INTRODUCTION

Community – acquired pneumonia (CAP) is a serious illness, up to 40% of adults with CAP require hospital admission, also it is the commonest infectious cause of death and the sixth leading cause of death among diseases as hospital mortality varies between 5% and 12% and up to 50% in those admitted in ICU. In addition to 1% mortality in CAP managed in the community in outpatient clinics ***(Chalmers et al., 2008).***

Despite being the cause of this significant morbidity and mortality, pneumonia is often misdiagnosed, mistreated and underestimated ***(Loscalzo, 2013).***

The diagnosis of pneumonia, once thought to be accomplished simply by physical examination, history taking, and specific auscultatory findings, has recently become highly dependent on imaging, as studies comparing examinations by expert physicians to chest radiography have verified the failure of auscultation as a diagnostic method in evaluation of pneumonia, yet physicians are under an increasing burden to be more accurate, and missing pneumonia is seen as a substantial liability ***(Blaivas, 2012).***

Thus an adequate treatment is reliant on an early diagnosis of pneumonia, yet the diagnosis is not always clear at presentation to the ED ***(Cortellaro et al., 2012).***

Additionally, the common approach in general private practice of prescribing antibiotics to any patient presenting with

a cough and fever contributes to increasing antibiotic resistance ***(Blaivas, 2012).***

Currently, chest X-ray is widely recognized as a crucial step in the diagnosis of pneumonia, its advantages are the relatively low dose of ionizing radiations administered to the patients and the complete and immediate visualization of the whole chest. However, this modality also has significant disadvantages: It cannot be administered to some groups of patients (e.g. pregnant women), both projections (postero-anterior and lateral) often are impossible to acquire in the ED Moreover, the time requested to carry out standard chest radiography and to draw up a report may lead to a delay in diagnosis and a prolonged stay in the ED, contributing to ED overcrowding, and, above all, chest radiographs exhibit a limited accuracy for use in the diagnosis of some illnesses ***(Zanobetti et al., 2011).***

That led to increase the usage of CT scan in the diagnosis of pneumonia during the last decade. CT could be considered the ‘‘gold standard’’ technique in the diagnosis of pneumonia, however it cannot be used as a first-line radiologic examination in all patients with suspected pneumonia ***(Nafae et al., 2013).***

On the other hand using lung ultrasound saves time and decreases the need for CT, whose drawbacks include delayed care implementation, irradiation, cost (therefore available only in resource-rich countries), and the required supine position. Lung ultrasound is nearly equivalent to CT in detecting most

disorders, can be repeated at will, and provides additional information ***(Lichtenstein and Meziere, 2008).***

Also bedside chest ultrasound is a reliable tool for the diagnosis of pneumonia in the ED, probably being superior to CXR in this setting. It is likely that its wider use will allow a faster diagnosis, conducive to a more appropriate and timely therapy ***(Cortellaro et al., 2012).***

Interestingly, lung ultrasound has grown to such an extent that an evidence-based consensus conference was held in2010 and 2011, grading supporting evidence and bringing together dozens of published experts from multiple countries around the world. The consensus conference found lung ultrasound to have broad utility in evaluating patients for pneumonia, lung contusions, pneumothorax, pulmonary edema, pulmonary embolisms, and other pathologic conditions. In general, ultrasound imaging performed better than plain radiography ***(Blaivas, 2012).***

Aim of the Work

The aim is to study the role of chest ultrasonography in the diagnosis of pneumonia in Emergency Department.

COMMUNITY-ACQUIRED PNEUMONIA

Pneumonia is an inflammatory condition of the lung, especially affecting the microscopic air sacs (alveoli), associated with fever, chest symptoms, and a lack of air space (consolidation) on a chest X-ray ***(McLuckie, 2009).***

Community-acquired:

Community-acquired pneumonia (CAP) is infectious pneumonia in a person who has not recently been hospitalized. CAP is the most common type of pneumonia. The most common causes of CAP vary depending on a person's age, but they include Streptococcus pneumoniae, viruses, the atypical bacteria, and Haemophilus influenza. Overall, Streptococcus pneumonia is the most common cause of community-acquired pneumonia worldwide. Gram-negative bacteria cause CAP in certain at-risk populations ***(Galetto-Lacour et al., 2013).***

Epidemiology:

The World Health Organization estimates that lower respiratory tract infection is the most common infectious cause of death in the world (the third most common cause overall), with almost 3.5 million deaths yearly ***(World Health Organization, 2013).***

While in Africa, pneumonia is one of the most frequent reasons for adults being admitted to hospital; one in ten of these

patients die from their disease. It is several-fold higher in the elderly and HIV-infected individuals ***(Scott et al., 2000).***

