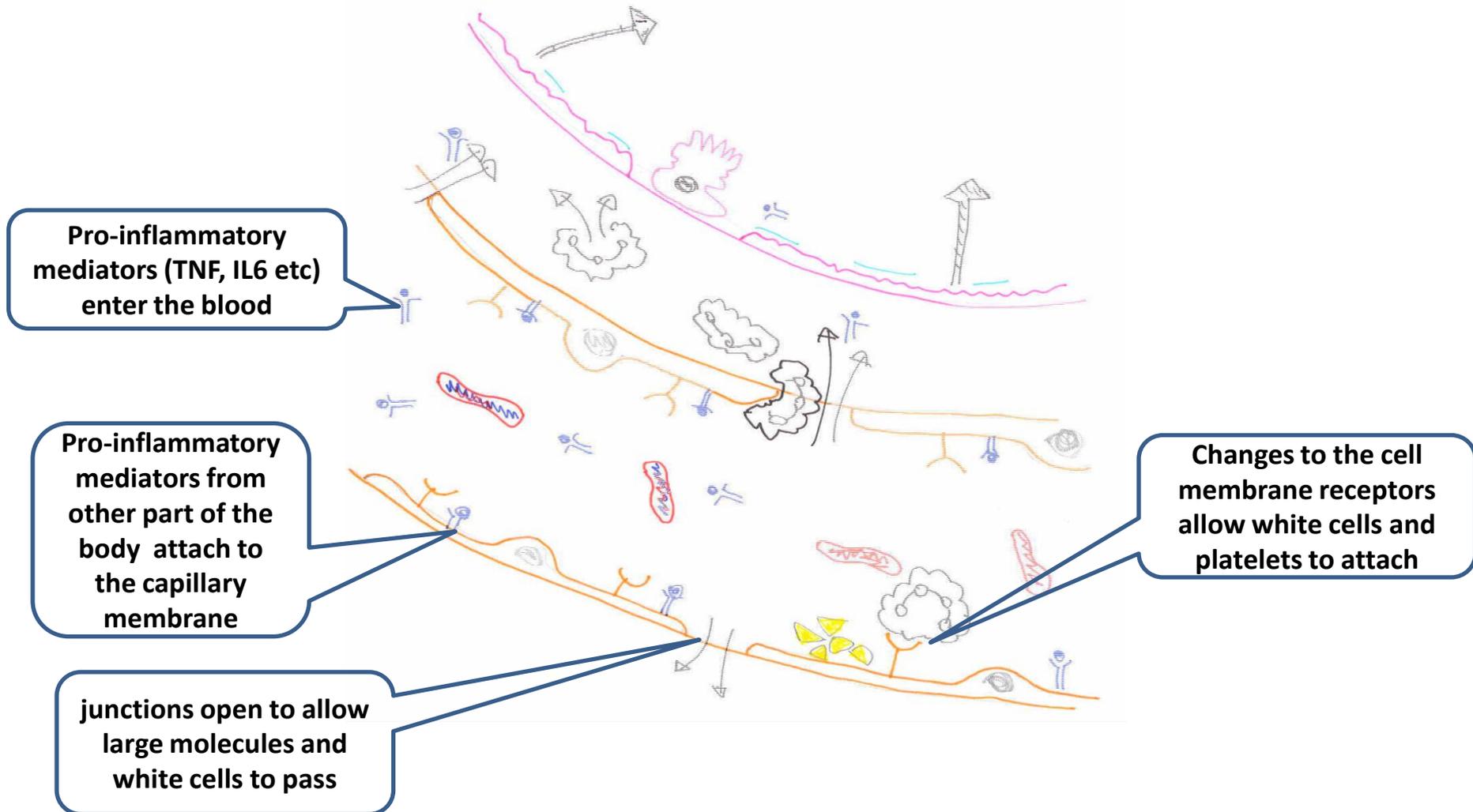
Capillary cells (shown in orange)

