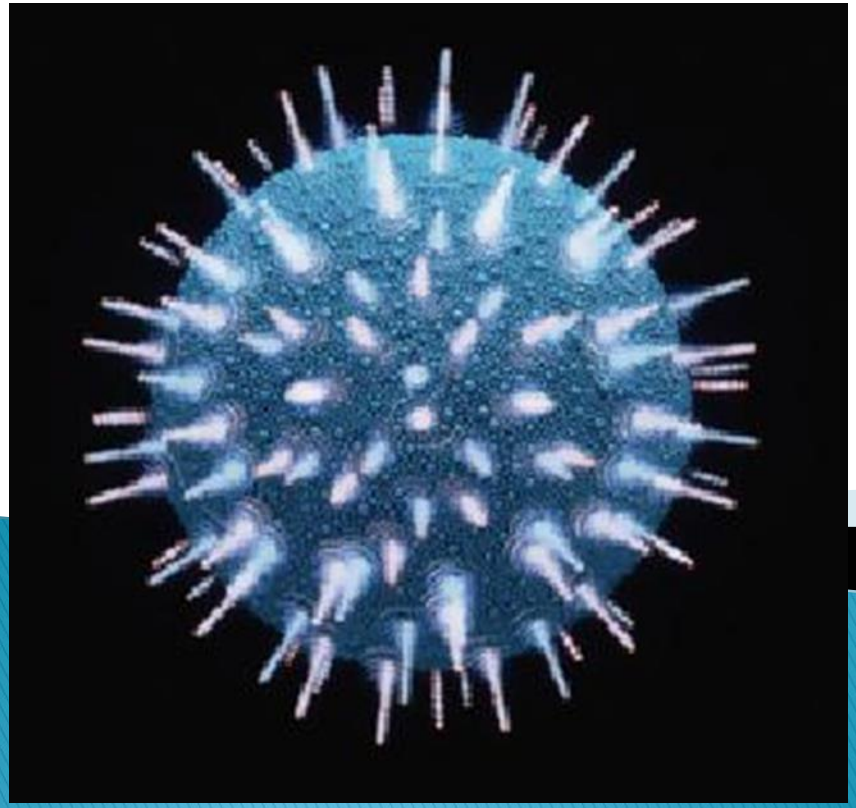
Viral Pneumonia



oregonaidshotline.wordpress.com

Viral pneumonia: Not just for kids!

Viral Pneumonia

- Viruses recently recognized as important pathogens in CAP due to improved diagnostic tests (PCR)
- Cause of 2 – 35% of CAP in adults (more in kids)
- Recent emergence of new viral respiratory pathogens

Marcos MA, Esperatti M, and Torres A. Viral pneumonia. Curr Opin Infect Dis 22:143–147
Falsey AR, Walsh EE. Viral pneumonia in older adults. Clin Infect Dis. 2006 Feb 15;42(4):518-24
Murray and Nadel's Textbook of Respiratory Medicine 5th Edition

Risk factors for viral PNA in adults

- Elderly: Higher rates of hospitalization and death from viral PNA in persons >60 yo
- COPD and asthma: frequently complicated by respiratory viral infections
- Immunocompromised pts at increased risk

Marcos MA, Esperatti M, and Torres A. Viral pneumonia. Curr Opin Infect Dis 22:143–147
Falsey AR, Walsh EE. Viral pneumonia in older adults. Clin Infect Dis. 2006 Feb 15;42(4):518-24

Risk factors for viral PNA in adults

Table 1. Factors that contribute to severe respiratory infections associated with aging.

Respiratory factors
Decreased respiratory muscle strength
Decreased protective mucous level
Decreased lung compliance
Decreased levels of elastin and collagen in alveolar ducts
Immune function
Cellular immunity
Decreased naive T cell count
Increased memory T cell count
Decreased T cell proliferation
Imbalance of Th1 and Th2 responses
Increased level of inflammatory mediators
Humoral immunity
Decreased B cell responses to new antigens
Increased autoantibodies
Innate immunity
Decreased NK cell cytotoxicity
Decreased NK cell response to IL-2
Increased TNF, IL-1, IL-6, and IL-8 levels

Falsey AR, Walsh E[illegible]viral pneumonia in older adults. Clin Infect Dis. 2006 Feb 15;42(4):518-24

