MED437
KING SAUD UNIVERSITY

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MICROBIOLOGY
437

Healthcare Associated Pneumonia

Important!
Doctor's Notes
Only found in females' slides
Only found in males' slides
Extra Notes

تحت المراجعة
غيداء آل معمم
&
عبدالرحمن الحيسوني

" I'm not telling you it's going to be easy. I'm telling you it's going to be worth it."

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 antimicrobial agents used for the treatment of health care associated pneumonia.
- Evaluate response to treatment and recognize reasons for failure of treatment.

Pneumonia:infection of the pulmonary parenchyma.

1- community acquired pneumonia:

acquired in the community, by community acquired organism. usually susceptible (sensitive) to antibiotic.
eg. streptococcus pneumonia

*Nosocomial = originating in a hospital *

2-Nosocomial pneumonia: is

1- hospital associated pneumonia (HAP) or

2- **health care associated pneumonia (HCAP).** Can be

• Occurring at least 48-72 hours after admission into health care institution and not incubating (مو أول ما يتنوم) at the time of hospitalization eg. pneumonia caused by organisms in hospital which are usually resistant to antibiotics

-eg. Pseudomonas aeruginosa.

- the 2nd most common hospital-acquired infections after urinary tract infection. Accounting for 31 % of all nosocomial infections

- the leading cause of death from hospital-acquired infections.

- The incidence is highest in ICU (intensive care unit) patients.

A- Hospital Acquired Pneumonia(HAP) mortality for HAP is 30% to greater than 70%.

B- Ventilator Associated Pneumonia (VAP) patients with assisted respiration for a period of 48 hours.
incidence of nosocomial pneumonia in ventilated patients is 10-fold higher than non-ventilated patients

Pathogenesis

- For pneumonia to occur, at least one of the following **three conditions** must occur:
  - Significant impairment of host defenses
  - Introduction of a sufficient size inoculum to overwhelm the host's lower respiratory tract defenses
  - Introduction of highly virulent organisms into lower respiratory tract
- (number of bacteria which is introduced in the respiratory tract should be very high and the virulence of bacteria الوسائل العدوائية اللي تستخدمها الباكتيريا عشان تنقل المرض و عدد الباكتيريا)
- Most common is microaspiration of oropharyngeal secretions colonized with pathogenic bacteria

Classification of nosocomial pneumonia

Early-onset nosocomial pneumonia	Late-onset nosocomial pneumonia
Occurs during the first 4 days of admission	Occurs more than 4 days of admission
-Causative agents: 1- S.pneumoniae 2- H.influenzae 3- MSSA 4-Anaerobes	-More commonly by gram -ve organisms -Especially: 1- P.aeruginosa 2- Acinetobacter 3-MRSA 4- Enterobacteriaceae (Klebsiella, enterobacter, Serratia)

Causative Agents

Enteric Gram negative bacilli:

Are 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.

S. aureus:

Is isolated in about 20~40% of cases and is particularly common in:

- Ventilated patients after head trauma, neurosurgery, and wound infection.(b/c mostly we have gram + in those areas)
- In patients who had received prior antibiotics or Prolonged care in ICU

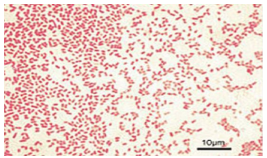
Anaerobes:

Are common in patients predisposed to aspiration

Anaerobic bacteria in the nasopharynx like bacteroides and fusobacterium species if the patient inhaled the bacteria it will go to the lung and might cause pneumonia

P. aeruginosa and Acinetobacter:

are common causes of late-onset pneumonia, particularly in ventilated patients.



الان مثلا جانا مريض عنده gram negative bacilli كيف اعرف اذا هي pseudomonas or acinetobacter؟
1st thing we should know that in the gram stain both look the same with the same color and shape.
2nd CPR is a very advanced test and sometimes it can't be available so we will do biochemical test!
If the specimen is oxidase positive this means its pseudomonas
if oxidase negative it's acinetobacter.
للتوضيح الاوكسيديز تيست هوا اختبار نسويه عشان نشوف اذا الباكتيريا فيها انزيم معين اسمه cytochrome c oxidases اذا سوينا التيست وطلعت الباكتيريا بوزتف يعني ان الباكتيريا تستخدم الاوكسجين عشان تصنع طاقة واذا صارت نيقتف يعني انها ما تقدر تستخدم اوكسجين عشان تصنع الطاقه

MRSA(methicillin resistant S.aureus):

Is seen more commonly in patients who:

- Received corticosteroids
- Undergone mechanical ventilation >5 days
- Presented with chronic lung disease
- Had prior antibiotics therapy

Ventilator associated pneumonia (VAP):

with anaerobes occurred more often with oropharyngeal intubation than nasopharyngeal intubation.

