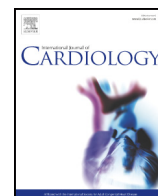




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Influence of COPD on outcomes of patients hospitalized with heart failure: Analysis of the Spanish National Hospital Discharge Database (2001–2015)

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ABSTRACT

Objective: To examine trends in incidence and outcomes of heart failure (HF) hospitalizations among patients with or without chronic obstructive pulmonary disease (COPD) in Spain (2001–2015).

Methods: We used national hospital discharge data to select hospital admissions for HF as primary diagnosis. Incidence, comorbidities, diagnostic and therapeutic procedures, length of hospital stay (LOHS), readmissions rate, costs and in hospital mortality (IHM) was analyzed according to the presence or absence of COPD. Charlson comorbidity index (CCI) was used to assess comorbidity.

Results: We identified 1,501,811 admissions for HF (19.55% with COPD). Incidence was significantly higher in COPD patients for all years analyzed. We found a significant increase in crude incidence over time in both groups of patients. Overall the incidence was 2.42-times higher among COPD patients (IRR 2.42; 95%CI 2.39–2.46). The joinpoint analysis showed that among men with COPD admissions for HF increased by 2.90% per year. Time trend analyses showed a significant decrease in IHM for both groups. Factors independently associated with higher IHM in both groups included: female gender, higher age, comorbidities according to CCI, longer LOHS and readmissions. The presence of COPD was not associated with a higher IHM in patients hospitalized with HF (OR0.98, 95%CI 0.96–1.01).

Conclusions: Among men suffering COPD the incidence of HF hospitalizations increased from 2001 to 2015. Incidence of hospitalizations was more than twice higher in the COPD population. IHM decreased over time in both groups. Female gender and readmission predict higher IHM. There were no differences in mortality between patients with and without COPD.

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1. Introduction

Heart failure (HF) is a process of high prevalence actually, representing one of the most frequent reasons for hospital admissions [1,2]. It is a major clinical and public health problem worldwide, being associated with significant morbidity, mortality, and high healthcare expenditure [3].

HF patients are generally older and have a high number of comorbidities that often influence their health experience [4]. One of the most common of them is chronic obstructive pulmonary disease (COPD) [5]. These two diseases share common risk factors, such as advanced age, male sex, and smoking history, and may have similar clinical presentations because patients with both conditions suffer symptoms such as shortness of breath, fatigue, lightheadedness, exercise intolerance or chronic cough [6,7]. Diagnosing COPD in patients with HF is essential because their combination identifies a high-risk population [8]. In fact, the prognostic of patients with both disorders is worse than those with only one of the diseases [9]. Accordingly, the presence of COPD in patients with acute HF is associated with an increased burden of comorbidities, longer hospitalizations and reduced use of evidence-based therapies [10–12]. In addition, previous studies

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have shown that COPD not only increases HF hospitalizations, but also costs and mortality [13–17].

The prevalence of COPD in HF patients ranges from 20 to 30% [18] and nearly one-fifth of elderly patients with COPD have unrecognized coexistent HF [19]. Furthermore, prevalence studies have reported increases in the last years, possibly due to improved detection and because the life expectancy is raising [10].

Using the Spanish National Hospital Discharge Database (SNHDD), we aim to: i) examine trends in the incidence, clinical characteristics diagnostic and therapeutic procedures and in-hospital outcomes, such as readmission, in-hospital mortality (IHM) and length of hospital stay (LOHS) of heart failure (HF) as primary diagnosis among patients with or without COPD from 2001 to 2015 and; ii) identify factors associated with in-hospital mortality (IHM) among patients with HF as primary diagnosis according to COPD status.

2. Methods

This retrospective observational study was performed using the SNHDD. Details of the design and description of the SNHDD are available online. Briefly, this nationally representative database, which compiles all public and private hospital data, covers > 98% of hospital admissions in Spain. The SNHDD includes patient variables (sex, date of birth), admission and discharge dates, up to 14 discharge diagnoses, and up to 20 procedures performed during the hospital stay [20].

We selected admissions of patients (aged ≥ 40 years) with a primary diagnosis of HF in the SNHDD database. A primary HF diagnosis refers to hospitalizations mainly attributable to HF. That was identified via the following International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis codes, as recommended by the ACC/AHA task force on performance measures [21]. HF was classified as a primary diagnosis if any of the codes appear as the first diagnosis in the SNHDD database. The ICD-9-CM codes used to identify diagnosis and procedures are shown in Supplementary Table 1. We collected data between January 1, 2001 and December 31, 2015.

We grouped admissions by COPD status, considering COPD sufferers those with ICD-9-CM codes in any diagnostic position (2–14) and non COPD all the rest.

Clinical characteristics included information on overall comorbidity at the time of discharge, which was assessed by calculating the Charlson comorbidity index (CCI) excluding COPD [22]. Beside those conditions included in the CCI [23], the following specific conditions were analyzed: ischemic coronary disease, atrial fibrillation, anemia, pneumonia, pulmonary embolism, hypertension, acute renal failure and diabetes.

Irrespectively of the position at the procedures coding list, we retrieved data about following in-hospital procedures: echocardiogram, heart catheterization, pacemaker, spirometry, non-invasive mechanical ventilation, invasive mechanical ventilation, and red cell transfusion.

We estimated the proportion of admissions through the emergency room (ER) and the readmissions rate (patients that had been discharged from the same hospital within the previous 30 days. This variable is included in the database provided to us by the Ministry of Health) and the mean LOHS.

