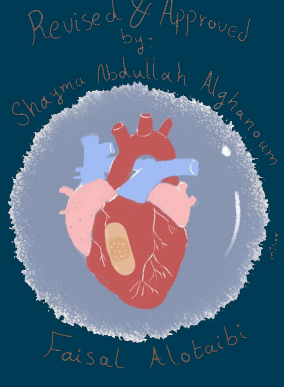
Hospital-Acquired Pneumonia

TEAM 439
MICROBIOLOGY



VERSION 1

Objectives

- Define the terms, pneumonia, community acquired pneumonia, health care associated pneumonia (HCAP) and ventilator associated pneumonia (VAP).
- Describe the pathogenesis of the health care associated pneumonia (hospital associated pneumonia) and VAP.
- Classify HCAP according to the time of onset
- Name the different causative bacterial agents .
- Classify and describe types of VAP.
- Recognize the ways by which VAP is prevented.
- Describe the different chemotherapeutic anti microbial agents used for the treatment of health care associated pneumonia.
- Evaluate response to treatment and recognize reasons for failure of treatment.

Colour index:

Red: Important & Doctor's notes.

Grey: Extra info & explanation.

Purple: Only in girl's slides.

Orange: Only in boy's slides.

Green: Lecture notes

Any future corrections will be in the editing file, so please check it frequently.

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Health Care Associated Pneumonia

Community Acquired Pneumonia

Acquired in the community, by community acquired organisms.
e.g .Streptococcus pneumoniae
It is usually susceptible to antibiotics.
(if the patient acquired pneumonia before 48 hrs it is CAP)

Types of Pneumonia

(Infection of the pulmonary parenchyma)

Health care Associated pneumonia

Acquired **48-72 hours after admission** to health care institutions eg. pneumonia caused by organisms in hospital which are usually resistant to antibiotics -
eg. Pseudomonas aeruginosa

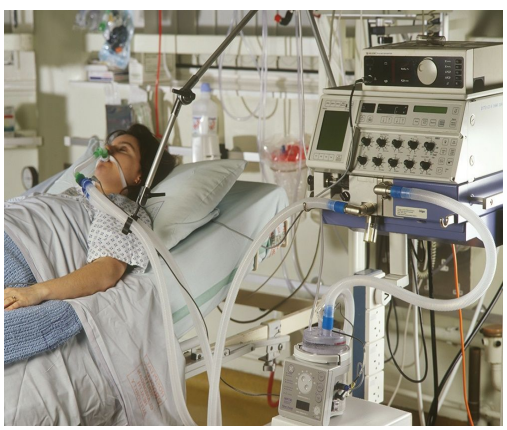
Introduction to HAP

Definition of Nosocomial Pneumonia	❖ Hospital associated pneumonia (HAP) or health care associated pneumonia (HCAP). Nosocomial means related to hospital.
When does occurs ?	❖ At least **48 hours** after admission and not incubating at the time of hospitalization.
How severe is it ?	❖ **Nosocomial pneumonia (HAP)** is the **2nd most common** hospital-acquired infections after urinary tract infection. Accounting for 31 % of all nosocomial infections ❖ Nosocomial pneumonia is the leading cause of death from hospital-acquired infections. ❖ The incidence of nosocomial pneumonia is **highest in ICU** (intensive care unit) patients.* ❖ It is more severe than CAP because patient are usually more sick and their immunity is worse. Also the fact that organisms in the hospital are more resistant such as MRSA.
Symptoms	Dyspnea, fever, cough. etc..