Ventilator-Associated Pneumonia (VAP)

Definition: Nosocomial pneumonia that has developed in patient who are receiving mechanical ventilation.

Classification

Early-onset:
within 48-72 hours after tracheal intubation, which complicates the intubation process

Late-onset:
after 72 hours

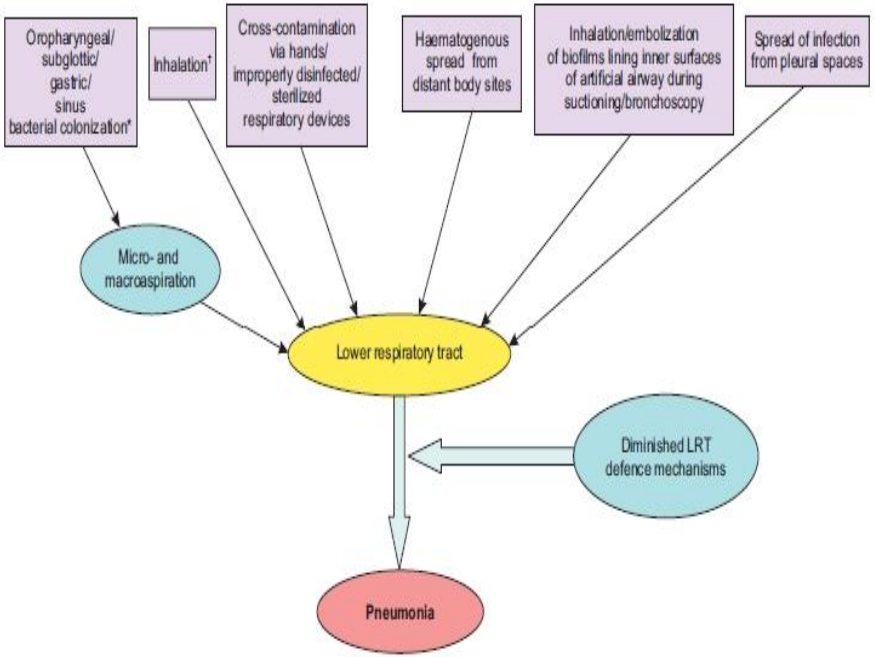
Pathogenesis: Requires 2 important processes:

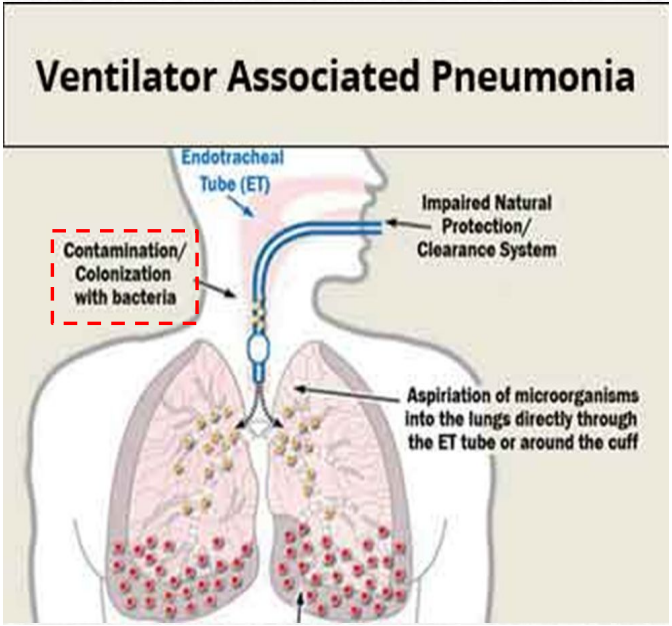
1. **Bacterial colonization of the aerodigestive tract**
2. **Aspiration of contaminated secretion into the Lower airway**

