Models for Assessing Severity of Community Acquired Pneumonia

Essay

Submitted for Partial Fulfillment of Master Degree
in **General Intensive Care**

By

Donia Ali Elsayed Mahmoud Elmasry

M.B.,B.Ch - Faculty of Medicine – Alexandria University

Supervised by

Prof. Dr. Sameh Michel Hakim

Professor of Anesthesia and Intensive Care
Faculty of Medicine - Ain Shams University

Dr. Hanaa Abd Allah EL Gendy

Assistant Professor of Anesthesia and Intensive Care
Faculty of Medicine - Ain Shams University

Dr. Mohamed Osman Taeimah

Lecturer of Anesthesia and Intensive Care
Faculty of Medicine - Ain Shams University

Faculty of Medicine
Ain Shams University
2017

Abstract

Introduction: Community-acquired pneumonia (CAP) is the most common serious infection encountered in medical practice, with 1% to 10% of patients requiring admission to a hospital. The mortality rate of patients admitted is considerable, ranging from 5% to 25%.

Motivated by the results of the British Thoracic Society (BTS) study different investigators have identified several risk factors associated with a high mortality rate. The assessment of the severity of CAP can be determined at three stages: (1) At home or during the general practitioner's (GP) consultation; (2) in the hospital outpatient clinic or emergency room; and (3) in the medical ward and/or intensive care unit (ICU).

Aims: The aim of this work is to review the available models for assessing the severity of community acquired pneumonia and their clinical value in regular intensive care practice.

Summary: Pneumonia is an infection that inflames the air sacs in one or both lungs. The air sacs may fill with fluid or pus, causing cough with phlegm or pus, fever, chills, and difficulty in breathing. Pneumonia can range in seriousness from mild to life-threatening. It is most serious for infants and young children, people older than age 65, and people with health problems or weakened immune systems.

Conclusion: Biomarkers can help differentiate patients with pneumonia from heart failure and chronic obstructive pulmonary disease (COPD) exacerbation, with the latter not requiring antibiotics. Another advantage of biomarkers is that serial measurements can be used to assess the treatment response.

No matter how accurate, simple and sensitive the score is, it shouldn't substitute medical evaluation and clinical reasoning. Ideally the best strategic approach for CAP is SMART-DOCTORS.

Keywords: Assessing Severity, Community Acquired Pneumonia, ICU

ACKNOWLEDGEMENT

First of all, all gratitude is due to **God** *almighty for blessing this work until it has reached its end, as a part of his generous help, throughout my life.*

Really I can hardly find the words to express my gratitude to **Prof. Dr. Sameh Michel Hakim** *Professor of Anesthesia and Intensive Care, Faculty of Medicine, Ain Shams University, for his supervision, continuous help, encouragement throughout this work and tremendous effort he has done in the meticulous revision of the whole work. It is a great honor to work under his guidance and supervision.*

I would like also to express my sincere appreciation and gratitude to **Dr. Hanaa Abd Allah EL Gendy** *Assistant Professor of Anesthesia and Intensive Care, Faculty of Medicine, Ain Shams University, for her continuous directions and support throughout the whole work.*

I would also like to express my deep appreciation to **Dr. Mohamed Osman Taeimah,** *Lecturer of Anesthesia and Intensive Care, Faculty of Medicine-Ain Shams University, for his great kindness, constant assistance and guidance.*

Last but not least, I dedicate this work to my family, whom without their sincere emotional support, pushing me forward this work would not have ever been completed.

Donia Ali Elsayed Mahmoud

Contents

List of Abbreviations

ARDS : Acute respiratory distress syndrome

ATS : American Thoracic Society

BAL : Bronchoalveolar lavage

BTS : British Thoracic Society

BUN : Blood urea nitrogen

CAP : Community acquired pneumonia

COPD : Chronic Obstructive Pulmonary Disease

CT : Computed tomography

CURB-65 : Confusion, Uremia, Respiratory rate, low Blood pressure, age 65 years or greater

CRB-65 : Confusion, Respiratory rate, low Blood pressure, age 65 years or greater

CRP : C-reactive protein

CXR : Chest X-ray

ER : Emergency room

FiO_2 : Fraction of inspired oxygen.