*Why? Because usually they are very sick so they can't move a lot less so their lung function could decrease & their lung capacity could decrease this could result in atelectasis which increases risk of infection

Intensive Care Unit (ICU)

- ❖ The incidence of nosocomial pneumonia in ventilated patients is **10-fold higher** than non-ventilated patients
- ❖ The reported crude mortality for HAP **is 30% to greater than 70%.**



Pathogenesis of HAP

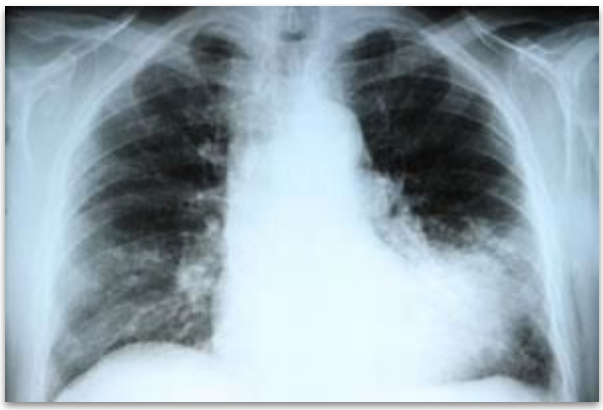
For pneumonia to occur, **at least one of the following three conditions must occur:**

1. Significant impairment of host defenses
   Innate or humoral
2. Introduction of a sufficient-size inoculum to overwhelm the host's lower respiratory tract defenses
3. The introduction of highly virulent organisms into the lower respiratory tract

Most common way of transmission is by **microaspiration** of **oropharyngeal secretions** colonized with pathogenic bacteria.

Microaspiration: saliva goes to the lung.

It is rarely inhaled as large droplets.

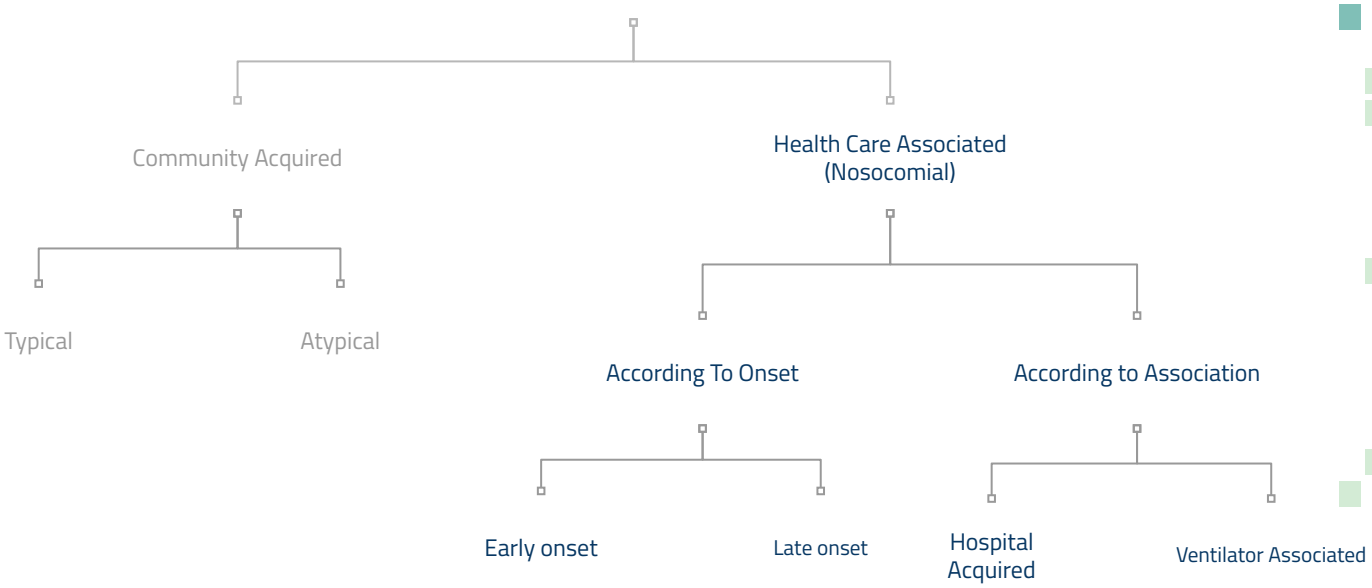


Symptoms of HAP might be; dyspnea (shortness of breath), cough, fever.