- Prevents mechanical clearance by cough and the mucociliary escalator.
- Source of infection: endogenous (normal flora) or exogenous

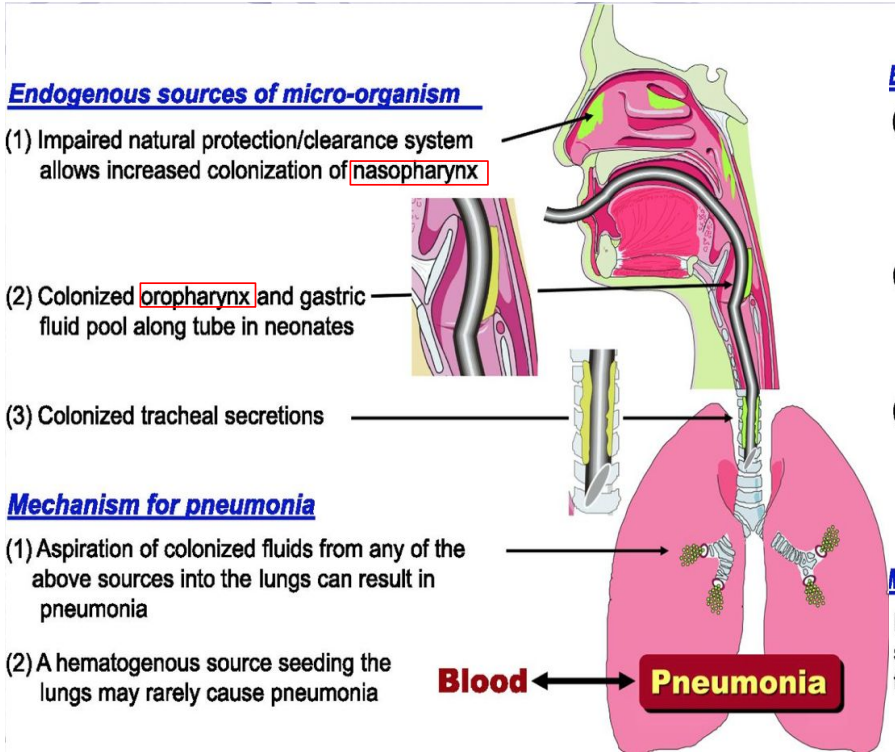
Pathogenesis of VAP

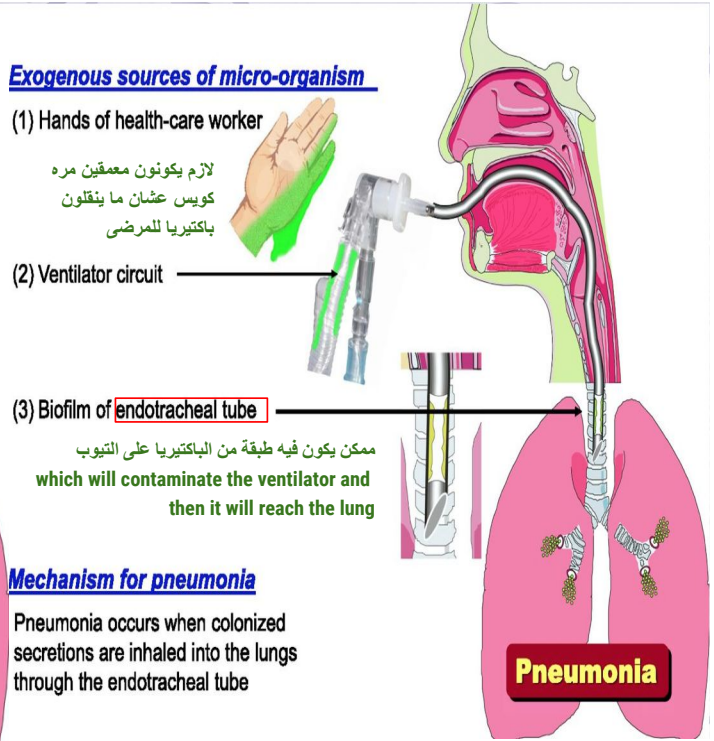
هذي الصوره لتوضيح الكلام اللي بالسلايد اللي قبل





Endogenous and Exogenous Infection





Prevention for VAP

The oral regimen using of 3 or more antibiotics to prevent it (topical Gentamicin, Colistin, Vancomycin cream given every 6h for 3 weeks) treating oropharyngeal colonization could prevent VAP.