Clinical syndromes

- Upper respiratory tract (cold, pharyngitis, bronchitis)
- Bronchiolitis: acute inflammatory disorder of small airways
  - obstruction with air trapping, hyperinflation, wheezing.
  - Most common < 2 yo
  - RSV most common, also human metapneumovirus, parainfluenza viruses, influenza A and B viruses, adenoviruses, measles virus, and rhinovirus
- Pneumonia
  - Similar presentation to bacterial PNA

Murray and Nadel's Textbook of Respiratory Medicine 5th Edition

Diagnosis

- Nasal swab specimens, nasal aspirates, or combined nose and throat swab specimens.
- Sputum, endotracheal aspirate samples, or BAL
- Rapid antigen detection, viral culture and PCR methods

Specific viral pathogens

***Panel*: Viruses linked to community-acquired pneumonia in children and adults**

- Respiratory syncytial virus
- Rhinovirus
- Influenza A, B, and C viruses
- Human metapneumovirus
- Parainfluenza viruses types 1, 2, 3, and 4
- Human bocavirus*
- Coronavirus types 229E, OC43, NL63, HKU1, SARS
- Adenovirus
- Enteroviruses
- Varicella-zoster virus
- Hantavirus
- Parechoviruses
- Epstein-Barr virus
- Human herpesvirus 6 and 7
- Herpes simplex virus
- Mimivirus
- Cytomegalovirus†
- Measles†

*Mostly in children. †Mostly in developing countries.

Ruuskanen et al. Viral pneumonia. Lancet. 2011 Apr 9;377(9773):1264-75

Influenza

- Annual winter epidemics x 6-8 wks (year round in tropics)
- Transmitted by small particle aerosols
- 2-3 day incubation period
- Max virus shedding is at onset of illness, continues for 5 to 7 days

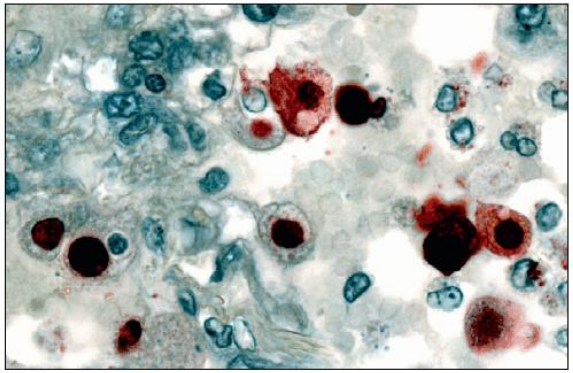


Figure 3: Immunolocalisation of 2009 pandemic influenza H1N1 viral antigen in lung tissue
Viral antigens (red staining) are present in nuclei of alveolar-lining cells. Reprinted from reference 132 with permission of the American Society for Investigative Pathology.

Ruuskanen et al. Viral pneumonia. Lancet. 2011 Apr 9;377(9773):1264-75

Murray and Nadel's Textbook of Respiratory Medicine 5th Edition

Falsey AR, Walsh E... viral pneumonia in older adults. Clin Infect Dis. 2006 Feb 15;42(4):518-24

Influenza

- Most common cause of viral PNA in adults
- family Orthomyxoviridae, Type A,B,C
- 2 envelope glycoproteins, Antigenic variation in H and N leads to epidemic nature
  - Hemagglutinin (H) initiates infectivity- binds to cell
  - Neuraminidase (N) protein cleaves new virus allowing spread

Falsey AR, Walsh [illegible] Viral pneumonia in older adults. Clin Infect Dis. 2006 Feb 15;42(4):5

Influenza

- Influenza pandemics occur when new viruses are introduced into the population
- Historic pandemics of 1918 (H1N1- 50 million deaths worldwide), 1957 (H1N1 and H2N2), 1968 (H3N2)
- Avian influenza H5N1 – 1997 outbreak, 58% with PNA
- Novel H1N1 influenza A virus emerged in Mexico and USA in Spring 2009
  - High risk populations: infants, young kids, healthy adults 20-40s, pregnant/postpartum women, immunocompromised, obesity, DM, COPD, asthma
  - Elderly less susceptible to H1N1 due to prior exposure
  - Mortality in hospitalized pts 7% -17%

Murray and Nadel's Textbook of Respiratory Medicine 5th Edition

Influenza

- Each year, 300,000 hospitalizations (63% in >65 yo), and 36,000 deaths (85% in >65 yo) due to influenza
- 30% of pts hospitalized for influenza have CXR infiltrates
- secondary bacterial PNA in ? ~10%

