Original Article

Alcohol Use Disorders and Community-Acquired Pneumococcal Pneumonia: Associated Mortality, Prolonged Hospital Stay and Increased Hospital Spending

Miguel Gili-Miner, a,b,* Julio López-Méndez, a,b Luis Béjar-Prado, a Gloria Ramírez-Ramírez, a,b Ángel Vilches-Arenas, a,b José Sala-Turrens c

a Departamento de Medicina Preventiva y Salud Pública, Universidad de Sevilla, Sevilla, Spain
b Servicio de Medicina Preventiva y Salud Pública, Hospital Universitario Virgen Macarena, Sevilla, Spain
c Servicio de Documentación Clínica, Hospital Universitario Virgen Macarena, Sevilla, Spain

ARTICLE INFO

Article history:
Received 26 October 2014
Accepted 21 January 2015
Available online 20 October 2015

Keywords:
Pneumococcal pneumonia
Alcohol use disorders
Mortality
Hospital stay
Costs

ABSTRACT

Introduction: The aim of this study was to investigate the impact of alcohol use disorders (AUD) on community-acquired pneumococcal pneumonia (CAPP) admissions, in terms of in-hospital mortality, prolonged stay and increased hospital spending.

Methods: Retrospective observational study of a sample of CAPP patients from the minimum basic datasets of 87 Spanish hospitals during 2008–2010. Mortality, length of hospital stay and additional spending attributable to AUD were calculated after multivariate covariance analysis for variables such as age and sex, type of hospital, addictions and comorbidities.

Results: Among 16,202 non-elective admissions for CAPP in patients aged 18–74 years, 2685 had AUD. Patients admitted with CAPP and AUD were predominantly men with a higher prevalence of tobacco or drug use disorders and higher Charlson comorbidity index. Patients with CAPP and AUD had notably higher in-hospital mortality (50.8%; CI 95%: 44.3–54.3%), prolonged length of stay (2.3 days; CI 95%: 2.0–2.7 days) and increased costs (1869.2 €; CI 95%: 1498.6–2239.8 €).

Conclusions: According to the results of this study, AUD in CAPP patients was associated with increased in-hospital mortality, length of hospital stay and hospital spending.

© 2014 SEPAR. Published by Elsevier España, S.L.U. All rights reserved.

Trastornos por consumo de alcohol y neumonía neumocócica adquirida en la comunidad: mortalidad atribuible, prolongación de estancias y sobrecostes hospitalarios

RESUMEN

Introducción: El objetivo de este estudio es el análisis del impacto de los trastornos asociados al consumo de alcohol (TCA) en las neumonías neumocócicas adquiridas en la comunidad (NNAC), en términos de exceso de mortalidad intrahospitalaria, prolongación de estancias y sobrecostes.

Material y métodos: Estudio observacional retrospectivo de una muestra de pacientes que presentaron NNAC recogidos en los conjuntos mínimos básicos de datos de 87 hospitales españoles durante el periodo 2008–2010. Se calculó la mortalidad, la prolongación de estancias y los sobrecostes atribuibles a los TCA.

* Please cite this article as: Gili-Miner M, López-Méndez J, Béjar-Prado L, Ramírez-Ramírez G, Vilches-Arenas Á, Sala-Turrens J. Trastornos por consumo de alcohol y neumonía neumocócica adquirida en la comunidad: mortalidad atribuible, prolongación de estancias y sobrecostes hospitalarios. Arch Bronconeumol. 2015;51:564–570.

* Corresponding author.
E-mail address: mgili@us.es (M. Gili-Miner).
**Introduction**

Mortality due to infectious diseases in Spain has been falling over the last few decades, but pneumonia remains the primary cause of death in this group (35.9%). The most common type of pneumonia, and the one that causes most hospitalizations, is community-acquired pneumococcal pneumonia (CAPP). The incidence of which remains high in Spain and the rest of Europe.

