Acta Scientific MEDICAL SCIENCES (ISSN: 2582-0931)

Volume 5 Issue 3 March 2021

Research Article

Severe Community-acquired Pneumonia in Obese Patients and Need for Mechanical Ventilation

Fetco-Mereuță Diana*, Caşcaval Virginia, Matcovschi Sergiu, Grib Livi, Talmaci Cornelia, Țerna Eudochia, Chihai Viorica and Dumitraş Tatiana

Department of Internal Medicine, State University of Medicine and Pharmacy "Nicolae Testemițanu", Republic of Moldova

***Corresponding Author:** Diana Fetco-Mereuță, Department of Internal Medicine, State University of Medicine and Pharmacy "Nicolae Testemițanu", Chişinău, Republic of Moldova.

Received: January 15, 2021

Published: February 08, 2021

Abstract

Background: Community-acquired pneumonia (CAP) is a heterogeneous entity with a variable clinical presentation and a wide range of responsible pathogens that differ depending upon age, comorbidities and recent exposures. Obesity is associated with an increased risk of acquiring infections such as community-acquired pneumonia.

Methods: In this retrospective case-control study, we analyzed 82 case histories of patients hospitalized with severe community-acquired pneumonia, from January 2017 to November 2019, based on clinical, laboratory and instrumental data.

Results: The results of the study showed that invasive mechanical ventilation and tracheostomy was applied more frequently for obese patients with severe community-acquired pneumonia. Among the comorbidities, the presence of chronic obstructive pulmonary disease (COPD) had a weak positive correlation with severe CAP evolution in the group with obesity.

Conclusion: Obesity, in association with COPD, has been shown to have a negative impact on CAP severity, explained by higher rate of application of invasive mechanical ventilation and the need for tracheostomy.

Keywords: Severe Community-acquired Pneumonia; Obesity; Invasive Ventilation; Comorbidities; Clinical Characteristics

Abbreviations

CAP: Community-acquired Pneumonia; COPD: Chronic Obstructive Pulmonary Disease; PCT: Procalcitonin; ICU: Intensive Care Unit; BMI: Body Mass Index.

Introduction

Community-acquired pneumonia (CAP) has become the fourth most common cause of death worldwide, exceeded only by ischemic heart disease, stroke and chronic obstructive pulmonary disease (COPD) [3].

CAP is a heterogeneous entity with a variable clinical presentation and a wide range of responsible pathogens that differ depending upon age, comorbidities and recent exposures. Although outcomes improved with the advent of antibiotics, CAP continues to be one of the world's leading causes of hospitalization, morbidity and mortality [29].

During recent decades, the number of patients requiring intensive care management due to severe community-acquired pneumonia has increased globally, especially among the elderly, patients with comorbidities and the immunocompromised [17]. One third of CAP presents a severe form which can be potentially fatal [13]. A large population-based surveillance study on hospitalized CAP patients found that 21% of patients required intensive care unit (ICU) admission, with 26% of them needing mechanical ventilation [11].

Obesity is a public health problem that has reached epidemic proportions with an increasing worldwide prevalence [10]. Obesity is independently associated with an increased risk of acquiring infections such as community-acquired pneumonia [6]. Furthermore, obesity could lead to worse outcomes in those who develop infections, perhaps as a result of dysregulation of the inflammatory cascade involving increased levels of cytokines, adiponectin and leptin and exaggerated macrovascular and microvascular re-

sponses [12,21]. Obesity also leads to impairments in lung function that include adverse changes in mechanics and airway resistance and impaired gas exchange [7]. Moreover, obesity is also associated with the risk of major chronic conditions such as diabetes mellitus, cardiovascular disease and liver diseases, and those diseases may cause an elevated risk of pneumonia [9].

Materials and Methods

In this retrospective case-control study, we analyzed case histories of patients hospitalized with severe community-acquired pneumonia, during January 2017- November 2019. The study included 82 patients aged 34-83 years, divided in two groups: group 1 (41 patients with obesity) and group 2 (41 normal weight patients).

