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MEDICINE
KING SAUD UNIVERSITY
436

Microbiology
team 436

Lecture :
Health Care Associated Pneumonia

important
Extra notes
Doctors notes

وتقال هذه الجملة إذا دهم الإنسان أمر عظيم لا "لا حول ولا قوة إلا بالله العلي العظيم" يستطيعه ، أو يصعب عليه القيام به.

Objectives:

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

Health care associated Pneumonia:

Pneumonia

Definition : Infection of the pulmonary Parenchyma

It can be

Community acquired pneumonia

acquired in the **community**, by community acquired organism

eg. Streptococcus pneumoniae

usually <u>susceptible</u> (sensitive) **to antibiotic**.

Mainly caused by susceptible organisms like:
1- S.Pneumonial which is susceptible to penicillin.
2- H.influenza which is susceptible to ampicillin

Health care associated pneumonia
(Nosocomial pneumonia)

acquired 48-72 hours (2-3days) after admission to health care institutions.
Pneumonia that is caused by organisms in hospital which are **usually resistant to antibiotics**

eg. Pseudomonas aeruginosa

- Hospital acquired pneumonia (HAP)
- Ventilator associated pneumonia (VAP)
  - in patients with assisted respiration for a period of 48 hours

Nosocomial pneumonia:

Definition:

- ✓ is defined as hospital associated pneumonia (HAP) or health care associated pneumonia (HCAP).
- ✓ Occurring at least 48-72 hours after admission and not incubating at the time of hospitalization.

Introduction:

- Nosocomial pneumonia 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** patients (intensive care unit) وحدة العناية المركزة(الفائقة).
- 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%.

Nosocomial: a disease originating in a hospital. مرض ينتقل عن طريق بيئة المستشفى

Pathogenesis[1]:

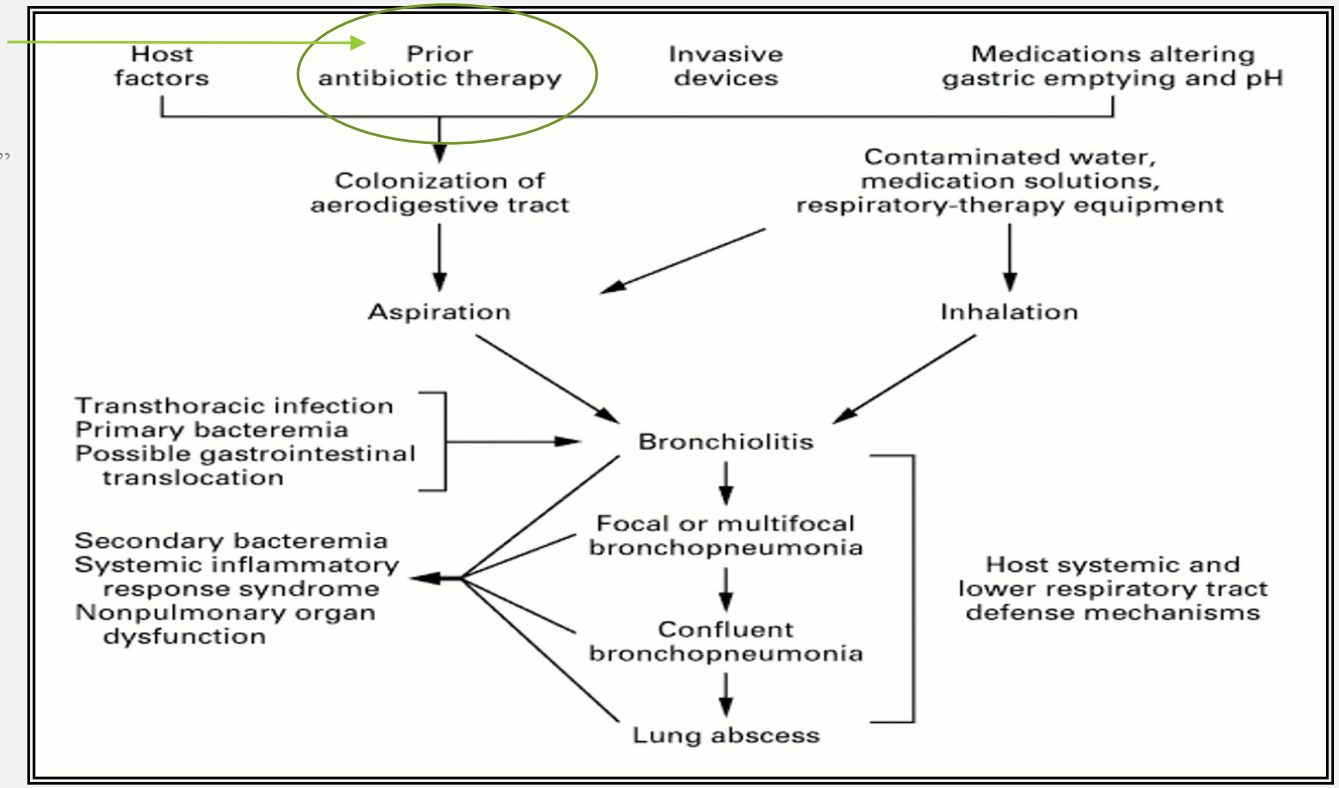
- One of the following three conditions at least[2] is required for pneumonia to occur:

  1) Significant impairment (weakness) of the host defenses[3].