Nonpharmacologic Strategies

1. Effective hand washing and use of protective gowns and gloves.
2. Semi Recumbent positioning. (شبه مستلقي
its around 45° to prevent aspiration)
3. Avoidance of large gastric volume. (eat small meals)
4. Oral (non-nasal) intubation.
5. Continuous subglottic suctioning.
6. Humidification with heat and moisture exchanger.
7. Posture change. (change the patient position)

Pharmacologic Strategies

1. Stress-ulcer prophylaxis (use anti-ulcer)
2. Combination antibiotic therapy
3. Prophylactic antibiotic therapy
4. Chlorhexidine oral rinse (its an antiseptic used for the mouth like mouthwash to decrease the chance of getting gram + bacteria)
5. Prophylactic treatment of neutropenic patients (in immunocompromised patients they will have low neutrophils count so we will give them a WBC or antibodies transfusion to improve the level of immunological defense in the body)
6. Vaccines

Treatment

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

How can we know if a patient in ICU have pneumonia or not?
Fever, abnormal chest x-ray, and decrease in vital signs.

- **Initially** be treated with a broad-spectrum antibiotic regimen aimed at covering all likely bacterial pathogens.
- This regimen should subsequently be narrowed, according to the result of culture.

- The treatment depends on the pathogen.
- The pathogen may be **influenced** by coexisting illnesses, prior treatment, and 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.

يعني اذا المريض له اسبوع بالICU نقول نسبة انه عنده P. aeruginosa 23.4% وكل ما يقعد زياده كل ما تزيد احتمالية انه عنده P. aeruginosa

Treatment

- The mortality can be reduced with early appropriate empiric therapy.

(Form 30 % with appropriate therapy to more than 90 % with inappropriate therapy) .

- Guidelines by American Thoracic Society has divided patients into three groups, each with a set of probable pathogens.

Group 1:	mild to moderate HAP with no risk factor (not immunosuppressed)
Group 2:	mild to moderate HAP with risk factor
Group 3a:	severe HAP, early-onset with no risk factor
Group 3b:	severe HAP, late-onset or with risk factor

- For mild-to-moderate HAP, monotherapy has been shown to be effective. Less or no resistance use 1 antimicrobial
- For severe HAP in which infection with resistant organisms is likely, combination therapy probably should be instituted until culture result are available. More resistance use 2 or more antimicrobial

Treatment

- Patients with S. aureus infection, agents against this organism are necessary, including **Vancomycin** if MRSA is suspected. Side effect? Nephrotoxicity

  - **Linezolid** is compatible (similar) with Vancomycin. The advantage of Linezolid is less possible nephrotoxicity. If the patient is immunocompromised we can't give them something that will damage their kidney that's why we use a drug with less toxicity.

- Combination of antipseudomonal drugs is controversial:

1. **Traditional**:

antipseudomonal Beta-lactam with an Aminoglycoside. e.g. of antipseudomonal Beta-lactam: Cephalosporins→ ceftaroline & Penicillin → piperacillin **with** Clindamycin

Synergy but potential nephrotoxicity.

2. **Another approach:**

antipseudomonal Beta-lactam with a Fluoroquinolone. e.g ciprofloxacin has less nephrotoxicity and better concentration than clindamycin.

No benefit of synergy but reduce concern of nephrotoxicity, and quinolone gets into the lungs at higher concentrations.

Response to therapy

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

Infectious causes:

- Resistant pathogen
- Superinfection (additional infections → anaerobic, gram+, or fungal infections)
- Unusual pathogens (not common pathogens but usually affect ICU patients like lagunilla which comes from the use of hot water)
- Lung abscess (in this case we will have to aspirate the puss then use antibiotics)
- Extrapulmonary infection

