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Review Article

Pneumonia in the Elderly

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Abstract

Pneumonia is the leading cause of morbidity and mortality in geriatric patients worldwide.. Pneumonia in geriatrics increases mortality and has become the main cause of visits to emergency departments and hospital care units. Diagnosis of pneumonia in geriatrics is often delayed because generally, patients do not complain of fever, cough, and changes in mental status (delirium). Hospitalized geriatric patients with pneumonia will have a poor prognosis within 1 year. The incidence of pneumonia in geriatric is associated with physiological changes in geriatric patients (reduced cough reflexes and mucociliary clearance mechanisms), impaired immune systems (both natural and acquired immunities), changes in social situations (malnutrition), and diseases common to geriatric patients (diabetes mellitus, chronic obstructive pulmonary disease, chronic heart failure, cancer, and chronic renal insufficiency). Geriatric pneumonia generally consists of community-acquired pneumonia, nursing home-acquired pneumonia (NHAP), and nosocomial pneumonia based on location and time of infection. Pneumonia Severity Index (PSI), Confusion, Urea, Respiratory Rate, Blood Pressure, Age (CURB-65) and modified American Thoracic Society (ATS) guidelines are modalities commonly used to assess the severity of pneumonia. Clinicians dealing with geriatric patients with pneumonia will be faced with the challenge of choosing the right antibiotics, antibiotic-resistant microorganisms, and patient's comorbidities. Various factors are associated with patient mortality such as age, hypoxemia, comorbidity, causal microorganisms, malnutrition, and antibiotic administration time. Vaccination as a safe and effective effort to prevent pneumonia in geriatrics has not been widely performed.

Keywords: *Pneumonia in the Elderly; Diagnosis; Severity; Challenge*

Background

Pneumonia is the leading cause of morbidity and mortality in geriatric patients worldwide [1,2]. Incidence of community-acquired pneumonia increases with age, ranging from 25 to 35 cases per 1000 residents in populations over 65 years old. Pneumonia in geriatrics increases mortality and has become the main cause of visits to emergency departments and hospital care units [3]. Incidence of pneumonia in geriatrics for patients with a history of chronic disease treatment ranges from 33 to 114 cases per 1000 population every year. Fein mentioned that 2% of all geriatric patients receiving home care would have a risk of pneumonia. The mortality rate of patients with pneumonia in geriatrics in the community is reported to be about 30% and this number will increase to 57% in geriatric patients with a history of home care. Diagnosis of pneumonia in geriatrics is often delayed because generally, patients do not complain of fever, cough, and changes in mental status (delirium). Hospitalized geriatric patients with pneumonia will have a poor prognosis within 1 year. A case-control study of 158,960 outpatient community acquired pneumonia patients and 794,333 inpatients as a control group showed a 1-year mortality rate in community acquired pneumonia patients of 41% versus 29% in the control group [2].

The incidence of pneumonia in geriatric is associated with physiological changes in geriatric patients (reduced cough reflexes and mucociliary clearance mechanisms), impaired immune systems (both natural and acquired immunities), changes in social situations (malnutrition), and diseases common to geriatric patients (diabetes mellitus, chronic obstructive pulmonary disease, chronic heart failure, cancer, and chronic renal insufficiency) [3].

This literature review discusses the classification, pathophysiology, diagnosis, treatment, and prevention for pneumonia in geriatrics.

Classification

Based on considerations of sociological aspects, the term geriatric is addressed to citizens over 65 years of age [3]. Pneumonia is a pulmonary inflammation caused by microorganisms (bacteria, viruses, fungi, parasites) excluding *Mycobacterium tuberculosis*. Geriatric pneumonia generally consists of community-acquired pneumonia, nursing home-acquired pneumonia (NHAP), and nosocomial pneumonia based on location and time of infection. Community-acquired pneumonia is usually acquired by patients living in the communities. Nosocomial-acquired pneumonia is acquired during hospitalization and is classified as ventilator-associated pneumonia and hospital-acquired pneumonia [1].