Alcohol use disorders (AUDs) are a well-recognized risk factor for CAPP and have an impact on complications and outcomes of patients during admission. AUDs increase the risk of developing sepsis during pneumonia, a complication that prolongs hospital stay, worsens prognosis and increases the rate of unscheduled readmissions.

We explored this problem in patients aged 18–74 years, admitted to a selected group of 87 Spanish hospitals between 2008 and 2010, and attempted to control for other confounding and interaction factors, such as age, sex, type of hospital, other addictions and comorbidities. The aim of this study was to analyze the potential influence of AUDs on mortality, prolonged stay and increased costs among patients admitted due to CAPP.

**Methods**

**Type of Study, Sample and Participants**

This was a retrospective, observational study conducted in a selected group of Spanish hospitals.

For the group to be representative of the national situation and the autonomous communities in Spain, 87 hospitals were selected from all the autonomous communities using a stepwise sampling method that took into account the Health Ministry stratification of hospitals according to size and complexity.

Written or computerized clinical history data were used to code the diagnosis of each patient and the procedures he/she underwent, in accordance with the 9th Revision of the International Classification of Diseases and Causes of Death (ICD-9). Specialist personnel were responsible for coding the data and entering it in the database. These databases, known as minimum basic datasets (MBD), contain demographic information, dates of admission and discharge, type of admission and type of discharge, diagnostic codes for the main and secondary diagnoses, external causes and procedures, classified using ICD-9 codes. They also include diagnosis-related groups (DRGs), and each hospital is categorized according to size and complexity.

**Variables**

Cases with ICD-9 code 481 in any of the MBD diagnostic codes were defined as cases of CAPP. Scheduled admissions and patients transferred to another hospital were excluded.

**Results**

**Patient Characteristics**

At total of 16,202 admissions for CAPP were identified: 10,635 men (65.6%) and 5567 women (34.4%). Distribution by age group
and sex of patients admitted for CAPP are shown in Fig. 1. The number of admissions can be seen to rise progressively with age, primarily in men, until the age of 74 years.

A total of 2685 patients with CAPP had AUDs (16.6%), and differences between the sexes were notable: 2353 men (22.1%) and 332 women (6.0%). Distribution by age and sex of admissions for CAPP with AUDs is shown in Fig. 2, where it can be seen that AUDs were more common among men, mainly in the 45–54 years age group, followed by those aged 55–64, and then 35–44. The highest prevalence of AUDs among women was found in the 35–44 year age group, followed by those aged 45–54, and 55–64.

The characteristics of CAPP patients with and without AUDs are shown in Table 1. Patients with AUDs were mainly men, and had a higher rate of other addictions, mainly smoking (77.6%) and other drugs (19.4%). They also presented a higher prevalence of some of the comorbidities studied on admission, such as electrolyte disturbances, weight loss, coagulopathies, chronic lung disease, liver disease and AIDS, and a higher Charlson comorbidity index score.

Mortality

Distribution of mortality among CAPP patients according to age group and sex is shown in Fig. 3. Death rates were higher among men, and increased progressively with age.

The characteristics of patients admitted for CAPP who died and did not die during admission are shown in Table 2. CAPP patients who died were older (mean age, 60.5 years) and mainly men (73.3% of those who died). Some comorbidities were also found more frequently on admission, such as arrhythmias, pulmonary circulation disorders, electrolyte disturbances, weight loss, coagulopathies, congestive heart failure, cerebrovascular disease, dementia, liver disease, hemiplegia or paraplegia, kidney disease, cancer, leukemia, lymphoma and metastatic cancer, and a higher Charlson comorbidity index score.

Attributable Mortality, Prolonged Stay and Increased Costs

Results of the multivariate analysis of covariance, which included age, sex, hospital group, all addictions, and the Charlson comorbidity index, are shown in Table 3. Of the 2685 CAPP patients with AUDs, 256 died (crude mortality rate: 9.5%), compared to 892 of the 13,517 CAPP patients without AUDs (6.6%). In the multivariate model, adjusted mean mortality rates were significantly higher among CAPP admissions with AUDs (9.8% vs 6.5%), with a 3.3% mean difference, representing an excess of AUD-associated mortality of 50.8%.