Any extra fluid drained as lymphatic fluid or returns to capillary at venous end

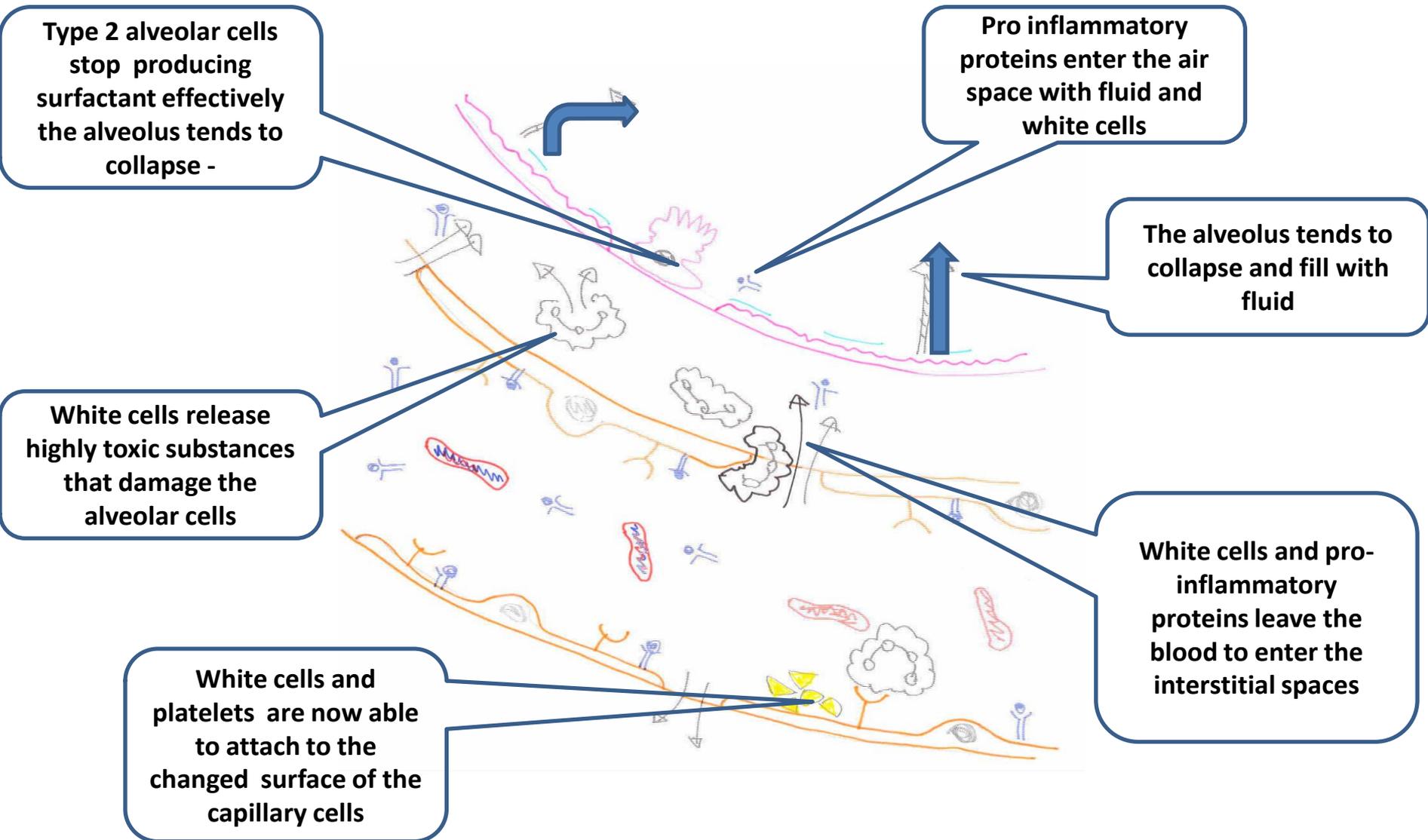
Tight junctions between capillary cells allow small molecules only to pass