The term Health Care-Associated Pneumonia (HCAP) is found in guidelines issued by the American Thoracic Society (ATS) in 2005. The definition of HCAP is patients with clinical symptoms of pneumonia that are being hospitalized and having a history of previous care at home or health facilities, wound care history, history of chronic dialysis, or contact history with family members who have a risk of drug-resistant microorganism transmission in the past 30 days or have been hospitalized for at least 48 hours in the last 90 days [4].

Changes of Respiratory System Physiology

Lung physiology will reach its peak at the age of 20 - 25 years, and will progressively decrease with age. Decreased lung physiology due to age factor will affect lung expansion capacity and increase airway resistance, which in turn will increase the risk of lower respiratory tract infections. Changes in lung physiology in geriatrics include decreased lung elasticity, decreased expansion of the chest wall, and decreased strength of respiratory muscles. The respiratory center lacks an adequate response to hypoxia or hypercapnia in geriatric patients so that dyspnea, tachypnea, and other respiratory distress as early signs and symptoms of pneumonia are often discovered late [2].

Changes in Immune System

Geriatric patients will experience a change in natural and adaptive immunity. Cellular physiology components of natural immunity such as neutrophils, macrophages, and Natural Killer cells are reduced. The ability of macrophages to produce Tumor Necrosis Factor (TNF), a pro-inflammatory cytokine, will be reduced [5]. Geriatric patients will experience impaired temperature responses that include impaired sympathetic-neural-vasomotor responses, disturbance of body heat production, and temperature perception disturbance. Basal temperatures in geriatric patients are generally lower than that of young adult patients [6,7].

Bronchoaspiration

The airway defense system in geriatric patients is reduced due to a decrease in mucociliary clearance mechanism. The incidence of aspiration as a cause of pneumonia in geriatrics was reported to be quite high, as high as 71% in the pneumonia group and 10% in the control group. Frequency of aspiration is also reported to be increased in dementia and stroke patient. Administration of nutrients through the feeding tube does not reduce the risk of bronchoaspiration. Aspiration is a pathogenic mechanism that plays a major role in the pathogenesis of pneumonia in geriatrics [2].

Clinical Symptoms

Coughing, sputum production, fever with fluctuating temperatures, and chest pain are more common in community-acquired pneumonia patients. Tachypnea (respiratory rate > 20x/minutes) and tachycardia (pulse > 100x/minutes) are found in two thirds of patients

with pneumonia in geriatrics and are often found 3 - 4 days before the onset of other symptoms [8]. Triad symptoms such as cough, fever, and dyspnea are found in only 56% of patients [9].

Symptoms	CAP %	NHAP %
Cough	49 - 81	40 - 63
Fever > 38^0	2 - 76	64 - 75
Dyspnoe	36 - 82	39 - 79
Sputum	38 - 66	37 - 38
Chills	8 - 58	16 - 24
Pleural pain	9 - 43	4 - 24
Altered mental state	12 - 45	53 - 77
Focal	64 - 82	80

Table 1: *Range of frequencies reported for common symptoms of pneumonia in patients hospitalised for CAP or NHAP [10].*

Supporting Examination

Hematology

Routine hematological examination showing leukocytosis and increasing neutrophil were less common in geriatric patients. Examination of C-reactive protein (CRP) has a high sensitivity to detect pneumonia. A normal CRP level can exclude pneumonia in geriatric patients. Persistent increase of CRP after antibiotic treatment is a poor prognostic factor and other causes need to be considered such as inadequate antibiotics, parapneumonic effusion, or empyema. Procalcitonin has a lower sensitivity (54%) in patients aged 50 - 85. Leukocytosis, increased neutrophil cells, leukopenia, and lymphopenia are poor prognostic factors. The ATS guidelines suggest that blood gas analysis (BGA) should be performed in hospitalized patients with high degree of severity or a history of chronic disease. BGA examination not only detects hypoxemia, it can also detect hypercapnia which is often found in geriatric patients. BGA examination should be performed when oxygen saturation as measured using pulse oximetry is below 94%. Adequate oxygen saturation monitoring is performed using pulse oximetry for patients treated in the inpatient ward. Hyponatremia and elevated liver enzymes also occurred frequently; however, they are not considered as the poor prognostic factors. Low albumin level and renal failure are related to the increasing mortality rate [11].