The same table shows that means adjusted for hospital stay were significantly higher among CAPP admissions with AUDs (15.0 vs 12.7 days), with a mean AUD-associated extended stay of 2.3 days.

Finally, means adjusted for costs of hospital stay were significantly higher among CAPP admissions with AUDs (€10,595.50 vs €8726.30), representing an additional cost of €1869.20 for each AUD-associated CAPP.

Discussion

Pneumococcus remains the most common causative agent of community-acquired pneumonia. In the United States, however, the rate has declined, and is now only detected in 10%–15% of hospitalized cases. This reduction has been attributed to the combined influence of various factors, such as widespread administration...
of the pneumococcal polysaccharide vaccine in adults,\textsuperscript{23} almost universal administration of the pneumococcal conjugated vaccine in children,\textsuperscript{24} and falling smoking rates.\textsuperscript{25} In Spain and other European countries where these vaccines have been used less and where high smoking rates persist, pneumococcus is still responsible for the greatest proportions of community-acquired pneumonia.\textsuperscript{2,26}

The results obtained in this study indicate that AUDs have a considerable impact on in-hospital mortality in CAPP patients, causing significantly prolonged hospital stays and generating additional costs per discharged patient. Both occasional excessive consumption of alcohol and chronic alcohol abuse or dependency syndromes cause serious disturbances in specific and non-specific immunity, generating a risk factor not only for CAPP but also for the serious complications observed in these patients.\textsuperscript{1,14,27}

Due to size of the sample and the diversity of the hospitals in this study, our results are generalizable and need not be limited to patients from one or a few hospitals. This, to the best of our knowledge, is the first study conducted in Spain that calculates excess mortality, prolonged stay and additional costs attributable to AUDs in CAPP patients.

The major challenge in analyzing the influence of AUDs on the prognosis and other outcomes of hospitalized patients is adequate control of the confounding bias. Length of stay, costs, and in-hospital mortality differ depending on the reason for admission, the severity of the disease, comorbidities, type of hospital, and other demographic and social patient characteristics.\textsuperscript{28} Including the hospital group in the multivariate model for controlling the confounding bias is very important, since scientific evidence has shown that quality of medical care and outcomes differ depending on hospital type, facilities and standards of care.\textsuperscript{1,6,7,10}

Our study has several limitations. Our data were sourced exclusively from the MBDs, and no additional patient data were provided. Throughout the study, the definitions of addictive disorders, CAPP and comorbidities were used exactly as assigned by the doctors in each hospital, and coded and entered into the databases by the data managers, with no knowledge of interhospital variability. ICD-9 codes for identifying CAPP are those internationally used for studies based on hospital discharge databases, but there is no means of corroborating these diagnoses with any clinical, radiological and laboratory criteria for diagnosing CAPP that may be mentioned in the clinical records. Previous studies have found that ICD-9 code 481 is highly sensitive and highly specific for hospitalized cases of CAPP if all and not only the principal diagnostic codes are included. This is because CAPP patients are frequently admitted with sepsis, respiratory failure or other diagnoses that are coded as the principal diagnosis, and the diagnosis of CAPP is relegated to one of the secondary diagnoses.\textsuperscript{17,18,29} To avoid this data bias, all diagnostic codes were taken into consideration in this

---

Table 1: Characteristics of patients with community-acquired pneumococcal pneumonia with and without alcohol use disorders.