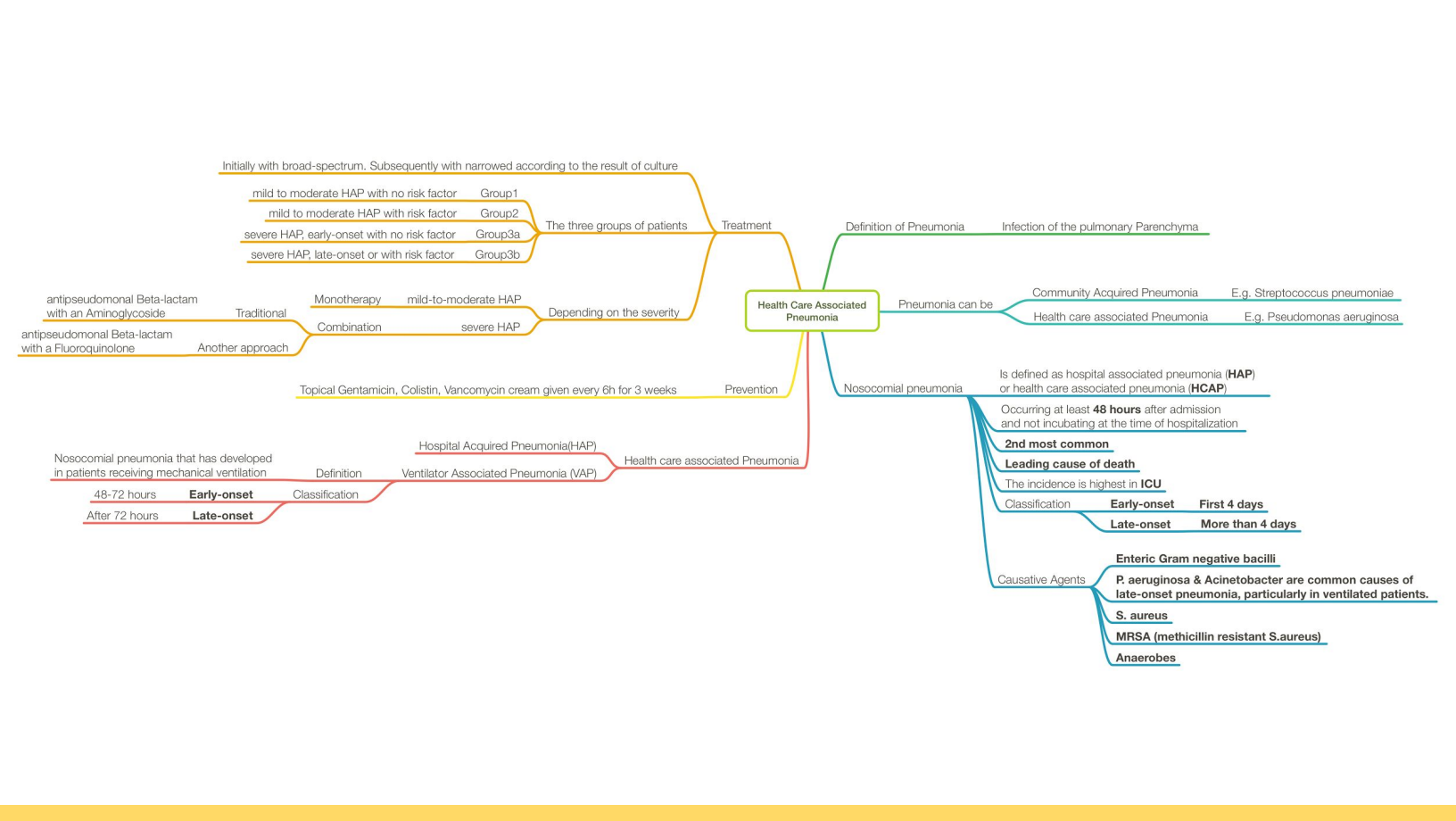
Noninfectious events:

- **Heart:**

congestive heart failure (CHF)

- **Lung:**

Fibroproliferative acute respiratory distress syndrome(ARDS)
Pulmonary emboli
Atelectasis