Falsey AR, Walsh E... viral pneumonia in older adults. Clin Infect Dis. 2006 Feb 15;42(4):518-24

Influenza

Clinical manifestations

- Acute onset fever, chills, dry cough, dyspnea,
- Pharyngeal pain, nasal congestion
- HA, myalgias, malaise, anorexia, GI sxs
- Altered mental status (more in older persons)

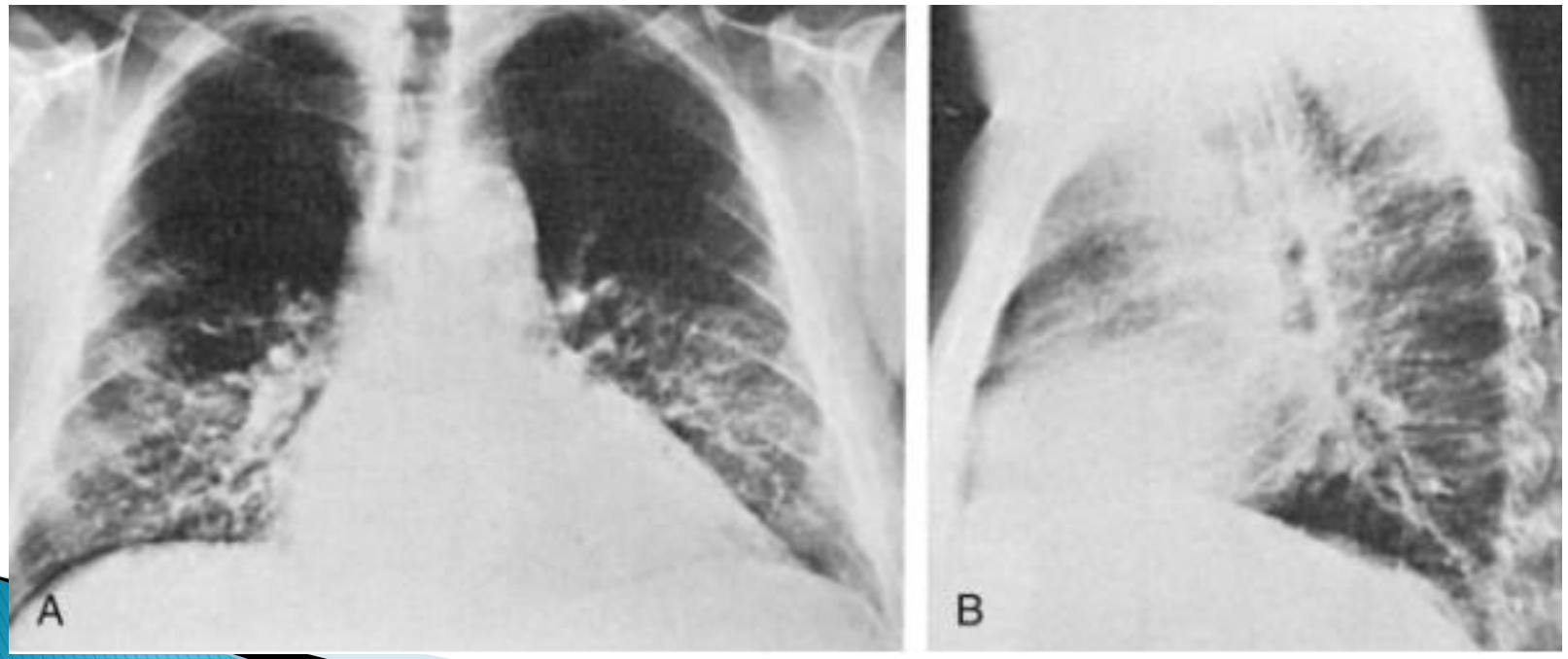
Murray and Nadel's Textbook of Respiratory Medicine 5th Edition

Falsey AR, Walsh E... viral pneumonia in older adults. Clin Infect Dis. 2006 Feb 15;42(4):518-24

Influenza

Imaging

- CXR may have bilateral reticulonodular infiltrates, sometimes lower zone predominant



Murray and Nadel's Textbook of Respiratory Medicine 5th Edition

Influenza

- Secondary bacterial PNA
  - Mst common in elderly, or underlying pulm or cardiac dz
  - Period of improvement followed by increased cough, sputum production, and consolidation
  - Mst common Strep pneumo, then S. aureus and Grp A Strep