The inclusion criteria were: clinical data (sudden onset, fever, chills, progressive dyspnoea, muco-purulent or purulent sputum, physical signs of lung consolidation and pleural chest pain), recent infiltrate on chest x-ray examination, bacteriological examination (sputum culture performed), body mass index (BMI): for obese patients BMI ≥ 30 kg/m^2 and for normal weight patients BMI 18.5-24.9 kg/m^2 and laboratory tests (full blood count, C-reactive protein, fibronogen and procalcitonin).

Assessment of pneumonia severity was performed by the following scores: CAP-PIRO, DS-CRB-65, CURB-65 and assessment of inflammation severity by SIRS score.

Statistical analysis

Data were statistically analyzed using the Statistical Package for Social Science (SPSS, version 20). The results were expressed as n (%) for categorical variables and mean ± SD for continuous variables. The correlation analysis of the variables was performed using the non-parametric test Spearman's Rho. A p-value less than 0.05 was considered statistically significant.

Results and Discussion

According to the etiology of severe community-acquired pneumonia, no statistically significant differences were found between the study groups, but *Streptoccocus pneumoniae* and *Streptoccocus viridans* were the predominant etiological agents (7.5% vs. 2.4% and 14.6% vs. 15.9%, p > 0.05).

The mean age of patients with obesity and severe community-acquired pneumonia was 64.6 ± 12.9 years versus 62.2 ± 9.7 years in normal weight group (p > 0.05). Clinical data were without significant differences between the groups, except for pleural pain, with a higher frequency in the group of CAP and obesity: 15.9% vs. 6.1% (rs = 0.23, p < 0.05). Invasive ventilation was applied in 19% vs. 15% of cases (p=0.05), in group 1 and group 2, respectively. Although the mean duration of invasive ventilation did not differ significantly (5.7 ± 2.5 vs. 5.5 ± 3.7, p > 0.05), tracheostomy was performed in 6 cases (7.3%) only in the group with obesity (rs = 0.28, p < 0.05). The average length of hospital stay was longer in group with obesity 15.2 ± 7.3 days vs. 12.5 ± 5.7 days, (p > 0.05) (Table 1).

Clinical and demographic data	Group 1: patients with obesity and CAP	Group 2: normal weight patients and CAP	P-value
Age (years, M ± SD)	64.6 ± 12.9	62.6 ± 9.7	0.43
Productive cough(n, %)	18 (21.9%)	15 (18.2%)	0.52
Pleural pain (n, %)	13 (15.9%)	5 (6.1%)	0.03
Localized crackles (n, %)	23 (28%)	26(31.7%)	0.4
Systolic blood pressure <90mmHg (n, %)	10 (12.2%)	2 (2.4%)	0.01
Impaired consciousness (n,%)	10 (12.2%)	7 (8.5%)	0.12
Fever (°C, M ± SD)	38.8 ± 3.3	37.6 ± 6.8	0.17
Invasive ventilation (n, %)	16 (19.5%)	12 (15%)	0.05
Tracheostomy (n, %)	6 (7.3%)	0	0.01
The duration of invasive ventilation (days, M ± SD)	5.7 ± 2.5	5.5 ± 3.7	0.96
The length of hospital stay (days, M ± SD)	15.2 ± 7.3	12.5 ± 5.7	0.87

Table 1: Clinical characteristics of severe CAP in obese versus normal weight patients.

Comorbidities were present in all patients included in the study. Most patients presented more than six comorbidities. Among the comorbidities, the presence of chronic obstructive pulmonary disease (COPD) was more characteristic for obese patients: 21% vs. 8%, ($p < 0.05$). The most common comorbidities found in patients were: chronic heart failure 45% vs. 48%, diabetes mellitus 20% vs. 16%, chronic liver disease 11% vs. 9% and chronic renal failure 9% vs. 11%, ($p > 0.05$), in group 1 and group 2, respectively.