Classification of HAP, according to onset.

	Early-onset Nosocomial Pneumonia	Late-onset Nosocomial Pneumonia
Time	Occurs during the **first 4 days** of admission.	Occurs **more than 4 days** of admission.
Overview	Usually similar to CAP.	Includes more Gram -ve bacteria & more resistant bacteria.
Causative Organisms	Usually is due to S. pneumoniae	More commonly by **Gram negative organisms**, especially: **P.aeruginosa, Acinetobacter**
	MSSA (Methicillin **sensitive** S.aureus)	MRSA. (Methicillin **resistant** S.aureus)
	H. Influenza & Anaerobes	Enterobacteriaceae (enteric bacteria e.g Klebsiella , Enterobacter, Serratia)

Pneumonia



Ventilator-associated pneumonia (**VAP**) is a type of lung infection that occurs in people who are on mechanical ventilation breathing machines in hospitals.

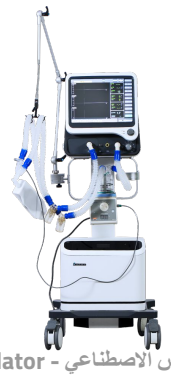
Hospital-acquired pneumonia (**HAP**) or nosocomial pneumonia refers to any pneumonia contracted by a patient in a hospital at least 48–72 hours after being admitted.

Causative Organisms of HAP & VAP

Pseudomonas aeruginosa Gram-negative, rod shaped, nonfermentative, oxidase +ve.	★ Common causes of late-onset pneumonia, **particularly in ventilated patients.**
Acinetobacter Gram-negative, rod shaped, non-sugar fermenting, oxidase -ve.	
Enterobacteria Enteric Gram negative bacilli e.g. (Escherichia, Enterobacter, Serratia)	Isolated most frequently particularly in patients with late-onset disease and in patients with serious underlying disease often already on broad-spectrum antibiotics. (Prior use of broad-spectrum antibiotics and an immunocompromised state make resistant Gram-negative organisms more likely.)
Staph. Aureus في البداية تكون MSSA بس بعدين يكتسب المريض بكتيريا MRSA مقاومة أكثر وتصير يعني تكون بالـEarly وبالـLate onset بعد	Isolated in about 20~40% of cases and is particularly common in: 1. Ventilated patients after head **trauma**, **neurosurgery**, and wound infection 2. In patients who had received prior antibiotics or Prolonged care in ICU **MRSA** is seen more commonly in patients who: ❖ **Received corticosteroids** as they suppress the immune system ❖ **Undergone mechanical ventilation for more than 5 days** (The longer the incubation period, the higher the risk of getting more resistant organisms) ❖ Presented with chronic lung disease ❖ Had prior antibiotics therapy
Anaerobes (Not a common or important cause)	❖ Common in patients predisposed to aspiration. (VAP) ❖ VAP with anaerobes occurred more often with oropharyngeal intubation than nasopharyngeal intubation. أنبوب التنفس ممكن يكون مدخلينه من الأنف nasopharynx وممكن يكون مدخلينه من الفم و oropharynx، إذا كان من الفم احتمالية الـ anaerobes تزيد لأن الـoropharynx مليان anaerobes بصوت بروف حنان: زاكرو ياخاييييين #FoundationRecap

Ventilator Associated Pneumonia (VAP)

Nosocomial pneumonia that has developed in **patient who are receiving mechanical ventilation**. (Ventilation is Tracheal intubation : tube through the trachea which complicates the intubation process)



Ventilator - جهاز التنفس الاصطناعي

Pathogenesis of VAP

1

Mechanical ventilation **prevents mechanical clearance** by cough and the mucociliary escalator.