Microbiology

A study on hospitalized geriatric patients shows that *Streptococcus pneumoniae* is the most dominant pathogenic bacteria in community-acquired pneumonia patients (58%) and NHAP (30%). Pneumonia caused by *S. pneumoniae* is more common in patients with a history of other lung diseases, liver disorders, or alcohol abuse [12]. *Haemophilus influenzae* is reported in geriatric patients with community-acquired pneumonia (14%) and NHAP (7%). Various studies reported that *H. influenza* infection was associated with exacerbation of chronic obstructive pulmonary disease (COPD) and infected bronchiectasis [13].

Kuman	CAP (%)	NHAP (%)
Streptococcus pneumoniae	5 - 58	4 - 30
Haemophillus influenzae	2 - 14	0 - 2
Staphylococcus aureus	0 - 7	0 - 4
Moraxella catarrhalis	0 - 4	2 - 3
Pseudomonas aeroginosa	1 - 5	0 - 4
Escherichia coli	1 - 7	0 - 2
Klebsiella pneumonia	0 - 4	4 - 6
Non-tipikal		
Legionella pneumophilia	0 - 15	0 - 1
Chlamydia pneumoniae	0 - 28	0 - 18
Coxiella burnetti	0 - 6	--
Mycoplasma pneumoniae	1 - 13	1
Virus		
Influenza A	1 - 32	0 - 4
Parainfluenza	0 - 4	1

Table 2: *Frequencies for most frequently isolated microorganism for CAP and NHAP [10].*

Microoragnism	Risk factors
Pseudomonas aeruginosa	Severe COPD with FEV_1 < 35%
	COPD > 4 cycles of antibiotic treatment in the last year
	Bronchiectasis with previous colonization Nasogastric tube for enteral alimentation
	Admission in the ICU
Enterobactericeae and or Anerobs	Functional impairment
	Risk factors of aspiration
	Dysphagia
	Gastroesophageal reflux
	History of vomiting
	Cerebrovascular diseases
	Dementia
	Periodontal diseases
	Bad oral hygiene
Methicillin - resistant *S. aureus*	Submitted to bed sores or wounds
	Clinical severity + recent hopitalization + previous endovenous antibiotic + institucionalization
	Previous colonization

Table 3: *Risk factors for different microorganisms [3].*

Radiology

Chest radiography plays an important role in establishing the diagnosis of pneumonia, determining the severity of pneumonia, identifying serious complications such as cavity, parapneumonic effusion, or empyema, as well as in identifying other lung diseases such as COPD, pulmonary tuberculosis, interstitial lung disease, bronchiectasis, or lung cancer. Computed tomography examination is useful for identifying airway obstruction due to proximally-located tumors, identifying the location and extent of pleural effusion, or for determining differential diagnosis. The radiological features of pneumonia in geriatrics include infiltrates or inhomogeneous consolidations with oval shape and less-defined border [2].

Bronchoscopy

Bronchoscopy should be considered for pneumonia in geriatric patients who do not respond well to antibiotics, or in immunocompromised patients. In patients with severe pneumonia, bronchoscopy may lead to complications such as hypoxemia (11%), post-bronchoscopy fever (5%), and temporary cardiac arrhythmia (2%). Bronchoscopy may help establish an etiological diagnosis of lung infiltrate [3].