Most patients from both groups were present multilobar/bilateral infiltrates on x-ray examination (33% vs. 26%, $p > 0.05$). Also, on chest radiography at discharge the incomplete radiological resolution of the pulmonary infiltrate was more common for obese patients with severe CAP (37% vs. 23%, $p > 0.05$) and complete radiological resolution more common in normal weight patients (18% vs.5%, p=0.01).

The complications were reported in all the cases, of them - 100% of acute respiratory failure in both groups, acute respiratory distress syndrome in 9% vs. 10%, cardiogenic pulmonary edema in 11% vs. 13%, septic shock in 4% vs. 10%, cerebral edema in 2% vs. 5% and multiple organ dysfunction syndrome in 6% vs. 5%, ($p > 0.05$), in group 1 and group 2, respectively. The mortality rate in patients with severe community-acquired pneumonia was identical (8.5%) in obese and normal weight group.

Patients with severe community-acquired pneumonia and obesity had weak positive correlation with the presence of pleural pain ($rs = 0.23$, $p < 0.05$), with tracheostomy ($rs = 0.28$, $p < 0.05$), the presence of COPD ($rs = 0.26$, $p < 0.05$) and elevated level of procalcitonin (PCT) ($rs = 0.2$, $p < 0.05$) (Table 2).

Variables for correlational analysis	Rs, Spearman	P
Impaired consciousness	-0.2	p > 0.05
Pleural pain	0.23	p < 0.05
Invasive ventilation	0.1	p > 0.05
Tracheostomy	0.28	p < 0.05
Chronic obstructive pulmonary disease (COPD)	0.26	p < 0.05
Chronic liver disease	0.06	p > 0.05
Chronic renal failure	-0.05	p > 0.05
Chronic heart failure	0.09	p > 0.05
Diabetes mellitus	0.06	p > 0.05
C reactive protein (CRP) >6 mg/ml	0.05	p > 0.05
Fibrinogen >4 g/l	0.01	p > 0.05
Procalcitonin> 2 ng/ml	0.02	p < 0.05

Table 2: Correlation analysis of severe CAP in obese patients.

Discussion

Regarding to the data of our study, the predominant microbial agents were *Streptoccocus pneumoniae* and *Streptoccocus viridans.* Other studies also had reported *Streptococcus pneumoniae* was the commonest causative agent of CAP. Globally, *Streptococcus pneumoniae (pneumococcus)* is widely accepted as being the most common pathogen in CAP, usually presented with acute symptoms of lower respiratory tract infection, historically called "typical presentation". An estimated prevalence of 19.3% to 34% was reported for *S. pneumoniae* in Europe [24].

Compared with patients of normal weight, patients who are obese, experience more frequent respiratory failure requiring mechanical ventilation [26]. In mechanically-ventilated patients with morbid obesity as the severity of illness increases, the risk of death increases. Morbid obesity is also associated with higher rates of tracheostomy [16]. Findings of our study showed that invasive ventilation was applied more frequently in obese patients versus normal weight patients (19% vs. 15% of cases, $p > 0.05$) and tracheostomy was performed in 6 cases (7.3%, $p < 0.05$), only in the group with obesity. However, our data are consistent with other studies which suggest that a high BMI is associated with severe outcomes among adults hospitalized with CAP.

The results of Zizza., *et al.* study, suggest the relationship between BMI and length of stay because the high values of BMI, exhibited greater lengths of stays while normal-weight exhibited the shortest length of stay [30]. According to data of our study, the length of hospital stay was longer in the group with obese patients (15.2 ± 7.3 days vs. 12.5 ± 5.7, $p > 0.05$).

There is a higher prevalence of obesity in COPD population compared with the general population [4]. Previous studies have shown that about 65% of the COPD population is overweight or obese [5, 14]. Patients with COPD and obesity are at a greater risk of pneumonia than the general population [4]. Clinical studies of pneumonia including outpatient, inpatient and ICU cohorts have shown that COPD is a frequently reported comorbid condition [22]. Compared to patients without COPD, patients with COPD are likely to have more severe pneumonia, increased number of hospital admissions, and worse outcome [23]. In the first year after a COPD diagnosis, individuals risk for pneumonia is 16 times higher than in those without COPD [27]. The obtained data reported that the presence COPD had a weak positive correlation with severe CAP evolution in obese group: 21% vs. 8% ($rs = 0.26$, $p < 0.05$).