2

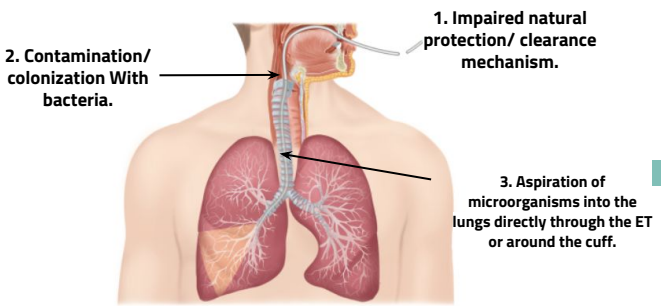
Bacterial colonization of the aerodigestive tract.

3

Aspiration of **contaminated** secretion into the Lower airway (Microaspiration)

Note: If the patient needs increased ventilation support (e.g. increased tidal volume) then this is a clear sign of VAP and we need x-ray to confirm it (infiltrate).

اذا صار المريض يحتاج فنتليشن أقوى يعني أن عنده مشكلة ولازم ناخذ أشعة ونشوف فيه infiltrate ولا لا



1. المريض ما يقدر يبلع أو يكح بالتالي 2. تتكاثر البكتيريا بالمكان وتفرز حاجات، وبعدها 3. يتنفس المريض هذه الإفرازات اللي ما قدر يتخلص منها.

Classification of VAP

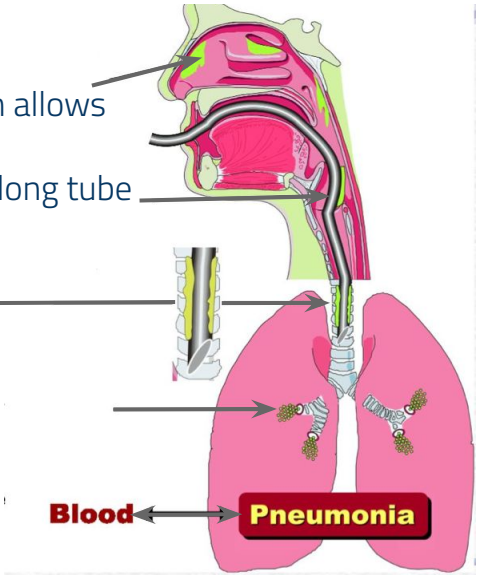
	Early-onset	Late-onset
Time	Within **48-72** hrs after tracheal intubation	After **72** hrs of tracheal intubation
Note	We start counting the days of The onset of the disease from the tracheal intubation, not from the admission to the hospital.	
Causative Organisms	Same as HAP	

Source of Infection: endogenous VS. exogenous

1. Endogenous: من المريض نفسه

Source of microorganisms:

- **Impaired natural protection**/ clearance system allows increased colonization of nasopharynx.
- **Colonized oropharynx and gastric fluid** pool along tube in neonates.
- **Colonized tracheal secretions.**



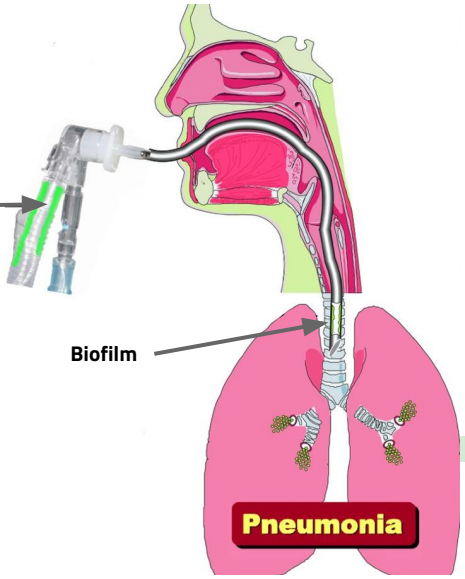
Mechanism of Pneumonia:

- Aspiration of colonized fluids any of the above sources Into the lungs can result in pneumonia.
- A hematogenous sources seeding the lungs may **rarely** cause pneumonia.

2.Exogenous: من المستشفى أو الكادر الطبي

Source of microorganisms:

- Hands of health care worker.
- Ventilator circuit. دائرة جهاز التنفس الاصطناعي نفسها ملوثة
- Biofilm of endotracheal tube.