# What are the processes involved in causing lung damage? 2. the first stages of ARDS



# What are the processes involved in causing lung damage? 3. developing ARDS



# What are the processes involved in causing lung damage?

## 4. Fibrotic stages of ARDS

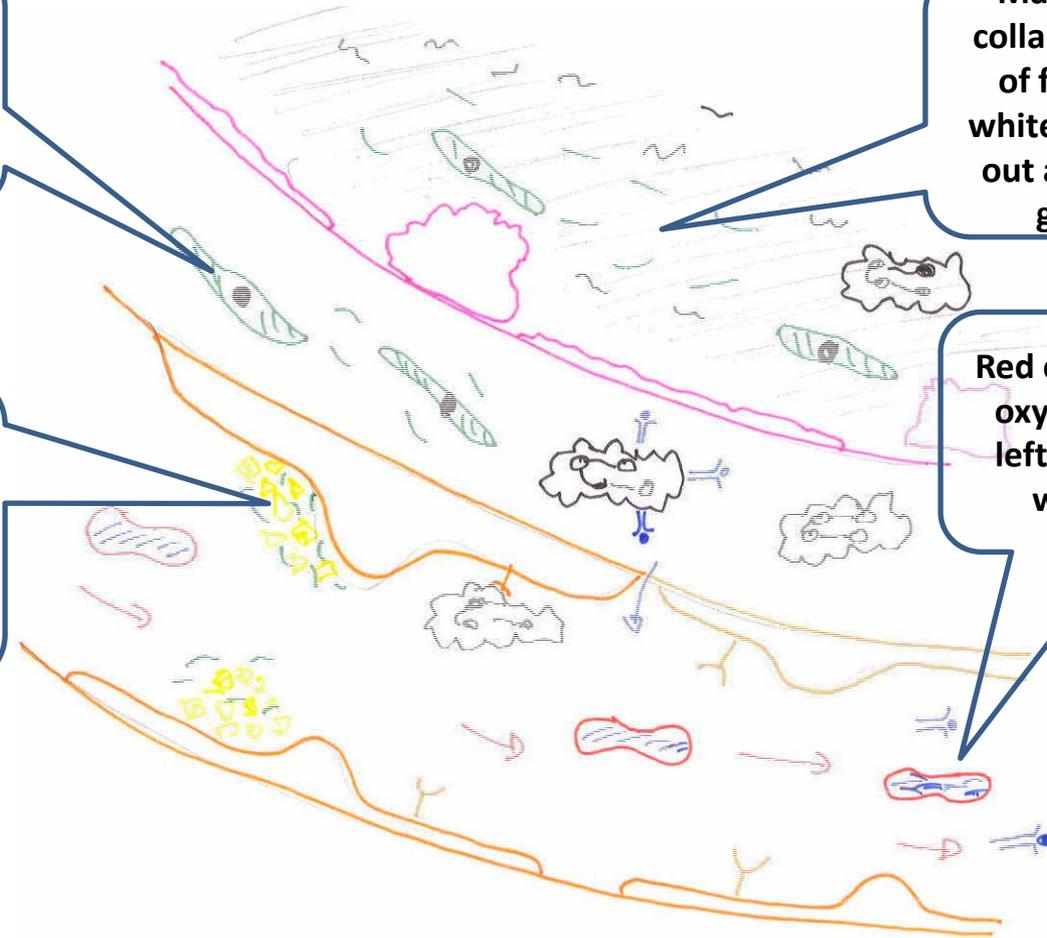
Fibroblasts enter the lung interstitial spaces and alveoli and start laying down fibrin

Many alveoli have collapsed and are full of fluid, fibrin and white cells so pushing out air and stopping gas exchange

Collections of platelets and fibrin start to block the capillary having collected on the surface; this increases pulmonary artery resistance

Red cells do not collect oxygen return to the left side of the heart without oxygen

The intense inflammatory reaction releases pro-inflammatory chemicals that can damage other organs