We also estimated costs. Costs were calculated using Diagnosis-Related Groups (GRD) [24].

The main end points in our investigation were trends in incidence rates of hospitalizations and IHM in patients admitted with a primary diagnosis of HF. IHM was defined by the proportion of patients who died during admission for each year of study.

We have considered five time periods that included three consecutive years each (2001–03; 2004–06; 2007–09; 2010–12; 2013–15).

We estimated the crude incidence rates of admission with a primary diagnosis of HF in patients with COPD and non-COPD patients calculated per 100,000 inhabitants, in order to assess time trends. We calculated COPD-specific incidence rates by dividing the number of admissions per year, sex, and age group by the corresponding number of people in that population group using the age-adjusted, sex-adjusted estimated prevalence of COPD obtained from National Health Surveys and based on data EPI-SCAN study [25,26]. We also calculated incidence rates for non-COPD patients by dividing the number of cases per year, sex and age group by the corresponding number of people in that population group (excluding those with COPD), according to the data from the Spanish National Institute of Statistics, as reported on 31 December of each year [27].

In our study we used log linear joinpoint regression to identify the period in which trend changes in annual HF incidence rates by COPD status. The incidence rates included in the joinpoint regression were adjusted by age and sex, when appropriate, using the direct standardization method and the 2015 population as the reference. We also estimated the annual percentage of change (APC) in each of the periods delimited by the points of change [28]. The Joinpoint Regression Program, version 4.0.4, was used for the analysis [29].

A descriptive statistical analysis was performed for all continuous variables and categories. Variables are expressed as proportions as means with standard deviations. A bivariable analysis according to year was performed using the χ^2 test for linear trend (proportions) and ANOVA (means), as appropriate.

To assess differences between those patients with and without COPD, for each year and for the total sample, the statistical tests conducted for continuous variables were the t-test for normal distributions and the Mann-Whitney test for non-normal distributions; categorical variables were compared using the Chi-square test and incidences were compared using Poisson regression. Estimates correspond to Incidence Rate Ratios (IRR) with their 95% confidence intervals (95%CI).

To compare the IHM according to study variables between patients with COPD and without COPD patients we used logistic regression models adjusted by age and sex when appropriate.

To identify variables associated with IHM as a binary outcome among patients with HF, we performed three multivariable logistic regression analyses (COPD, non-COPD, both). The variables included in the models were those with significant results in the bivariable analysis and those considered relevant in other investigations. Estimates were Odds Ratio (OR) with their 95%CI.

All statistical analyses were performed with Stata version 10.1 (Stata, College Station, Texas, USA). Statistical significance was set at $P < 0.05$ (2-tailed).

The study maintains data confidentiality at all times. Given the anonymous and mandatory nature of the database, it was not necessary to obtain informed consent or approval by an ethics committee in accordance with Spanish legislation.

3. Results

In our study we identified a total of 1,501,811 hospitalizations of patients aged 40 years or more with a primary diagnosis of HF in Spain (2001–2015). Patients with COPD accounted for 19.55% of total (161,509 women and 132,070 men). The prevalence of COPD remained stable overtime.

Table 1 shows the crude incidences, clinical characteristics and in-hospital outcomes in patients with or without COPD who were admitted with a primary diagnosis of HF.

Among patients with COPD, we found that the crude incidence of HF was 1145 cases per 100,000 COPD population in 2001–03 and 1190 in 2013–15. In patients without COPD the incidence of admissions increased significantly over the study period from 332 to 457 cases per 100,000 non-COPD population (Table 1). Crude incidences were more than twice higher in people with COPD than in non-COPD people for all years analyzed.

Using the Poisson regression model, adjusting by age and sex, we found that the incidence for a primary diagnosis of HF admission over the entire time period was 2.42-times higher among patients with COPD than those without COPD (IRR 2.42; 95%CI 2.39–2.46). This means, that in our study, patients with COPD have 2.42 more probabilities of being admitted for a HF than patients with the same age and sex distribution but without COPD.

The results of the joinpoint analysis showed that sex and age-adjusted admissions in COPD patients with HF remained stable from 2001 to 2015 (Supplementary Fig. 1A). According to sex, in men admissions increased from 2001 to 2015 by 2.90% per year (Supplementary Fig. 1B) and in women, decreased not significantly by 0.06% per year (Supplementary Fig. 1C).

In non-COPD patients, men and women, the joinpoint analyses are shown in Supplementary Fig. 1D, E and F. There are a significantly increased from 2001 to 2010 with APC of around 3% (Supplementary Fig. 1D) for the entire sample. In men, admissions increased by 2.42% per year from 2001 to 2015 (Supplementary Fig. 1E) and in women increased by 4.17% per year from 2001 to 2007 (Supplementary Fig. 1F) to remain stable afterwards.

In patients who had an admission for HF there was a significant female predominance (55.01% for COPD and 54.88% for non-COPD). Overall, patients with and without COPD had around 78 years mean age. COPD patients had more coexisting medical conditions (mean CCI 2.04 ± 0.94 vs. 1.97 ± 0.091) (P values < 0.001). Age increased significantly over time in both groups, however female sex decreased in those with and without COPD (55.74% and 55.23% in 2001–03 vs. 53.95% and 54.03% in 2013–15, respectively, $P < 0.001$).

In patients with and without COPD admission through ER and readmission rates were around 17% and 95%, respectively. Readmissions and admission by ER increased in both groups during the study period (Table 1).

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