Moreover viral respiratory infections can occur in epidemics and can spread rapidly within communities across the globe. Every year, influenza causes respiratory tract infections in 5–15% of the population and severe illness in 3–5 million people ***(WHO, 2003).*** As happened in 2003, severe acute respiratory syndrome (SARS), caused by a previously unrecognized corona virus, rapidly spread throughout the world ***(Centers for Disease Control and Prevention, 2013).***

Pathogenesis

The lungs are constantly exposed to particulate material and microbes that are present in the upper airways and, by microaspiration, enter the lower respiratory tract. Nevertheless, the lower airways usually remain sterile because of the pulmonary defense mechanisms. These host defenses can be categorized as innate (nonspecific) or acquired (specific). Thus the development of CAP indicates either a defect in host defenses, exposure to a particularly virulent microorganism ***(Wunderink and Waterer, 2004).***

Virulence factors:

Some microorganisms have developed specific mechanisms to overcome pulmonary host defenses and establish infection; Examples include ***(Wunderink and Waterer, 2004)***:

Bacterial:

Chlamydophila Pneumonia produces a ciliostatic factor, Mycoplasma Pneumoniae can shear off cilia, S. Pneumoniae and Neisseria Meningitidis produce proteases that can split secretory IgA. In addition, the pneumococcus produces other virulence factors, including: the capsule that inhibits phagocytosis, pneumolysin, a thiol-activated cytolysin that interacts with cholesterol in host cell membranes, neuraminidase, and hyaluronidase. Also Mycobacterium species, Nocardia species, and Legionella species are resistant to the microbicidal activity of phagocytes ***(Wunderink and Waterer, 2004)***.

Viral:

Influenza virus markedly reduces tracheal mucus velocity within hours of onset of infection and for up to 12 weeks post-infection. And when the immune system responds to the infection, even more lung damage may occur as white blood cells, mainly mononuclear cells, primarily generate the inflammation ***(Singanayagam et al., 2009).*** As well as damaging the lungs, many viruses simultaneously affect other organs and thus disrupt other body functions; Viruses also make the body more susceptible to bacterial infections; in this way bacterial pneumonia can arise as a co-morbid condition ***(Figueiredo, 2009).***

Predisposing host conditions:

In addition to microbial virulence factors, diseases and conditions in the host may lead to impairment of pulmonary defense and increased risk of CAP, These conditions include diabetes mellitus, coronary artery disease, CHF, immunosuppression, neurologic disease, active malignancies, alcohol consumption, increasing age, bacteremia, leukopenia, hypotension, altered mental status, tachypnea, hypoxemia, aspiration pneumonia, and infections due to gram-negative organisms ***(Mandell et al., 2007).***

Risk factors for drug-resistant Streptococcus pneumonia include age greater than 65 years, beta-lactam therapy within the past 3 months, immunosuppression (either as the result of an illness or induced by treatment with corticosteroids), multiple medical co-morbidities, alcoholism, and exposure to a child in a day care center. Risk factors for enteric gram-negative organisms are recent antibiotic therapy, underlying cardiopulmonary disease, residence in a nursing home, and multiple medical comorbidities. While risk factors for Pseudomonas aeruginosa are structural lung disease such as bronchiectasis, broad-spectrum antibiotic therapy that lasted for at least 7 days in the past month, corticosteroid therapy with at least 10 mg of prednisone per day, and malnutrition ***(Dahr, 2012).***

Drugs

Several studies have suggested an increased incidence of nosocomial pneumonia when the gastric pH is increased by the

use of H_2 blockers, proton pump inhibitors (PPIs) or antacids ***(Gulmez et al., 2007).***

While other studies have shown an association between use of antipsychotic drugs and CAP, although the mechanism remains unclear, use of antipsychotic drugs was associated with an almost 60 percent increase in the risk of pneumonia among elderly persons requiring hospitalization ***(Knol et al., 2008).***

Patients with COPD who were receiving inhaled glucocorticoids were at increased risk for CAP, and patients with asthma who were receiving inhaled anticholinergic agents (ipratropium bromide) were at increased risk for CAP ***(Almirall et al., 2010).***

Modes of transmission: Inhalation and aspiration are the two most common means of acquiring an infectious pneumonia ***(Cunha, 2006).***

1- Inhalation: of small airborne infectious particles (airborne transmission). Most microorganisms that cause pneumonia are able to survive on airborne droplets; these droplets can float in the air for quite a long time and if still infectious can sometimes cause pneumonia ***(Chan et al., 2001).***