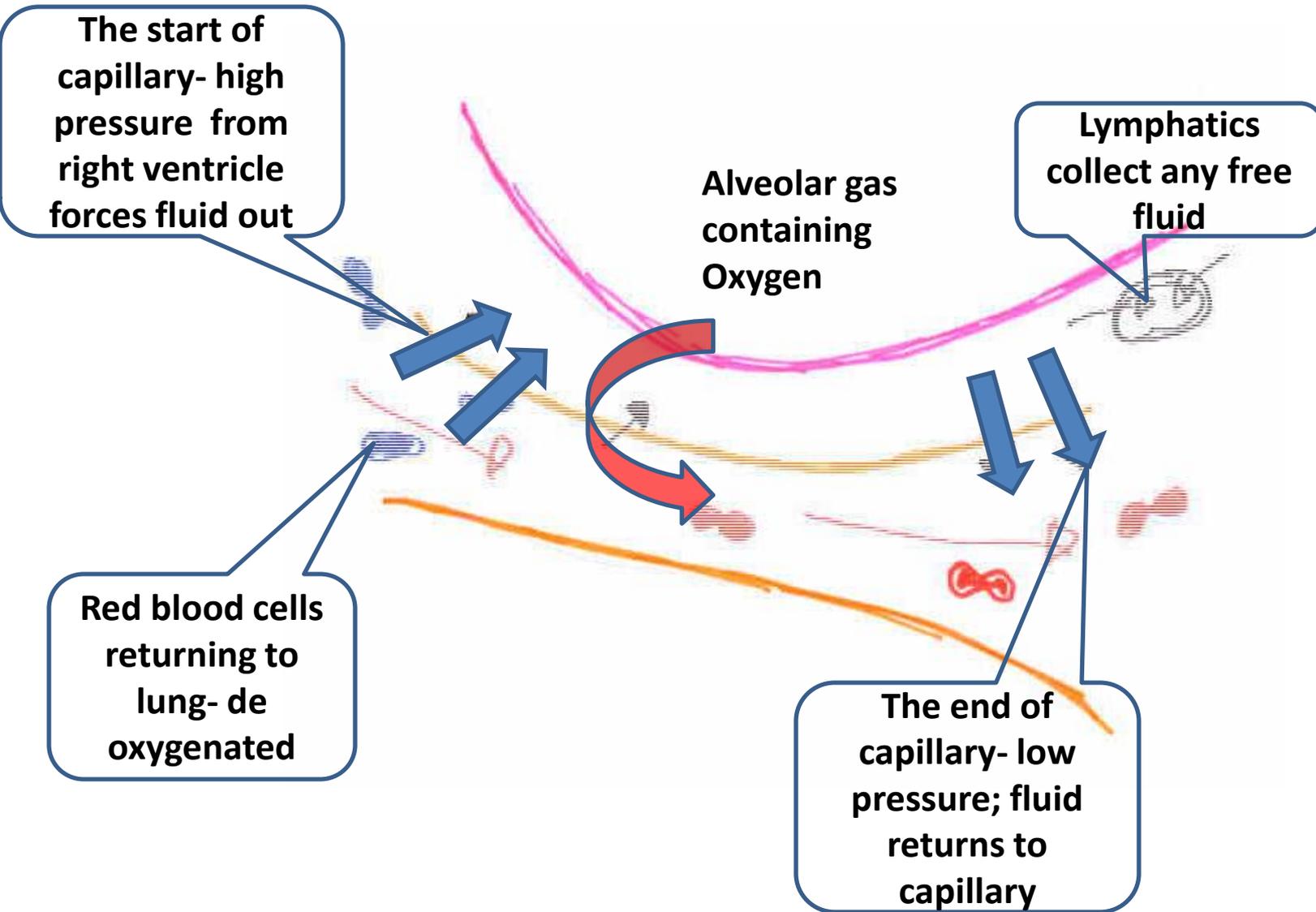


# The repair stages of ARDS

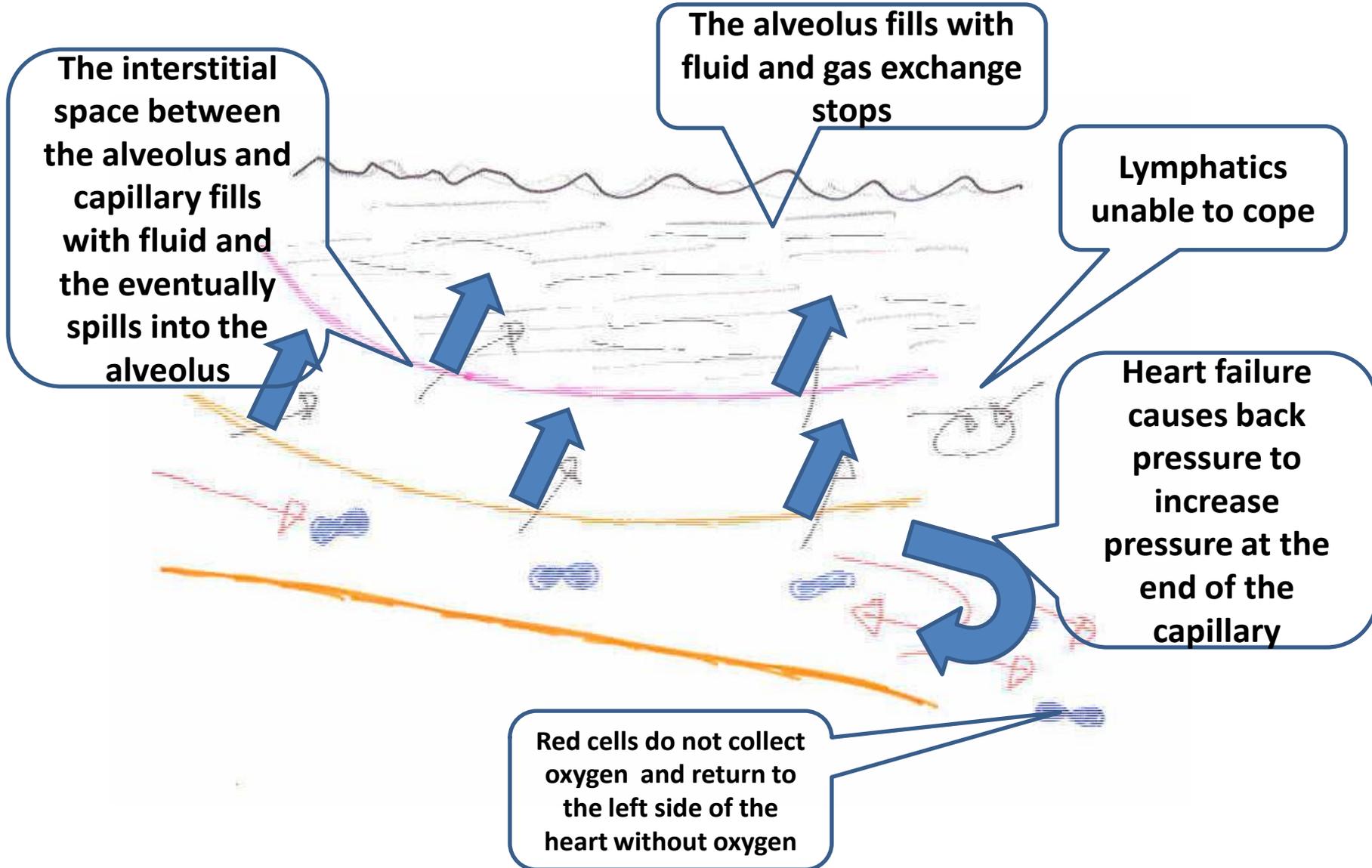


- Most patients recover from ARDS if the initial cause can be treated.
- Recovery is no more understood than the development of the disease.
- Messaging between cells continues to be important.
- Programmed apoptosis of pro-inflammatory cells is important.
- The fibrin deposits may act as a splint for new cell growth.
- We don't seem to be able to help this process but we can delay or stop it!

