European Journal of Internal Medicine xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

European Journal of Internal Medicine

journal homepage: www.elsevier.com/locate/ejim

Original Article

Time trends in incidence and outcomes of hospitalizations for aspiration pneumonia among elderly people in Spain (2003 — 2013)

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ARTICLE INFO

Article history:
Received 13 October 2016
Received in revised form 22 December 2016
Accepted 30 December 2016
Available online xxxx

Keywords:
Pneumonia
Aspiration
Pulmonary
Epidemiology
Hospital mortality
Aged

ABSTRACT

Background: Aspiration pneumonia (AP) is an infectious process causing high rates of mortality. The purpose of this study was: 1, to describe the incidence from 2003 to 2013 of AP hospitalizations; 2, to assess time trends in hospital outcomes variables, and; 3, to identify the factors independently associated with in-hospital mortality (IHM).

Methods: A retrospective observational study using the Spanish National Hospital Database, with patients discharged between January 2003 and December 2013 was conducted. Inclusion criteria were: Subjects aged 75 years or older whose medical diagnosis included AP events code according to the ICD-9-CM: 507.x in the primary diagnosis field. Patient variables, up to 14 discharge diagnoses per patient, and up to 20 procedures performed during the hospital stay (ICD-9-CM), Charlson Comorbidity Index, readmission, length of hospital stay (LOHS), and IHM were analyzed.

Results: We included 111,319 admissions (53.13% women). LOHS decreased in both sexes ($P < 0.001$) and was significantly higher in men (10.4 ± 10.31 vs. 9.56 ± 10.02 days). Readmissions increased significantly in women during the study (13.94% in 2003 to 16.41% in 2013, $P < 0.001$). In both sex, IHM was significantly higher in >94 years old subjects (OR: 1.43, 95%CI 1.36–1.51) and in those with readmissions (OR: 1.20, 95%CI 1.15–1.23). For the entire population, time trend analyses showed a significant decrease in mortality from 2003 to 2013 (OR: 0.96, 95%CI 0.95–0.97).

Conclusions: Patients with AP are older, male, and have more comorbidities than those without AP. Over time, LOHS and IHM decreased in both sexes, but readmissions increased significantly in women.

1. Introduction

Aspiration is the inhalation of oropharyngeal or gastric content into the lower respiratory tract [1–3]. Several pulmonary syndromes may occur after aspiration, depending on the amount and nature of the aspirated material, the frequency of aspiration, and the host's response to the aspirated material Aspiration pneumonia (AP) is an infectious process caused by the inhalation of oropharyngeal secretions that are colonized by a pathogenic bacteria [1,2–4]. Previous studies [1,2,5–7] reported Gram-negative (*Haemophilus influenzae*) and Gram-positive (*Staphylococcus aureus*, *Streptococcus pneumoniae*) pathogens, and anaerobia bacteria's with aerobic Gram-negatives [2]. Difficulties for studying AP include the lack of a sensitive and specific marker for aspiration, the overlap between AP and other forms of pneumonia (community-acquired pneumonia, CAP), and the lack of differentiation between AP and aspiration pneumonitis (wherein the inhalation of gastric-contents causes inflammation without the subsequent development of bacterial infection) [7]. Current data suggest that AP accounts for 4.7%–66.8% of older hospitalized patients with pneumonia [1,6–12]. In fact, the incidence of AP increases in elderly people (around 10 times more) and also in hospitalized patients (23.8%) [13,14].

Aspiration pneumonia occurs in people with chronic neurological disorders (stroke, dementia, Parkinson's disease, multiple sclerosis),

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http://dx.doi.org/10.1016/j.ejim.2016.12.022
0953-6205/

esophageal dysfunction, impaired conscious, dehydration, vomiting, dysphagia, reduced cough reflex, poor swallow [1,3–5,15], oropharyngeal and dental plaque colonization by organisms [2,5], and bad oral health [16]. Other factors predisposing to AP include older age, male gender, lung diseases, diabetes mellitus, head and neck cancer, angiotensin I-converting enzyme deletion, malnutrition, antipsychotic drugs, proton pump inhibitors, and angiotensin-converting enzyme inhibitors [14,16]. In addition, older patients suffering AP were more likely cared in the intensive care unit (ICU) [1,4,6], had longer length of hospital stay (LOHS) [1,6,10–12], had more frequent inpatient admission and recurrence pneumonia [1,6–8,10,11,13,17,18], in-hospital mortality (IHM) [1,5,6,10–13,17–19] and health-costs of care [19].

No previous study has investigated temporal trends in hospitalized people with AP and outcomes, and factors associated with IHM and LOHS in Spanish elder population. Therefore, the objectives of the current study were: 1, to describe and analyze the incidence from 2003 to 2013 of AP hospitalizations according to sex and comorbidities among Spanish elderly people; 2, to assess time trends in hospital outcomes variables such as IHM, readmissions and LOHS and 3, to identify the factors independently associated with IHM.