Miteva., *et al.* found that one of the most common associated diseases in patients with CAP was diabetes mellitus (23,6%),

chronic heart failure (23,5%) and cerebrovascular disease (17,2%) [19]. In another studies on patients with severe CAP, Vidal., *et al.* and Falguera *et al.* also found diabetes, COPD, chronic renal disease, cardiovascular disease and liver disease, were present in high percentage of patients and had a negative impact on the prognosis of severe CAP [8,28].

A prospective observational study at Hospital Clinic, Barcelona, in the period of 2000-2013, included 4644 adults with diagnosis of CAP. Of these, 1069 (23%) had multi-lobar pneumonia and 585 (13%) presented bilateral infiltrates. Of the 585 patients with bilateral involvement, 198 (34%) were admitted to the ICU, 81 (16%) patients required invasive mechanical ventilation more frequently than the unilateral involvement and had a longer stay in hospital [18]. Morgan., *et al.* also mentioned that multi-lobar consolidation is often present in severe CAP and it can be suggestive for risk stratification in severity scores assessment [20].

Procalcitonin values vary according to the severity of pneumonia, and this association is stronger than between the disease severity and other clinical and laboratory variables [25]. There are many reports that show PCT levels on admission correlate with the severity of pneumonia and prognosis [15,25].

Ayman S.El-Dib., *et al.* in the study conducted at Tanta University Hospital during 2012-2013, found a statistically significant elevation of PCT in severe CAP [2]. Abbasi*., et al.* showed that elevated plasma PCT was positively associated with body mass index and waist circumference in obese subjects [1]. It should be noted that in our study, patients with community-acquired pneumonia and obesity had weak positive correlation with elevated level of PCT ($rs = 0.2$, $p < 0.05$).

Conclusion

The study revealed that obesity was associated with a longer hospitalization stay. No association was found between duration of mechanical ventilation, but tracheostomy was performed only on the obese patients. Clinical data were without significant differences between the groups, except for pleural pain with a higher frequency in the group of obese patients. Among the comorbidities, the presence of chronic obstructive pulmonary disease was more characteristic for those obese. No statistical differences between chest X-ray features were found in groups, most patients presented multi-lobar/bilateral infiltration. Incomplete radiological resolution of pulmonary infiltrate at discharge was more characteristic for patients with obesity.

Conflict of Interest

There is no conflict of interest.

Bibliography

1. Abbasi A., *et al.* "Plasma procalcitonin is associated with obesity, insulin resistance, and the metabolic syndrome". *Journal of Clinical Endocrinology and Metabolism* 95.9 (2010): 26-31.

2. Ayman S.El-Dib, *et al.* "Diagnostic and prognostic role of procalcitonin in CAP". *Egyptian Journal of Chest Diseases and Tuberculosis* 64.4 (2015): 871-875.

3. Ceccato A., *et al.* "Invasive Disease vs Urinary Antigen-Confirmed Pneumococcal Community-Acquired Pneumonia". *Chest* 151.6 (2017): 1311-1319.

4. Eisner MD., *et al.* "Body composition and functional limitation in COPD". *Respiratory Research* 8.1 (2007): 7.

5. Eriksson B., *et al.* "Only severe COPD is associated with being underweight: results from a population survey". *ERJ Open Research* 2.3 (2016): e00051.

6. Falagas ME., *et al.* "Obesity and infection". *Lancet Infection Disease* 6 (2006): 438-446.

7. Falagas ME., *et al.* "Effect of body mass index on the outcome of infections: a systematic review". *Obesity Review* 10 (2009): 280-289.

8. Falguera M., *et al.* "Etiology and outcome of community-acquired pneumonia in patients with diabetes mellitus". *Chest* 128.5 (2005): 3233-3239.