Modality for Assessing the Severity of Pneumonia

(ATS) guidelines are modalities commonly used to assess the severity of pneumonia. Pneumonia Severity Index is a scoring system used to classify the severity of pneumonia when a patient arrives and determines whether the patient needs to be hospitalized or getting care at home. The CURB-65 scoring is a modification of the British Thoracic Society (BTS) guidelines used to predict mortality rates in hospitalized pneumonia patients. Modification of ATS guidance is used to determine the criteria of patients with pneumonia requiring treatment at the intensive care unit (ICU) [4].

Characteristic	Point
Age	
Men	Age (year)
Women	Age (year - 10)
Nursing home resident	10
Coexisting illness	
Neoplastic disease	30
Liver disease	20
Congestive heart failure	10
Cerebrovascular disease	10
Renal disease	10
Physical examination findings	
Altered mental status	20
Respiratory rate > 30 min	20
Systolic blood pressure < 90 mm Hg	20
Temperature < 35 or > 40^0C	15
Pulse > 125/ min	10
Laboratory and radiographic findings	
Arterial pH < 7,35	30
Blood urea nitrogen > 30 mg/dL	20
Serum sodium < 130 mmol/ L	20
Serum glucose > 250 mg/dL	10
Hematocrit < 30%	10
Partial pressure of oxygen < 60 mmHg	10
Pleural effusion	10

Table 4: *Pneumonia severity index scoring system [4].*

Confusion (defined as Mental Test Score or 8 or less, or new disorientation in person, place or time)
Urea > 7 mmol/ L
Respiratory rate ≥ 30/ min
Blood pressure (systolic < 90 mmHg or diastolic ≤ 60 mmHg)
Age ≥ 65 yr

Table 5: *Modified British Thoracic Society (CURB-65) [4].*

Criteria for severe community-acquired penumonia
Presence of 1 major or minor criteria
Major
Septic shock
Need for ventilation
Minor
Multilobar disease (> 2 lobes)
Systolic BP < 90, diastolic BP < 60
PaO_2/FiO_2 < 250

Table 6*: American Thoracic Society guidelines [4].*

Differential Diagnoses

Differential diagnoses should be considered if the patient does not show clinical improvement after adequate antibiotic treatment. Infections of rare microorganisms found in the population and *Mycobacterium* should be ascertained. Noninfectious and neoplastic inflammation should also be considered, such as vasculitis, idiopathic acute eosinophil pneumonia, chronic eosinophil pneumonia, and bronchoalveolar carcinoma [15].

Treatment

Considerations for outpatient care are to be made when vital signs are stable, consciousness is normal or returns to normal, and oxygenation improves. In general, patients with pneumonia at an old age will begin to stabilize on the third and fourth day of treatment. Geriatric patients in weak condition will become stable after 2 - 7 days. If the microorganism has not been identified, it is advisable to continue the equivalent antibiotic from the same spectrum. Patients receiving medications such as amoxicillin-clavulanic acid, quinolone, macrolide, or clindamycin should be continued with the same antibiotic due to the fact that the oral bioavailability of these drugs are proportional to intravenous administration. Patients receiving cephalosporin groups should be continued with cefditoren due to the fact that it is of similar spectrum [3].

Patient	Scenario	Treatment
Patient without frailty	Outpatient treatment	Amoxicillin/ clavulanate or cefditoren + klaritromisin or moxifloxacin atau levofloxasin
	Treatment at admission	Amoxicillin/ clavulanate or ceftriaxone + azitromisin or moxifloxacin atau levofloksasin
Patient with frailty	Mild frailty	Amoxicillin/ clavulanate or ceftriaxone + azitromisin or moxifloxacin atau levofloksasin
	Moderate - severe frailty	Ertapenem or Amoxicillin/ clavulanate
The rare pathogen	*Enterobacteriaceae*/anaerob	Ertapenem or Amoxicillin/ clavulanate
	Methicillin- resistant S. aureus	Add linezolid
	P. aeruginosa	Piperacillin/ tazobactam or imipenem atau meropenem or cefepime + Levofloxacin atau ciprofloxacin or amikasin or tobramisin