# Similarities and differences to left ventricular failure: normal



# Changes in heart failure



ARDS does not effect the whole lung in a uniform way- more effects in posterior parts



# Some effects on physiology

- Decreased lung volume- stiff lungs with reduced compliance
- Alveolar flooding and collapse- increased shunt and hypoxia.
- Increased pulmonary vascular resistance
- Increased dead space
- (See presentations on blood gases and ventilation basics for explanations of these terms)

# Definitions of ARDS

- It is important to define ARDS because:
  - This allows us to study it and try new treatments
  - We should diagnose ARDS in our patients when they have it- this is important because:
    - 1. ARDS looks like other things which may have specific treatments which we need to make sure are given to the correct patients.
    - 2. The way patients with ARDS are ventilated and managed is important to allow the disease to resolve- we need to make sure these patients are managed correctly and we won't if we don't make the diagnosis.
    - 3. We should be collecting audit data defining the outcome of our ARDS patients.

There is no blood test for ARDS so it is basically a clinical diagnosis supported by radiology. Recently a group of experts met in Berlin to draw up a list of diagnostic tools for ARDS.



# Acute Respiratory Distress Syndrome

## The Berlin Definition

JAMA. 2012;307(23):2526-2533

Published online May 21, 2012. doi:10.1001/jama.2012.5669

**Table 3.** The Berlin Definition of Acute Respiratory Distress Syndrome

Acute Respiratory Distress Syndrome	
Timing	Within 1 week of a known clinical insult or new or worsening respiratory symptoms
Chest imaging <sup>a</sup>	Bilateral opacities—not fully explained by effusions, lobar/lung collapse, or nodules
Origin of edema	Respiratory failure not fully explained by cardiac failure or fluid overload Need objective assessment (eg, echocardiography) to exclude hydrostatic edema if no risk factor present
Oxygenation <sup>b</sup>	
Mild	200 mm Hg < $P_{aO_2}/F_{iO_2} \leq 300$ mm Hg with PEEP or CPAP $\geq 5$ cm H <sub>2</sub> O <sup>c</sup>
Moderate	100 mm Hg < $P_{aO_2}/F_{iO_2} \leq 200$ mm Hg with PEEP $\geq 5$ cm H <sub>2</sub> O
Severe	$P_{aO_2}/F_{iO_2} \leq 100$ mm Hg with PEEP $\geq 5$ cm H <sub>2</sub> O

Abbreviations: CPAP, continuous positive airway pressure;  $F_{iO_2}$ , fraction of inspired oxygen;  $P_{aO_2}$ , partial pressure of arterial oxygen; PEEP, positive end-expiratory pressure.

<sup>a</sup>Chest radiograph or computed tomography scan.

# What does this mean?

- There has to be a clinical cause
- The pulmonary opacities are caused by fluid collecting in alveoli- future presentations will review radiological changes- they have to be distinguished from similar changes seen in heart failure
- The severity; mild, moderate or severe is defined by the degree of hypoxia- this is measured by the difference between the inspired and arterial oxygen levels

# Summary

- ARDS is a poorly understood disease
- It is caused by the bodies own immune response to an injury
- The response is determined by the injury and the way the body responds, this response varies for different patients
- The disease causes fluid to enter the alveoli, this makes the lungs stiff and opaque on radiology and causes poor gas exchange
- With correct treatment most patients get better if the original problem resolves
- Continuing inflammation in the lung can cause multiple organ failure
- It can be confused with other diseases

# Footnote

- I hope that you found the presentation interesting!
- Please email any feedback/comments to [tony.thomas@srft.nhs.uk](mailto:tony.thomas@srft.nhs.uk)
- If you need a certificate to show that you have viewed the presentation please email me- you will have to answer a couple of questions about the presentation!