Biofilm : Thin layer from the secretion of the organism will cover the tube so it will be colonized with a lot of bacteria and aspirated, this protects the bacteria from antibiotics & the immune system.

Mechanism of Pneumonia:

Pneumonia occurs when colonized secretions are inhaled into the lungs through the endotracheal tube.

Prevention for VAP

1 Non-Pharmacologic Strategies

- **Effective hand washing** and use of protective gowns and gloves.
- Semirecumbent positioning. يكون المريض نصف جالس
- Avoidance of large gastric volume. يعطى وجبات صغيرة
- Oral (non-nasal) intubation. Colonization لانه راح يمنع ال
- Continuous subglottic suctioning. يتم شفط الإفرازات لدى المريض لمنع تراكمها
- Humidification with heat and moisture exchanger. ترطيب الهواء حول المريض باستخدام مرطبات الجو
- Posture change. تغيير وضعية المريض باستمرار

2 Pharmacologic Strategies

- Avoiding stress-ulcer prophylaxis. Patients in ICU are in risk of ulcer. They can be given prophylaxis to reduce stomach ph, but the problem is that this would increase the risk of infection.
- Prophylactic antibiotic therapy.
- Chlorhexidine (oral rinse). Disinfects the oral secretion from Gram +ve mainly staphylococcus aureus.
- Prophylactic treatment of neutropenic patients.
- Vaccines.

3 Oral Regimen

- Topical **Gentamicin, Colistin, Vancomycin** cream (given every 6h for 3 weeks) treating oropharyngeal colonization could prevent VAP.

غالباً تعطى هذه المضادات الحيوية I.V. Or I.M. لل normal individual ، لانه ما يتم امتصاصها بالمعدة، فهنا استخدموا هذه الخاصية وعملوا منها كريم عشان يأثر بشكل موضعي مو systemically. ويقلل عدوى البكتيريا في ال oropharynx

Treatment

Most initial **therapy is empiric** because no pathogen is identified or **results are not available** when antimicrobial decisions are made in most patients.

sputum sample ناخذ
وتشخيص HAP اصعب من تشخيص CAP

Initially be treated with a broad- spectrum antibiotic regimen aimed at covering all likely bacterial pathogens.

لذلك في البداية، وخلال انتظار الفحص لاكتشاف هل المريض عنده pneumonia ، نبدأ empirical antibiotic واللي يغطي Gram +ve and -ve حتى ننتظر نتيجة الفحص للعينة.

This regimen **should subsequently be narrowed**, according to the result of culture.

لما تطلع نتيجة العينة نبدأ نضيق نطاق ال antibiotic حسب نتيجة العينة.

The pathogen may be influenced by:

- Coexisting illnesses, prior treatment, length of hospitalization.
- The frequency of ICU-acquired P. aeruginosa carriage or colonization/infection was 23.4% at 7 days and 57.8% at 14 days.
- The mortality can be reduced with early appropriate empiric therapy. (Form 30% with appropriate therapy to more than 90 % with inappropriate therapy) .

Treatment, contd..

1. **Cefepime.**
   A fourth-generation cephalosporin, has a broad spectrum.

2. **Piperacillin-tazobactam.** (The go-to drug)
   A combination of the antibiotic piperacillin, and the β-lactamase inhibitor tazobactam.

3. **Meropenem.** (in case of resistance)
   A broad-spectrum carbapenem antibiotic.

4. **Levofloxacin.**
   A broad spectrum antibiotic of the fluoroquinolone drug class.

5. **Vancomycin** (used with above drugs).
   Used when there is a risk of MRSA or more severe infections.

Response to Therapy:

If no clinical response is noted or deterioration occurs, we need to consider:

- **Infectious causes:**
  - Resistant pathogen. so we need to check the susceptibility
  - Superinfection. تجيه عدوى ثانية بالإضافة للعدوى اللي عنده
  - Unusual pathogens. For example, Legionella
  - Lung abscess.
  - Extrapulmonary infection. infection other than the lung, e.g. viral

- **Non infectious events:**
  - Heart: congestive heart failure (CHF).
  - Lung: fibroproliferative acute respiratory distress syndrome (ARDS), pulmonary emboli, Atelectesis.