Table 7: *Empiric treatment in CAP in the elderly [3].*

Failure of treatment should be considered if the patient's condition is unstable after 3 - 4 days of antibiotic treatment, there is no clinical improvement, and if respiratory insufficiency or septic shock occurs within the first 72 hours. Geriatric patients with pneumonia with comorbidities such as COPD and heart failure will require more time to achieve stable conditions without failure of treatment. The causes of treatment failure include the inaccuracy in choosing antibiotics, antibiotic-resistant microorganisms, microorganisms that are rarely found in the population as the etiology of disease, not confirming the diagnosis of patient comorbidity, or not confirming diagnosis of other diseases such as pulmonary embolism and pulmonary neoplasm [3].

Considerations for Hospital Discharge

Clinical stabilization is produced when the vital signs normalize, the mental state is normal or returns to the basal condition and improvement in gas exchange diminishing oxygen requiredments is observed. Most of patients with pneumonia are usually stabilized between the third and fourth day. How ever, in frail elderly patients this time mau increase and delay time to clinical stability 2 - 7 days [3].

• Heart rate < 100 bpm
• Respiratory rate < 24 rpm
• Axillary temperature < 37,2^{0}C
• Systolic blood pressure > 90 mm Hg
• O_2 saturation > 90% • Good level of consciouness • Tolerance to oral route

Table 8: *Clinical stabilization criteria [16].*

Comorbidity and Prognosis

Comorbidity is a risk factor for lung infection and determines the patient's prognosis. Comorbidities such as cancer, diabetes, chronic respiratory disorders, chronic renal failure, and chronic heart failure increase the risk of lower respiratory tract infections including pneumonia [14]. Factors associated with length of hospital stay include age, delirium, NHAP, radiological aspiration, cyanosis, leukocytosis, and increased neutrophils in peripheral blood smear [17]. Various factors are associated with patient mortality such as age, hypoxemia, comorbidity, causal microorganisms, malnutrition, and antibiotic administration time. Adequate administration of antibiotics is one of the modifiable factors. Other factors related to mortality are history of home care, prolonged bed rest, delirium, no symptoms of fever (temperature < 37^{0}C), CRP > 100 mg/L, hypoalbuminemia, acute non-respiratory organ dysfunction (ARDS), infection of several lobes, suspected of aspiration and difficulties in swallowing [18,19]. Pneumonia Severity Index and CURB-65 have a comparable predictive value for predicting mortality in geriatric within 30 days [20].

Prevention

Vaccination as an effort to prevent pneumonia in geriatrics is still rarely performed compared to children. The efficacy of vaccination will decrease with age. Vaccination of pneumonia prevents invasive (bacteremia) pneumococcal disease. A research data combining pneumococcal and influenza vaccination in 259,627 individuals with a prospective study design showed that vaccination significantly reduced the incidence of hospitalization due to influenza (-46%), pneumonia in general (-29%), pneumococcal pneumonia (-36%), invasive pneumococcal disease (-52%), and overall mortality rate (-57%) [21]. Large-scale studies have shown influenza vaccination as a safe and effective preventive measure for reducing mortality and morbidity due to pneumonia [22].

Conclusion

Pneumonia in geriatrics is a challenge for clinicians when viewed from diagnostic, treatment, and prevention efforts. Pneumonia in geriatrics has no distinct symptoms, causing susceptibility, altered mental status, and high morbidity. Clinicians dealing with geriatric patients with pneumonia will be faced with the challenge of choosing the right antibiotics, antibiotic-resistant microorganisms, and patient's comorbidities. Vaccination as a safe and effective effort to prevent pneumonia in geriatrics has not been widely performed.

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