Health Care Associated Pneumonia
Definition of Pneumonia
Infection of the pulmonary Parenchyma
Pneumonia can be
Community Acquired Pneumonia
E.g. Streptococcus pneumoniae
Health care associated Pneumonia
E.g. Pseudomonas aeruginosa
Nosocomial pneumonia
Is defined as hospital associated pneumonia (HAP) or health care associated pneumonia (HCAP)
Occurring at least 48 hours after admission and not incubating at the time of hospitalization
2nd most common
Leading cause of death
The incidence is highest in ICU
Classification
Early-onset
First 4 days
Late-onset
More than 4 days
Causative Agents
Enteric Gram negative bacilli
P. aeruginosa & Acinetobacter are common causes of late-onset pneumonia, particularly in ventilated patients.
S. aureus
MRSA (methicillin resistant S.aureus)
Anaerobes
Treatment
Initially with broad-spectrum. Subsequently with narrowed according to the result of culture
The three groups of patients
mild to moderate HAP with no risk factor
Group1
mild to moderate HAP with risk factor
Group2
severe HAP, early-onset with no risk factor
Group3a
severe HAP, late-onset or with risk factor
Group3b
Depending on the severity
Monotherapy
mild-to-moderate HAP
Combination
severe HAP
Traditional
antipseudomonal Beta-lactam with an Aminoglycoside
Another approach
antipseudomonal Beta-lactam with a Fluoroquinolone
Prevention
Topical Gentamicin, Colistin, Vancomycin cream given every 6h for 3 weeks
Health care associated Pneumonia
Hospital Acquired Pneumonia(HAP)
Ventilator Associated Pneumonia (VAP)
Definition
Nosocomial pneumonia that has developed in patients receiving mechanical ventilation
Classification
48-72 hours
Early-onset
After 72 hours
Late-onset

MCQs

1- Which one is the 2nd most common hospital-acquired infections?

A. Community acquired pneumonia
B. Nosocomial pneumonia

2- Streptococcus pneumoniae is the organism which cause

A. Community acquired pneumonia
B. Hospital associated pneumonia
C. Health care associated pneumonia

3- To treat pneumonia we initially use

A. Narrow spectrum antibiotic
B. Broad spectrum antibiotic
C. Neither, wait for the result of the culture

4- Severe HAP, late-onset with risk factors is

A. Group 3a
B. Group 3 b
C. Group 2

5- The common causes of late-onset pneumonia, particularly in ventilated patients are

A. P. aeruginosa and Acinetobacter
B. S. Aureus
C. MRSA

6- Which of the following can cause pneumonia to patient who had Received corticosteroids

A. Anaerobes
B. S. Aureus
C. MRSA

SAQs

1. Name the organism which can cause health care associated pneumonia (HCAP).
2. What is the difference between the duration of early and late onset of nosocomial pneumonia?
3. List two important processes required for pathogenesis of VAP.
4. How can we prevent VAP?
5. There are three factors may be influenced the pathogen, mention them.
6. If a patient with kidney problems has pneumonia, what is the preferable drug we can use?
7. If a patient was in the ICU on a ventilator and he has head trauma or neurosurgery (for example they had brain tumor and went through a surgery) with gram positive cocci in cluster. What is the most likely causative agent?
8. What are the symptoms of Pneumonia?
9. A patient with HAP growing MRSA what is the drug of choice? Why?

Answers:

1. B
2. A
3. B
4. B
5. A
6. C

1. Pseudomonas aeruginosa
2. Early onset occurs in the first 4 days, late onset in more than 4 days.
3. Bacterial colonization of the aerodigestive tract, and Aspiration of contaminated secretion into the lower airway.
4. By topical Gentamicin, Colistin, Vancomycin cream given every 6h for 3 weeks
5. coexisting illnesses, prior treatment, and length of hospitalization.
6. Linezolid
7. S. aureus .
8. Fever, abnormal chest x-ray and vital signs are decreased.
9. Linezolid, because it has less toxicity which means there will be less kidney damage.

Team Leaders

Alanoud Almansour & Omar Alsuhaibani

Team Members

Alanoud Alessa
Alhanouf Jaloud
Dana Alrasheed
Hadeel Awartani
Khulood Alwehaibi
Nada Alobaid
Norah Alkadi
Noura Alothaim
Rahaf AlShammari
Reema Aldihan
Reema AlEnezy
Sara Alsultan
Shouq Alqahtani

Adel Alsuhaibani
Saad Alhaddab
Khaled Aldosari
Abdurhman Alhayssoni
Saif Almeshari
Mohammed Almohaimeed
Abdulhakim Alonaiq
Sulaiman Alzomia
Anas Alsaif
Mohammad Alasqah
Hussien Alami
Khaled Aloqeely
Saad Alfouzan
Mohammed Aldwaghri

Please contact us if you have any suggestion, correction, or question:
Microbiology.med437@gmail.com

Special thanks to:
Reem Alqahtani