<table>
<thead>
<tr>
<th>Variables</th>
<th>With Alcohol Use Disorders (n=2685)</th>
<th>Without Alcohol Use Disorders (n=13,517)</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>332 (12.4)</td>
<td>5,235 (41.8)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Men</td>
<td>2,353 (87.6)</td>
<td>8,282 (61.3)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Age (years), mean (CI 95%)</td>
<td>55.5 (55.5–56.0)</td>
<td>55.8 (55.0–56.0)</td>
<td>.7990</td>
</tr>
<tr>
<td>Smokers</td>
<td>2,084 (77.6)</td>
<td>5,526 (40.9)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Other drug users</td>
<td>522 (19.4)</td>
<td>1,123 (8.3)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Comorbidities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obesity</td>
<td>117 (4.4)</td>
<td>823 (6.1)</td>
<td>.0005</td>
</tr>
<tr>
<td>Uncomplicated hypertension</td>
<td>493 (18.4)</td>
<td>3,239 (24.0)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Complicated hypertension</td>
<td>98 (3.6)</td>
<td>694 (5.1)</td>
<td>.0011</td>
</tr>
<tr>
<td>Heart arrhythmias</td>
<td>340 (12.7)</td>
<td>1,849 (13.7)</td>
<td>.1595</td>
</tr>
<tr>
<td>Pulmonary circulation disorders</td>
<td>90 (3.4)</td>
<td>412 (3.0)</td>
<td>.4064</td>
</tr>
<tr>
<td>Valve disease</td>
<td>79 (2.9)</td>
<td>571 (4.2)</td>
<td>.0020</td>
</tr>
<tr>
<td>Iron-deficiency anemia</td>
<td>104 (3.9)</td>
<td>431 (3.2)</td>
<td>.0697</td>
</tr>
<tr>
<td>Post-hemorrhage anemia</td>
<td>5 (0.2)</td>
<td>65 (0.5)</td>
<td>.0335</td>
</tr>
<tr>
<td>Electrolyte disturbances</td>
<td>238 (8.9)</td>
<td>826 (6.1)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Weight loss</td>
<td>165 (6.1)</td>
<td>402 (3.0)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Hypothyroidism</td>
<td>44 (1.6)</td>
<td>435 (3.2)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Coagulopathy</td>
<td>154 (5.7)</td>
<td>494 (3.6)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Previous myocardial infarction</td>
<td>62 (2.3)</td>
<td>362 (2.7)</td>
<td>.2740</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>230 (8.6)</td>
<td>1,101 (8.1)</td>
<td>.4683</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>97 (3.6)</td>
<td>521 (3.8)</td>
<td>.5503</td>
</tr>
<tr>
<td>Dementia</td>
<td>23 (0.9)</td>
<td>163 (1.2)</td>
<td>.1207</td>
</tr>
<tr>
<td>Chronic lung disease</td>
<td>931 (34.7)</td>
<td>3,539 (26.2)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Rheumatic disease</td>
<td>13 (0.5)</td>
<td>206 (1.5)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Peptic ulcer</td>
<td>21 (0.8)</td>
<td>100 (0.7)</td>
<td>.8161</td>
</tr>
<tr>
<td>Mild liver disease</td>
<td>443 (16.5)</td>
<td>457 (3.4)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Diabetes without chronic complications</td>
<td>371 (13.8)</td>
<td>1,781 (13.2)</td>
<td>.3710</td>
</tr>
<tr>
<td>Diabetes with chronic complications</td>
<td>90 (3.4)</td>
<td>597 (4.4)</td>
<td>.0124</td>
</tr>
<tr>
<td>Hemiplegia or paraplegia</td>
<td>19 (0.7)</td>
<td>152 (1.1)</td>
<td>.0535</td>
</tr>
<tr>
<td>Kidney disease</td>
<td>102 (3.8)</td>
<td>578 (4.3)</td>
<td>.2600</td>
</tr>
<tr>
<td>Moderate or severe liver disease</td>
<td>245 (9.1)</td>
<td>130 (1.0)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Cancer, leukemia or lymphoma</td>
<td>302 (11.2)</td>
<td>1,663 (12.3)</td>
<td>.1260</td>
</tr>
<tr>
<td>Metastatic cancer</td>
<td>91 (3.4)</td>
<td>565 (4.2)</td>
<td>.0576</td>
</tr>
<tr>
<td>AIDS</td>
<td>320 (11.9)</td>
<td>978 (7.2)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Charlson index, mean (CI 95%)</td>
<td>2.4 (2.3–2.5)</td>
<td>1.7 (1.7–1.8)</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

* P<.0001 considered statistically significant.