  2) Introduction of a sufficient-size inoculum[4] that overwhelms the host's lower respiratory tract defenses* indirectly .

  3) Introduction of highly virulent organisms **directly** into the **lower respiratory tract** , which is common in microaspiration[5] of **oropharyngeal secretions**[6] that are colonized with pathogenic bacteria. [7]

Important, most ventilated patients are given broad spectrum antibiotics that can cause resistance



1 ICU patients are surrounded by many tubes which contain large number of inoculum "organisms" which invade in his respiratory tract.

2 The gold standard **for any bacterial infection** is culture.

3 The patient has diabetes, taking steroids, chemotherapy, or other diseases .

4 The infective agent which may be vaccinated or introduced to the body.

5 Inhalation of foreign materials into the lower airways.

6 Secretions gathering while the patient is lying down on ventilation .

7 Normal nose and throat flora are very dangerous in sterile sites of the body like the deep lungs.

You don't have to memorize the picture

*So they can't cough up the bacteria and secretions

Thanks To 435 Team

Classification of HAP: The classification of nosocomial pneumonia is based on its onset duration

1. **Early-onset nosocomial pneumonia:**
   - -Occurs during the first 4 days of admission.
   - -Usually is due to :
     - ✓ S. pneumonia
     - ✓ MSSA (Methicillin sensitive S.aureus)
     - ✓ H. Influenza
     - ✓ anaerobes.
2. **Late-onset nosocomial pneumonia:**

   -occurs more than 4 days of admission.

   -More commonly by :
     - ✓ **Gram negative** organisms, especially: P. aeruginosa, Acinetobacter, Enterobacteriaceae (Klebsiella, Enterobacter, Serratia)
     - ✓ MRSA (Methicillin resistant S.aureus) .

Important!

Causative Agents

- **Enteric Gram negative bacilli (Enterobacteriacae):**
  - ✓ are **isolated** most frequently particularly in patients with late-onset disease and in patients with serious underlying disease often already on broad-spectrum antibiotics.4
  - ✓Prior use of broad-spectrum antibiotics and an immunocompromised state make resistant Gram-negative organisms more likely.
- **P. aeruginosa and Acinetobacter:**
  - ✓ are **common causes of late-onset pneumonia**, particularly in ventilated patients.
- **S. aureus :**
  - ✓is 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(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

- **Anaerobes : (not a common cause to pneumonia)**
  - ✓are common in patients predisposed to aspiration .
  - ✓Ventilator associated pneumonia (VAP) with anaerobes occurred more often with oropharyngeal intubation than nasopharyngeal intubation

VENTILATOR ACQUAIRED PNEUMONIA:

- **Definition**: Nosocomial pneumonia that has developed in patient who is receiving mechanical ventilation. يعني تنفس او تهوية ميكانيكية
- **Classification**:
  - ✓ Early-onset: within 48-72 hours after tracheal intubation, which complicates the intubation process
  - ✓ Late-onset: after 72 hours. ممكن للتنفس او ايصال دواء او منع اختناق او ,لاي سبب كان (التراكيا)التراكيال انتيوبايشن هو لما يحطون انبوب من الفم او الانف الى القصبة الهوائية غيرها
- **Pathogenesis:**
  - ✓ **Requires 2 important processes:**
    1. Bacterial colonization of the aerodigestive tract. **الايرودايجستف تراكت يقصد فيه الجهاز التنفسي و الجزء العلوي من الجهاز الهضمي**
       (Lips, mouth, tongue , nose ,throat , vocal cords , part of the esophagus and windpipe)
    2. Aspiration of contaminated secretion into the
       Lower airway **سوائل الجهاز الهضمي تنزل على التراكيا و تحت فتسبب مشاكل.**
  - ✓ Prevents mechanical clearance by cough and the mucociliary escalator.
- Signs and symptoms Of having VAP :

1- need a lot of oxygen
2- fever
3-leukocytosis
4-increase secretion

PREVENTION:

- The oral regimen النظام او الخطة(topical Gentamicin, Colistin, Vancomycin cream given **every 6h for 3** weeks) treating oropharyngeal colonization could prevent VAP.