GP : General Practitioner

ICU : Intensive care unit

IDSA/ATS : Infectious Disease Society of America /American Thoracic Society

IL-1 : Interleuken 1

IRVS : Intensive respiratory or vasopressor support

PaO_2 : Partial pressure of arterial oxygen

PEEP : Positive end-expiratory pressure

PCT : Procalcitonin

PIRO : Predisposition, Insult, Response, Organ dysfunction

PSI : Pneumonia Severity Index

MDR : Multiple drug resistance

MRSA : Methicillin resistant staphylococcus aures

RSV : Respiratory syncytial virus

SCAP : Sever Community Acquired Pneumonia

SMART-COP : Low **S**ystolic blood pressure less than 90 mm Hg , **M**ulti lobar pneumonia , low **A**lbumin level less than 3.5 g/dL , high **R**espiratory rate 25 to 30 breaths/minute, **T**achycardia higher than 125 beats/minute, **C**onfusion, poor **O**xygenation, and low arterial **p**H less than 7.35

TNF-α : Tumor necrosis factor alpha

V/Q : Ventilation-perfusion

List of Tables

List of Figures

Introduction

Community acquired pneumonia (CAP) is the most common serious infection encountered in medical practice, with 1% to 10% of patients requiring admission to a hospital. The mortality rate of patients admitted is considerable, ranging from 5% to 25 % **(Polverino and Torres, 2011).**

Motivated by the results of the British Thoracic Society (BTS) study, several risk factors associated with a high mortality rate have been identified. The assessment of the severity of CAP can be determined at three stages: (1) At home or during the general practitioner's (GP) consultation; (2) in the hospital outpatient clinic or emergency room (ER); and (3) in the medical ward and/or intensive care unit (ICU) **(Polverino and Torres, 2011).**

Severity assessment is a key element in the management of CAP. The Pneumonia Severity Index (PSI) or the CURB-65 (confusion, uremia, respiratory rate, blood pressure, age 65 years old or more) can accurately identify patients with low risk of death who might be considered for outpatient care while those with high risk of death would be hospitalized **(Bui *et al*., 2011).**

Different scores, such the American Thoracic Society (ATS) criteria or the SMART-COP (low Systolic blood pressure less than 90 mm Hg, multilobar pneumonia, low albumin level less than 3.5 g/dL, high Respiratory rate 25 to 30 breaths/minute, tachycardia higher than 125 beats/minute, confusion, poor Oxygenation, and low arterial pH less than 7.35) score, were built to predict need for admission to ICU, vasopressors or mechanical ventilation. Each score has its own strengths and weaknesses and physicians must be aware of these limitations **(Bui *et al.*, 2011).**

Limitations of these prognostic tools include their variable utility in the elderly, and their failure to include certain comorbidities (chronic obstructive pulmonary disease (COPD) and immune suppression) and social factors, in their calculations **(Niederman, 2009).**

The need for ICU care is also not well-defined by measuring the PSI or CURB-65, and other tools such as those developed by the Infectious Diseases Society of America/ American Thoracic Society (IDSA/ATS) guideline committee and the SMART-COP rule may have greater utility for this purpose **(Restrepo *et al.*, 2010).**

No scoring system can replace clinical judgment about the admission decision and prospective studies have shown that physicians still admit at least 30%-60% of low morality risk patients when using PSI to guide this decision **(Niederman, 2009).**

It was found that in patients with severe community acquired pneumonia, delayed admission to the ICU is a risk factor associated with higher mortality **(Restrepo *et al.*, 2010).**

Aim of the Work

The aim of this work is to review the available models for assessing the severity of community acquired pneumonia and their clinical value in regular intensive care practice.

Chapter (I):

Definition, Epidemiology and Risk Factors for Community Acquired Pneumonia

Definition of Community Acquired Pneumonia:

It is defined as inflammation and consolidation of lung tissue due to an infectious agent. It is an infection that inflames the air sacs in one or both lungs. The air sacs may fill with fluid or pus (purulent material), causing cough with phlegm or pus, fever, chills, and difficulty in breathing. It is defined as pneumonia not acquired in a hospital or a long-term care facility. It can range in seriousness from mild to life-threatening. It is most serious for young children, people older than age 65, and people with health problems or weakened immune systems **(Marrie, 2015).**

The term pneumonia includes any inflammatory condition of the lung in which some or all of the alveoli are filled with fluid and blood cells, as shown in Figure 1 **(Guyton and Hall, 2016).**