Summary

Check our summary by clicking here

SAQ

SAQ1: A 50 year old is admitted to the hospital. 3 days later she develops cough, fever & shortness of breath. An chest radiograph showed chest infiltrates. A culture shows gram +ve cocci in clusters. A) What is the most probable diagnosis? B) Describe the onset? C) Most likely causative agent?

SAQ2: After surgery a patient was sent to the ICU and put on mechanical ventilation. A week later he developed a fever & x ray showed infiltrates. The patient also required increased ventilation. A sputum culture showed gram -ve, bacilli, oxidase -ve, non-fermenter. A) What is the most probable diagnosis? B) Describe the onset? C) Most likely causative agent?

SAQ3: A 36-year-old woman is brought to the emergency department for seizures that began 10 minutes prior to presentation with no clear precipitating cause. On physical exam, the patient is having a generalized tonic-clonic seizure. She is administered lorazepam and a second intravenous line is obtained for fosphenytoin, but the seizures do not abort. The patient is intubated, given propofol, and is admitted to the medical intensive care unit. On hospital day 4, the patient is difficult to wean from anticonvulsants and remains intubated. Her temperature is 101°F (38.9°C), blood pressure is 138/99 mmHg, pulse is 101/min, and respirations are 19/min with an oxygen saturation of 89% on room air. Physical examination is notable for crackles on the right anterior chest and a chest radiograph demonstrates a right lung lobar consolidation. Blood and sputum cultures were sent to the microbiology lab and came positive for a Gram-negative, rod shaped, nonfermentative, oxidase +ve.
A) What is the most probable diagnosis? B) Describe the onset? C) Most likely causative agent? D) While waiting lab results, what should have you done?

SAQ1: (A) Hospital acquired Pneumonia (B) Early-onset (C) MSSA

SAQ2: (A) Ventilator Associated Pneumonia (B) Late onset (C) Acinetobacter

SAQ3: (A) Ventilator Associated Pneumonia (B) Late onset (C) Pseudomonas aeruginosa (D) started on empiric antibiotic treatment, vancomycin and piperacillin-tazobactam

MCQs

Q1: An 80 year old man was hospitalized and sent to the intensive care unit after a car accident. 6 days after admission he developed pneumonia. A sputum culture showed a gram negative,bacilli , non-fermenter, oxidase +ve organism. What is the most likely cause of this disease?			
A- Actinobacter	B- Pseudomonas Aeruginosa	C- Klebsiella	D- Streptococcus Pneumoniae
Q2: A patient is admitted to the hospital after 4 days he begins to develop chills, fever, cough & dullness on percussion. Which of the following antibiotics should be given if MRSA is suspected?			
A- Piperacillin/ tazobactam	B- Meropenem & Vancomycin	C- Levofloxacin & Amoxicillin	D- Vancomycin
Q3: Which of the following is not a method used in the prevention of ventilator associated pneumonia?			
A- Oral intubation	B- Hand washing	C- Semi Recumbent positioning	D- Levofloxacin
Q4: HAP is the second most common nosocomial infection after			
A- Upper respiratory tract infections	B- Urinary tract infection	C- Lower respiratory tract infection	D- Bacteremia
Q5: Most common way of transmission seen in patient with HAP			
A- Microaspirations of oropharyngeal secretions	B- Microaspirations of nasopharyngeal secretions	C- Introduction of a sufficient size inoculum.	D- Inhalation of large droplets
Q6: Which one of the following is not an endogenous source of VAP infection			
A- Impaired natural protection	B- Colonized oropharynx and gastric fluid	C- Biofilm of endotracheal tube	D- Colonized tracheal secretions.

Q1	Q2	Q3	Q4	Q5	Q6
B	B	D	B	A	C

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