9. Formiguera X., *et al.* "Obesity: epidemiology and clinical aspects". *Best Practice and Research: Clinical Gastroenterology* 18 (2004): 1125-1146.

10. Heriberto RH., *et al.* "Obesity and Inflammation: Epidemiology, Risk Factors, and Markers of Inflammation". *International Journal of Endocrinology* (2013).

11. Jain S., *et al.* "Community-acquired pneumonia requiring hospitalization among U.S. adults". *The New England Journal of Medicine* 373 (2015): 415-427.

12. Kellum JA., *et al.* "Understanding the inflammatory cytokine response in pneumonia and sepsis: results of the Genetic and Inflammatory Markers of Sepsis (GenIMS) Study". *Archives of Internal Medicine* 167 (2007): 1655-1663.

13. Khawaja A., *et al.* "Etiology and outcome of severe community acquired pneumonia in immunocompetent adults". *BMC Infectious Diseases* 13.94 (2013).

14. Koniski ML., *et al.* "Distribution of body mass index among subjects with COPD in the Middle East and North Africa region: data from the BREATHE study". *International Journal of Chronic Obstructive Pulmonary Disease* 10 (2015): 1685-1694.

15. Krüger S., *et al.* "Procalcitonin predicts patients at low risk of death from community-acquired pneumonia across all CRB-65 classes". *European Respiratory Journal* 31 (2008): 349-355.

16. Kumar G., *et al.* "Obesity paradox' in invasive mechanical ventilation - fact or fiction". *Critical Care Medicine* 40.12 (2012): 1-328.

17. Laporte L., *et al.* "Ten-year trends in intensive care admissions for respiratory infections in the elderly". *Annals of Intensive Care* 8:84 (2018).

18. Liapikou A., *et al.* "Multilobar bilateral and unilateral chest radiograph involvement: implications for prognosis in hospitalised community-acquired pneumonia". *European Respiratory Journal* 48 (2016): 257-260.

19. Miteva D., *et al.* "The impact of comorbidities on the in-hospital mortality in patients with community-acquired pneumonia". *European Respiratory Journal* 46 (2015): 1840.

20. Morgan A., *et al.* "Severe community-acquired pneumonia". *BJA Education* 16.5 (2016): 167-172.

21. Murugan AT., *et al.* "Obesity and respiratory diseases". *Chronic Respiratory Disease* 5 (2008): 233-242.

22. Ramirez JA., *et al.* "Adults hospitalized with pneumonia in the United States: incidence, epidemiology, and mortality". *Clinical Infectious Diseases* 65 (2017): 1806-1812.

23. Rello J., *et al.* "Implications of COPD in patients admitted to the intensive care unit by community-acquired pneumonia". *European Respiratory Journal* 27 (2006): 1210-1216.

24. Rozenbaum MH., *et al.* "The role of Streptococcus pneumoniae in community-acquired pneumonia among adults in Europe: A meta-analysis". *European Journal of Clinical Microbiology and Infectious Diseases* 32 (2013): 305-316.

25. Muller B., *et al.* "Diagnostic and prognostic accuracy of clinical and laboratory parameters in community-acquired pneumonia". *BMC Infection Disease* 7 (2007): 10.

26. Shikora SA., "Enteral feeding tube placement in obese patients: considerations for nutrition support". *Nutrition in Clinical Practice* 2 (1997): 9-13.

27. Soriano J., *et al.* "Patterns of comorbidities in newly diagnosed COPD and asthma in primary care". *Chest* 128 (2005): 2099-2107.

28. Vidal A., *et al.* "Comorbidities impact on the prognosis of severe acute community-acquired pneumonia". *Porto Biomedical Journal* 2.6 (2017): 265-272.

29. Wunderink RG., *et al.* "Clinical practice. Community-acquired pneumonia". *The New England Journal of Medicine* 370.6 (2014): 543-51.

30. Zizza C., *et al.* "Length of Hospital Stays Among Obese Individuals". *American Journal of Public Health* 94.9 (2004): 1587-1591.