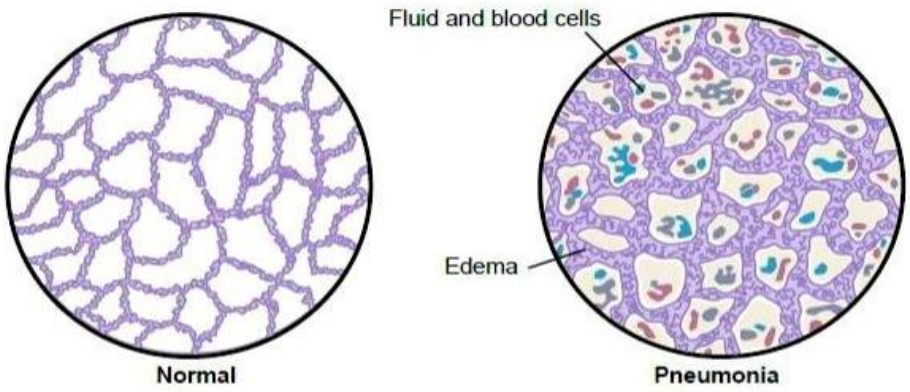

Figure 1: Lung alveolar changes in pneumonia **(Guyton and Hall, 2016).**

A common type of pneumonia is bacterial pneumonia, caused most frequently by pneumococci. This disease begins with infection in the alveoli; the pulmonary membrane becomes inflamed and highly porous so that fluid and even red and white blood cells leak out of the blood into the alveoli. Thus, the infected alveoli become progressively filled with fluid and cells, and the infection spreads by extension of bacteria or virus from alveolus to alveolus. Eventually, large areas of the lungs, sometimes whole lobes or even a whole lung become "consolidated" which means that they are filled with fluid and cellular debris. In persons with pneumonia, the gas exchange functions of the lungs decline in different stages of the disease.

In early stages, the pneumonia process might well be localized to only one lung, with alveolar ventilation reduced while blood flow through the lung continues normally. This condition causes two major pulmonary abnormalities:

(1) Reduction in the total available surface area of the respiratory membrane.

(2) Decreased ventilation-perfusion (V/Q) ratio. Both of these effects cause hypoxemia and hypercapnia **(Guyton and Hall, 2016).**

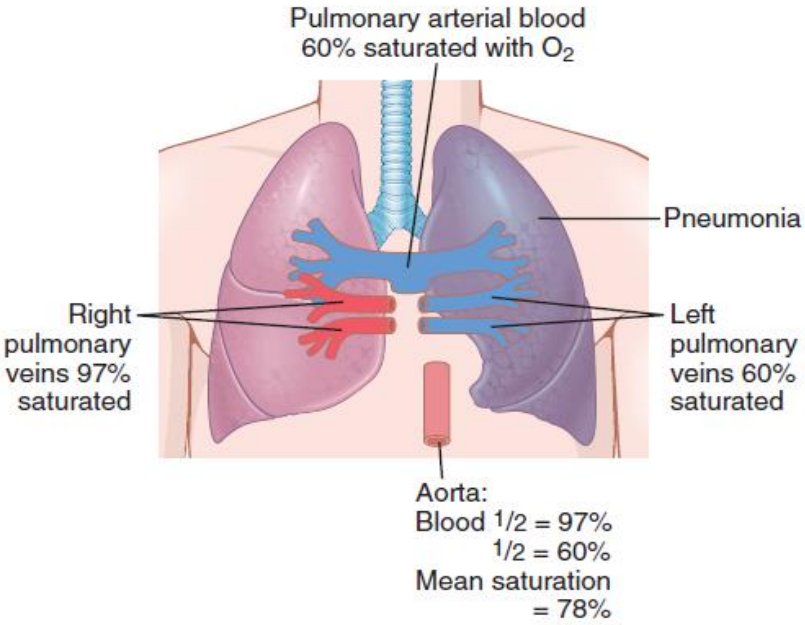

Figure 2: Effect of pneumonia on percentage saturation of oxygen in the pulmonary artery, the right and left pulmonary veins, and the aorta **(Guyton and Hall, 2016).**

Figure 2 shows the effect of the decreased V/Q ratio in pneumonia. The blood passing through the aerated lung becomes 97% saturated with oxygen, whereas that passing through the unaerated lung is about 60% saturated. Therefore, the average saturation of the blood pumped by the left heart into the aorta is only about 78%, which is far below normal **(Guyton and Hall, 2016)**.