Treatment of Influenza

Vaccines:

- Inactivated virus vaccines: inactivated purified virions or partially purified HA and NA preparations
  - Efficacy 70% to 90% in healthy adults/children if good antigenic match
- Live, attenuated vaccine
  - More effective in children
  - In adults equal or less effective than inactivated vaccine
  - Contraindicated in pregnant or immunosuppressed

Treatment of Influenza

Antivirals

- reduce severity and duration of illness
- M2 inhibitors (M2Is) amantadine and rimantadine
  - Only influenza A
- Neuraminidase inhibitors (NIs) oseltamivir and zanamivir
  - both influenza A and B

Available treatment for influenza

Table 4. Administration characteristics of influenza antivirals and associated adverse effects.

Antiviral	Activity	Route of administration	Dosage (5 days)	Adverse effects
Amantidine	Influenza virus A	Oral	100 mg/day[a]	CNS and gastrointestinal events
Rimantadine	Influenza virus A	Oral	100 mg/day	Mild CNS and gastrointestinal events
Zanamivir	Influenza viruses A and B	Inhaled	2 Inhalations twice/day	Bronchospasm
Oseltamivir	Influenza viruses A and B	Oral	75 mg twice/day[a]	Mild gastrointestinal events

[a] Dosage adjustment required with renal dysfunction.

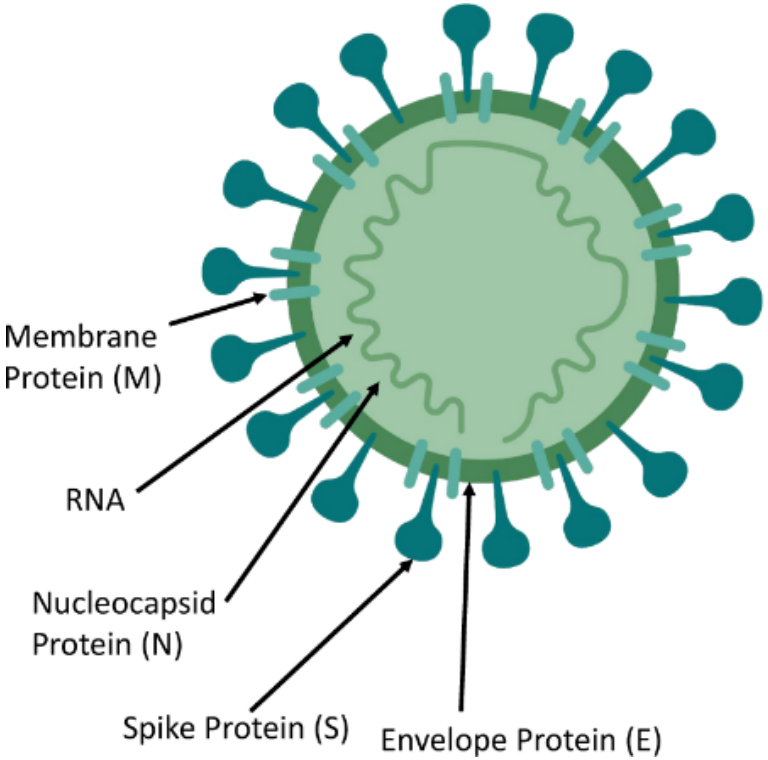
Falsey AR, Walsh E... viral pneumonia in older adults. Clin Infect Dis. 2006 Feb 15;42(4):518-24

Respiratory syncytial virus (RSV)

- 2nd most common cause of viral PNA in older adults
- Common in winter (November – April, peak Jan-Feb)
- Major cause of serious lower respiratory tract infections in young children
  - Primary RSV infection is nearly universal by age 2 and repeat infections are common due to incomplete immunity.
- Also important pathogen in adults, esp elderly, chronic lung disease, or immunocompromised
- Approx 10,000 deaths in persons > age 65 in the United States each year from RSV (2nd to influenza)

Falsey A. Respiratory Syncytial Virus Infection in Adults. Semin Respir Crit Care Med. 2007;28(2):171-181