\textsuperscript{a} CI 95%: 95% confidence intervals.
study, not only the principal diagnosis. Moreover, patients with programmed admission were excluded to reduce as far as possible the inclusion of cases with possibly nosocomial pneumococcal pneumonia.

Databases such as MBDs also have notable advantages. The data collected is usually entered in nearly all hospital discharge records. As all cases are included, quite accurate estimates can be made on incidence, prevalence, comorbidities, complications, and mortality of the diseases seen.\textsuperscript{30,31} These data can be analyzed retrospectively, unlike other designs that need prospective data collection. Data can be collected relatively quickly and easily over long periods and from a large number of patients, as was the case in our study, and such systematic collection considerably reduces costs. In these studies, less selection bias may be
generated than in studies in which patients or their legal representatives may refuse to provide written informed consent to participate. Another considerable advantage lies in the availability of defined costs for each DRG stratified by hospital group and year, which facilitates the calculation of excess costs due to CAPP and AUDs.

A consensus document produced by several Spanish scientific societies recommends anti-pneumococcal vaccination in adults with underlying disease, including patients with AUDs. This recommendation should be following in all care settings, including hospital departments in which patients with AUDs are identified.

The results of this study are a reminder that the diagnosis of alcohol, tobacco and drug abuse and the introduction of therapy should be one of the main therapeutic objectives prior to discharge of CAPP patients. Investigating the alcohol and drug use and smoking habit of each patient is the ethical and professional duty of each physician. Strategies such as a brief talk on the risks of alcohol, smoking and drugs, and a note in the discharge report advising the primary care physician of the problem in case the patient needs to be referred to specialized detoxification units, have been shown to be effective in preventing complications and readmissions. Reducing the number of admissions and readmissions attributable to these disorders would help to reduce the costs of sick leave from work and hospital stays, increase the availability of beds in hospitals and reduce the risk of death. Each case of CAPP associated with alcohol, smoking or drug addiction disorders that is avoided also reduces the overall burden borne by these patients and their families.

Conclusions

In patients admitted for CAPP, AUDs account for an excess in-hospital mortality of 50.8%, prolongation of stay of 2.3 days, and excess costs of €1869.20.

Funding

This study was funded by: (a) the Government Delegation for the National Drug Plan. Ministry of Health, Social Services and Equality (Grant No. 20099017, Project G41825811), and (b) Subsidies for Funding Biomedical and Health Science Research in Andalusia for 2013. Department of Health and Social Affairs of the Government of Andalusia (PI-0271-2013).

Authors’ Contribution

All authors are equally contributed to the study design, data analysis and interpretation, drafting and review of the article and approval of final version.

Conflict of Interests

The authors state that they had no conflict of interests.

References

4. Rozenbaum MH, Pechlivanoglou P, van der Werf TS, Lo-Ten-Foe JR, Postma MJ, Hak E. The role of Streptococcus pneumoniae in community-acquired pneumo-
ing and alcohol abuse are the most preventable risk factors for invasive pneumonia and other pneumococcal infections. Int J Infect Dis. 2014;25:59–64.
16. Ministerio de Sanidad, Servicios Sociales e Igualdad. Registro de Altas de los Hospi-
17. Lindenauner PK, Laghi T, Schieh MS, Pekow PS, Rothberg MB. Association of diag-
23. Moberley S, Holden J, Tatham DP, Andrews RM. Vaccines for preventing pneu-
ococcal infection in adults. CDS Rev. 2013;CD004022.
ing health outcomes. 2nd ed. Chicago, IL: Health Administration Press; 1997. p. 43–168.