2-Aspiration: of resident naso-oropharyngeal flora or large airborne particles after deposition in the naso-oropharynx (aspiration pneumonia). Usually aspiration of material into the lungs occurs during sleep; certain people aspirate more than others during sleep and as a result have more problems with

lower respiratory tract infections. Additionally other groups of people bothered by aspiration related lower respiratory tract infections are alcohol abusers, drug abusers, and comatose patients ***(Cunha, 2005).***

3-Hematogenous spread to the lung from another site of infection; People with endocarditis, septic pelvic or jugular thrombophlebitis may also experience lower respiratory tract infections. Pneumonia acquired by hematogenous spread to the lungs, often times is bilateral and uniform. But pneumonia transmitted by bronchogenic infection (inhalation, aspiration) is usually unilateral and tend to localize in the lung ***(Boersma et al., 2006).***

4-Direct extension from a contiguous site of infection. As Entamoeba histolytica can cause pneumonia by direct extension from an amebic abscess in the liver. Influenza and Respiratory syncytial viruses can spread from the upper respiratory tract to the LRT via infection of the respiratory epithelium ***(Raafat, 2002).***

5-Exogenous penetration and contamination of the lung can occur due to accidental trauma (car accident) or surgery ***(Cunha, 2006).***

Etiology:

Table (1): Most common etiologies of community acquired pneumonia.

Patient type	Causative organism
Outpatient	Streptococcus pneumonia Mycoplasma pneumonia Haemophilus influenzae Chlamydophila pneumonia Respiratory viruses ¥
Inpatient(non ICU)	S.pneumoniae M.pneumoniae C.pneumoniae H.influenzae Legionella species Aspiration Respiratory viruses ¥
Inpatient (ICU)	S.pneumoniae Staphylococcus aureus Legionella species Gram negative bacilli H.influenzae
NOTE: based on collective data from recent studies, ICU, intensive care unit ¥) influenza A and B, adenovirus, respiratory syncytial virus, and Para influenza.	

(Mandell et al., 2007)

Diagnosis:

Clinical evaluation:

Pneumonia is characterized by the presence of fever, altered general well-being, and respiratory symptoms such as cough (90%), expectoration (66%), dyspnea (66%), pleuritic pain (50%), and hemoptysis (15%); In elderly patients, especially those with multiple comorbidities, pneumonia may

present with general weakness, decreased appetite, altered mental status, incontinence, or decompensation due to underlying diseases ***(Torres et al., 2015).***

Table (2): Some clinical features reported to be more common with specific pathogens:

Streptococcus pneumoniae: increasing age, co-morbidity, acute onset, high fever and pleuritic chest pain.
Bacteraemic S pneumoniae: female sex, excess alcohol, diabetes mellitus, chronic obstructive pulmonary disease, dry cough.
Legionella pneumophila: younger patients, smokers, absence of co morbidity, diarrhea, neurological symptoms, more severe infection and evidence of multisystem involvement (eg, abnormal liver function tests, elevated serum creatine kinase).
Mycoplasma pneumoniae: younger patients, prior antibiotics, less multisystem involvement.
Chlamydophila pneumoniae: longer duration of symptoms before hospital admission, headache.
Coxiella burnetii: males, dry cough, high fever.

(Lim et al., 2009)

As well as the presence of tachypnea may precede other signs of pneumonia by 1 to 2 days. Tachycardia is another common initial sign but is less frequent and specific than tachypnea. Fever is absent in 30% to 40% of patients ***(Zalacain et al., 2003).***

Abnormalities on clinical examination include focal signs on chest examination, most commonly crackles, but occasionally the classical features of lung consolidation dullness to percussion, bronchial breathing and enhanced vocal resonance ***(Woodhead et al., 2005).***

Radiological evaluation:

Chest radiographs:

Routine postero-anterior and lateral chest radiographs are universally recommended for patients with suspected pneumonia ***(Mandell et al., 2003).***

In patients who are too ill to stand up, antero–posterior (AP) upright or supine projections offer alternative but considerably less satisfactory views. Because the AP projection is of inferior quality because of the shorter focal-film distance, the greater magnification of the heart, and often the restricted ability of these patients to suspend respiration or achieve full inspiration ***(Wever, 2013).***

Although several radiologic patterns have been associated with pneumonia caused by specific microorganisms, this is not a reliable method for diagnosing a specific pathogen ***(Virkki et al., 2002).***

Nonetheless, the presence of air-bronchograms and a lobar or segmental pattern is more characteristic of typical than atypical causes of pneumonia. In contrast, a mixed pattern (alveolar and interstitial disease) is more frequently observed with atypical pneumonias. Pneumonia complicating aspiration (frequently from anaerobes) most often involves the superior segment of the right lower lobe or posterior segment of the right upper lobe, or both, as well as the corresponding segments on the left; Infections developing from hematogenous seeding often appear as multiple