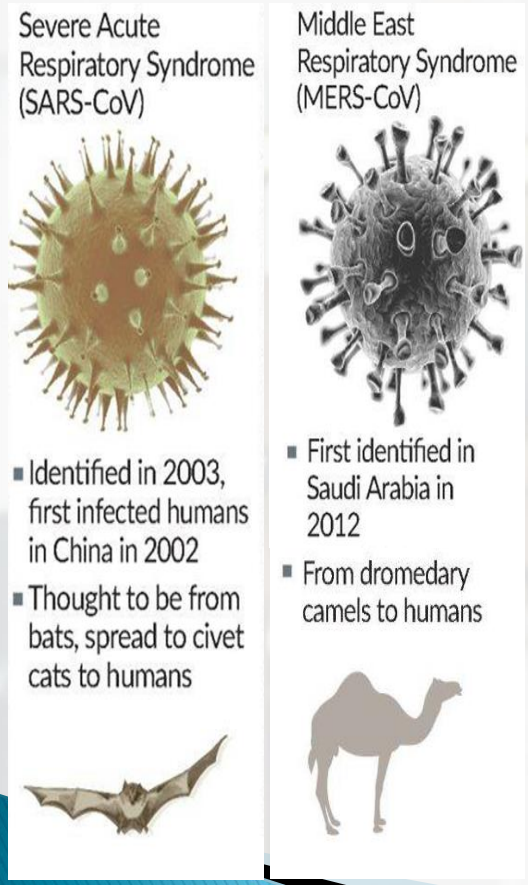
Coronavirus



Structural Protein	Function of Protein
Nucleocapsid Protein (N)	• Bound to RNA genome to make up nucleocapsid
Spike Protein (S)	• Critical for binding of host cell receptors to facilitate entry of host cell
Envelope Protein (E)	• Interacts with M to form viral envelope
Membrane Protein (M)	• Central organiser of CoV assembly • Determines shape of viral envelope

- It has been noted that some CoVs do not need to have the full ensemble of structural proteins to make virions, highlighting that certain proteins may be dispensable or compensated by the function of non-structural proteins.

Coronavirus Emergence



- Coronaviruses are a large family of viruses that are known to cause illness ranging from the common cold to more severe diseases such as **Middle East Respiratory Syndrome (MERS)** and **Severe Acute Respiratory Syndrome (SARS)**.
- **2019-novel coronavirus** (COVID-19) was identified in Wuhan, China. This is a new coronavirus that has not been previously identified in humans.

COVID-19

- The virus that causes COVID-19 is known as SARS-CoV-2
  It appears to have first emerged in Wuhan, China, in late 2019.
- The outbreak has since spread across China to other countries around the world. By the end of January, the new coronavirus had been declared a public health emergency of international concern by the WHO.
- The most commonly reported symptoms include a fever, dry cough and tiredness, and in mild cases people may get just a runny nose or a sore throat.
- In the most severe cases, people with the virus can develop difficulty breathing, and may ultimately experience organ failure. Some cases are fatal.
- The virus causes Acute Respiratory Distress Syndrome (ARDS).

ACUTE LUNG INJURY
ACUTE RESPIRATORY DISTRESS $

ALI/ARDS is a clinical devastating syndrome that affects both medical and surgical patients.

Despite great advances in understanding the pathogenesis of disease, mortality rate is still high.

Mortality rates ranges between 40-60%, although some trials had demonstrated lower mortality rates

The Berlin definition of acute respiratory distress syndrome

Timing	Within 1 week of a known clinical insult, a new or worsening respiratory symptoms
Chest imaging[a]	Bilateral opacities — not fully explained by effusions, lobar/lung collapse, or nodules
	Respiratory failure not fully explained by cardiac failure or fluid overload.
Origin of edema	Need objective assessment (e.g., echocardiography) to exclude hydrostatic edema if no risk factor present
Oxygenation[b]	the patient's oxygen in arterial blood (PaO2) to the fraction of the oxygen in the inspired air (FiO2). These patients have a PaO2/FiO2 ratio of less than 300.