- **Non-pharmacologic strategies:**
  - ✓ -Effective hand washing and use of -protective gowns and gloves.
  - ✓ -Semi recumbent positioning وضعية انه ينسدح و يرفع التورسو هي 45 درجة.
  - ✓ -Avoidance of large gastric volume كمية السوائل في المعدة
  - ✓ -Oral (non-nasal) intubation
  - ✓ -Continuous subglottic suctioning يشفطون السوائل عشان ما تنزل
  - ✓ -Humidification with heat and moisture exchanger
  - ✓ -Posture change تعديل وضعية الجسم

- **Pharmacologic strategies**:
  - ✓ -Stress-ulcer prophylaxis
  - ✓ -Combination antibiotic therapy
  - ✓ -Prophylactic antibiotic therapy
  - ✓ -Chlorhexidine oral rinse (disinfectant).
  - ✓ -Prophylactic treatment of neutropenic patients.(neutrophil count is less than normal)
  - ✓ -Vaccines

Treatment of HAP and VAP:

- Most initial therapy is empiric (based on expectations) because **no pathogen** is identified or results are not yet available when antimicrobial decisions are made in most patient .
    1. First, we will treat with a **broad spectrum** antibiotic regimen to cover all likely bacterial pathogens
    2. the regimen should subsequently be narrowed into a more specific antibiotic according to the bacteria shown in the culture's result.
- The pathogen is influenced by coexisting illnesses, prior treatment, and the length of hospitalization.
- The frequency of ICU acquired **Pseudomonas Aeruginosa** carriage, colonization or infection is 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.)

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

Read Only Group 1	Mild to moderate with no risk factor.
Group 2	Mild to moderate with risk factor.
Group 3A	Severe, early-onset with no risk factor.
Group 3B	Severe, late-onset or with risk factor.

- **For mild to moderate HAP:**
  - ✓ Monotherapy has been shown to be effective.
- **For severe HAP with resistant organisms:**
  - ✓ Combination therapy probably should be instituted until culture result are available.
- **For patients with Staph. Aureus infection:**
  - ✓ Agents against this organism are necessary, including Vancomycin if *MRSA* is suspected. **Linezolid** is comparable with Vancomycin, nevertheless, one of the main advantages of **Linezolid is that it does not cause nephrotoxicity**.
- **For patients with Pseudomonas Aeruginosa infection:**
  - ✓ Combination of antipseudomonal drugs is controversial.

    1) Traditional approach**:**
       - Antipseudomonal Beta-lactam + **Aminoglycoside**.
       - Synergy but potential nephrotoxicity.

       Synergy : working together to enhance the effectiveness

    2) Another approach**:**
       - Antipseudomonal Beta-lactam + **Fluoroquinolone**.
       - **No benefit of synergy** but reduces the concern of nephrotoxicity, and quinolone
       - gets into the lungs at higher concentrations.

When we think about treatment we should always select drugs that cover Pseudomonas Aeruginosa and MRSA

Important slide

For **Pseudomonas** we have to use 2 drugs from 2 different families

B-lactam
- Ceftazidime
- Pipracillin

Aminoglycoside
- Tobramycin
- Gentamycin
- Amikacin

Fluoroquinolone
- Ciprofloxacin
- levothoxacin

Carbapenum
- Meropenum
- Lmipenum

For Straphycoccus Aurues

MSSA
- Cefazplin (1st generation)
- Clyndamycin
- Cloxacillin

MRSA
- Vancomycin
- Or Linazolid

Response to therapy:

Read Only

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

Infectious Causes	Non-infectious events
• Resistant pathogen • Unusual pathogen • Superinfection • Extra-pulmonary Infection • Lung abscess	• Heart: ✓ Congestive heart failure (CHF). • Lung: ✓ Fibro-proliferative acute respiratory distress syndrome (ARDS) ✓ Pulmonary embolism. ✓ Atelectasis.

SAQ: Ahmed and Khaled were both admitted to the hospital after a car accident ,both of them were ventilated in the ICU . After one day Ahmed acquired pneumonia and after six days Khaled acquired pneumonia.

Q1: What organisms most likely caused Ahmed to develop pneumonia ?

Q2:What organisms most likely caused Khaled to develop pneumonia?

Q3: As a doctor how would you try to prevent pneumonia in ventilated patients?

Q4: What ANTIBIOTICS will you use to treat Ahmed and Khaled?

ANS

1)s.Pneumoniae , MSSA, H.Influenza, anaerobes

2) Gram negative organisms , **P.aeruginose , acinetobacter** , enterobacteriaceae , **MRSA**

3) By applying topical gentamycin , colistin ,vancomysin cream (given every 6 hours for 3 weeks)

4) Vancomycin , linezolid

GOOD LUCK!

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