Clinical disorders associated with development of ALI/ARDS

- **Direct(Pulmonary)**

Common

- Aspiration of gastric fluids
- Pneumonia

Less Common

-Inhalation injury
-Pulmonary contusion
 -Fat embolism
-Near Downing

Indirect(Extra pulmonary)

- **Common**
- Sepsis
- Severe trauma with prolonged hypotension
- Multiple Fractures

- **Less Common**
- Acute pancreatitis
- Cardiopulmonary by pass
- Drug overdose
- DIC
- Burn
- Head injury

Direct	Indirect
Pneumonia	Non-pulmonary sepsis
Aspiration of gastric contents	Major trauma
Inhalational injury	Pancreatitis
Pulmonary contusion	Severe burns
Pulmonary vasculitis	Non-cardiogenic shock
Drowning	Drug overdose
	Multiple transfusions or transfusion associated acute lung injury (TRALI)

Clinical picture

- dyspnea and hypoxemia,
- progressively worsens within hours to days, frequently requiring mechanical ventilation and intensive care unit–level care.
- The physical examination :
- Tachypnea and signs of respiratory distress
- Tachycardia, cyanosis, altered mental status
- Chest auscultation usually reveals rales, especially bibasilar

Complication

- Nosocomial pneumonia
- Multiple organ failure
- Deep venous thrombosis
- Gastrointestinal bleeding

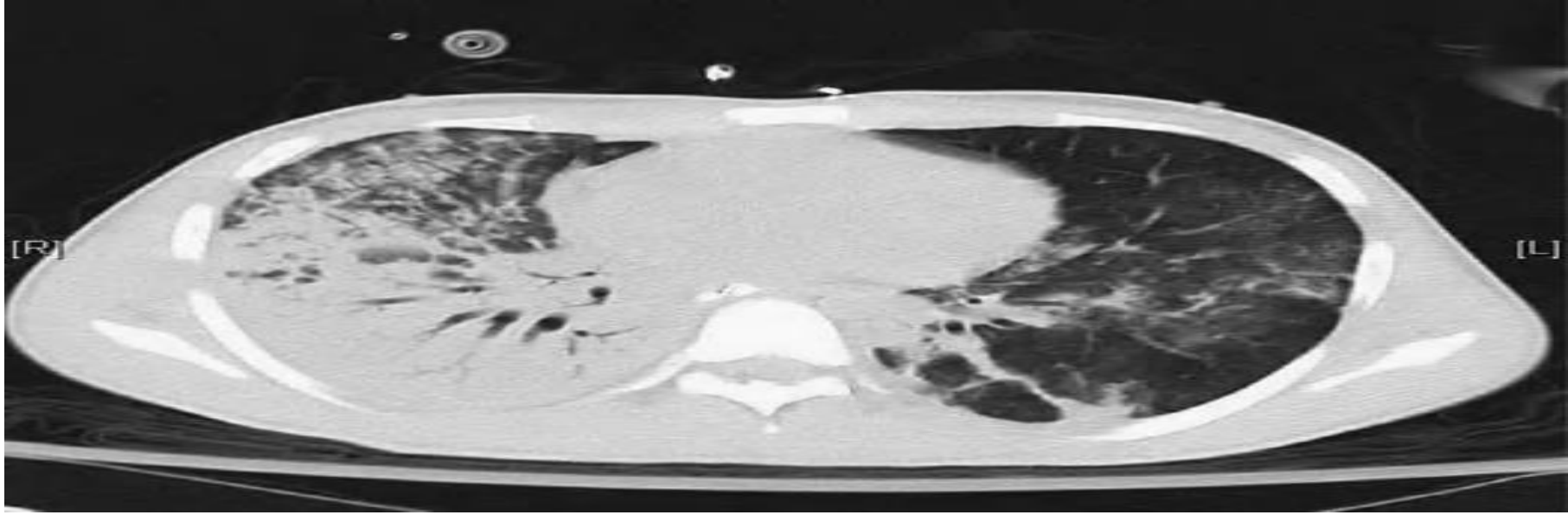
Pathology of ALI/ARDS

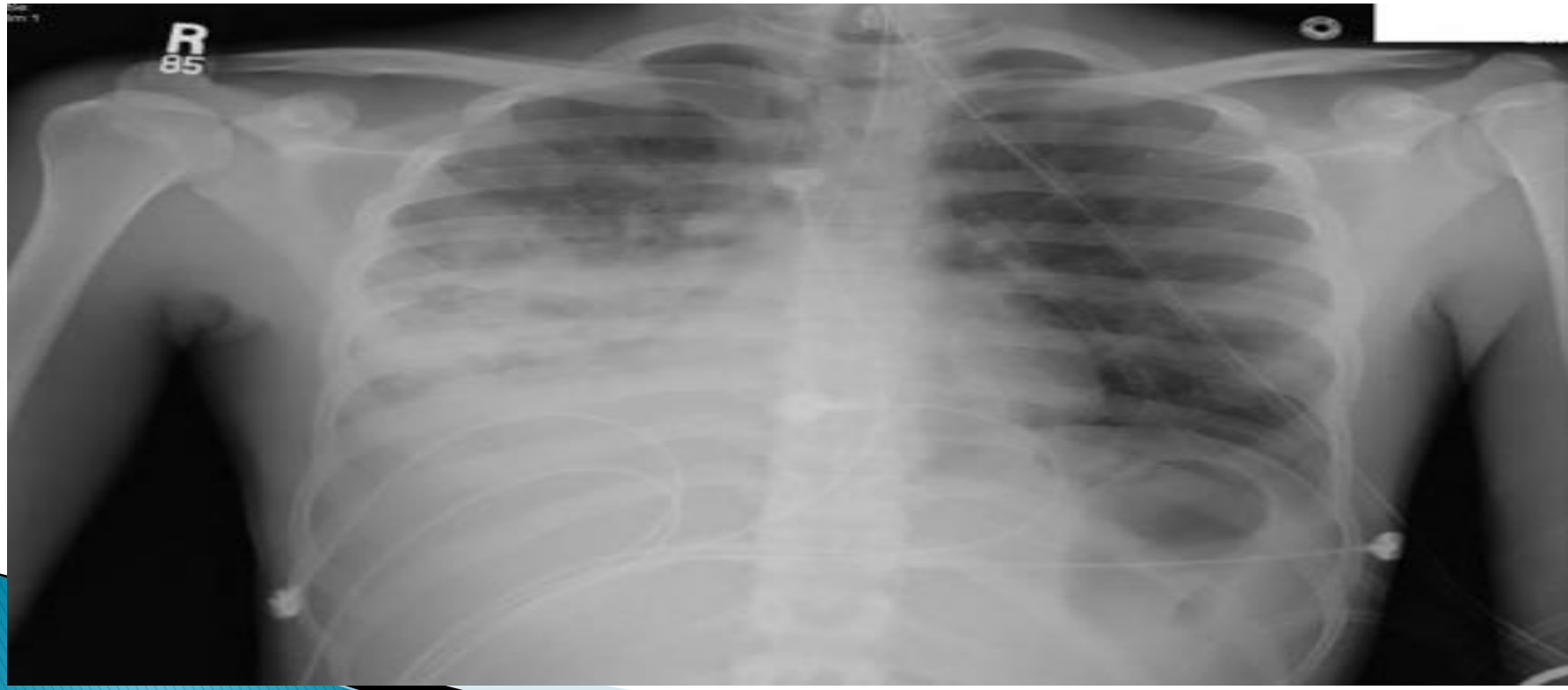
The pathological features of ARDS are typically described as passing through three overlap

- Exudative phase.
- proliferative phase.
- Fibrotic phase.

High Permeability (non cardiogenic) pulmonary edema

- Disrupted alveolar-capillary membrane
- Membrane allows fluid to leak into the interstitial space
- Widened interstitial space impairs diffusion


[R]
[L]


R
85

Investigation

- Chest-x ray: New, bilateral, diffuse, patchy or homogenous pulmonary infiltrate (pulmonary edema).
- Arterial blood gas: severity of hypoxemia.
- Echocardiography: exclude cardiogenic pulmonary edema
- Computed tomography: identify pulmonary cause; pneumonia or lung abscess or complication; pneumothorax , pleural effusion.

Investigations in patients with ALI or ARDS

Chest radiography: New, bilateral, diffuse, patchy, or homogeneous pulmonary infiltrates consistent with pulmonary oedema define both conditions.

Arterial blood gases: Indicate severity of hypoxaemia, defining acute lung injury and acute respiratory distress syndrome

Echocardiography: Helps to differentiate acute lung injury from cardiogenic pulmonary oedema

Computed tomography: Aids identification of pulmonary causes of acute lung injury (such as pneumonia, lung abscess) and detection of complications such as pneumothoraces and pleural effusions

Fibreoptic bronchoscopy with bronchoalveolar lavage: Helps to exclude infection, particularly in patients who are not improving despite treatmen

Therapeutic strategies

Treatment of patients with acute lung injury is essentially supportive, coupled with aggressive management of the precipitating condition.

- ✓General supportive measures
- ✓Ventilatory treatment
- ✓Nonventilatory treatments

- Nutrition
- Fluid therapy
- Corticosteroid
- Inhaled NO
- Exogenous surfactant
- Lung protective ventilatory strategy

THANK YOU