2. Material and methods

2.1. Data source

A retrospective observational study using the Spanish National Hospital Database (CMBD, Conjunto Mínimo Básico de Datos) was conducted. This administrative database is managed by the Spanish Ministry of Health, Social Services and Equality (MHSSE) and compiles public and private hospital data, covering therefore >95% of hospital discharges [20]. The CMBD includes patient variables (sex, date of birth), admission date, discharge date, up to 14 discharge diagnoses per patient, and up to 20 procedures performed during the hospital stay, by using the International Classification of Diseases-Ninth Revision, Clinical Modification (ICD-9-CM).

2.2. Patient selection

We retrospectively selected discharges for subjects aged 75 years or over whose medical diagnosis included AP events code according to the ICD-9-CM: 507.x in the primary diagnosis field and who were discharged between January 1, 2003 and December 31, 2013. Aspiration pneumonia from ICD-9-CM represents pneumonitis or pneumonia caused by inhalation of vomitus or food [14,21,22]. The ICD-9 code for AP is different from codes that describe other forms of pneumonia [14]. McCarthy et al. [23] studied the validity of 507.x code and reported that 91% of patients with the code for AP had a physician note documenting AP or objective clinical evidence [14].

2.3. Comorbidities

Irrespectively of the position at the diagnosis coding list, we retrieved data about all specific comorbidities included in the Charlson Comorbidity Index, specifically: myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, rheumatoid disease, peptic ulcer disease, mild liver disease, diabetes, diabetes with chronic complication, hemiplegia/paraplegia, renal disease, any malignancy (including lymphoma and leukemia, except malignant neoplasm of skin), moderate or severe liver disease, metastatic solid tumor, AIDS/HIV as described by Quan et al. [24] using the enhanced ICD-9-CM.

2.4. In-hospital outcomes

We estimated the proportion of readmission (patients that had been discharged from the hospital within the previous 30 days), the mean of LOHS and IHM. In-hospital mortality is defined by the proportion of patients who died during admission for each year of study.

2.5. Statistical analysis

All analyses were conducted separately for men and women. CMBD data from 2003 through 2013 were used to estimate the annual number or hospitalizations for AP among men and women aged 75 years or older. To assess time trends, the incidence rates of admissions for AP were calculated per 100,000 inhabitants. We calculated yearly AP-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 according to the data from the Spanish National Institute of Statistics, as reported on December 31 of each year [25]. Trends in the incidences were assessed using Poisson regression models adjusted by sex when appropriate. We also obtained P values for the comparison of comorbidities and in-hospital outcomes during hospitalization for AP as primary diagnosis between men and women.

A descriptive statistical analysis was performed for all continuous variables and categories by stratifying admissions for AP. Variables are expressed as proportions or means with standard deviations (LOHS). A bivariate analysis of variables according to year was performed using the $\chi 2$ test for linear trend (proportions) and ANOVA (means), as appropriate. Lastly, we performed logistic regression analyses with mortality as a binary outcome using age, comorbidities, readmission, LOHS and year of admission as independent variables for men and women and for the entire population to assess the influence of sex in IHM. The logistic regression multivariate model was built using the "enter modeling" method of STATA 14.0. To build the model we followed recommendations of Hosmer and Lemeshow [26]. The process included: a) univariate analysis of each variable; b) selection of the variables for the multivariate analysis. We include all the variables whose univariate test was significant and those we considered scientifically relevant according to the references reviewed; c) following the fit of the multivariate model the importance of each variable included in the model was verified. This included the examination of the Wald statistic for each variable and comparison of each estimated coefficient with the coefficient from the univariate model containing only that variable. Variables that did not contribute to the model based on these criteria were eliminated and a new model was fitted. The new model was compared to the old model using the LR test. Furthermore, estimated coefficients for the remaining variables were compared to those from the full model. This process of deleting, refitting and verifying continued until all the important variables were included in the model; and, d) once the model was obtained, we looked closely at the variables included (linearity) and checked for interactions in the model.

Estimates were Odds Ratios (OR) with their 95% confidence intervals. Statistical analyses were performed using Stata version 14.1 (Stata, College Station, Texas, USA). Statistical significance was set at $P < 0.05$ (2-tailed).

2.6. Ethical aspects

Data confidentiality was maintained at all times in accordance with Spanish legislation. Patient identifiers were deleted by the Spanish MHSSE before the database was provided to the authors to maintain patient anonymity. Since the dataset was anonymous and mandatory, informed consent was unnecessary. According to the Spanish Legislation it is not needed the approval of an Ethics Committee. Anonymized data was used and authors were not involved with the patients' medical treatment or had any interaction with the participants.

3. Results

From 2003 through 2013, we identified a total of 111,319 admissions for AP as primary diagnosis in patients aged 75 years or over in Spain. Women accounted for 53.13% of total (n = 59,146). Table 1

Please cite this article as: Palacios-Ceña D, et al, Time trends in incidence and outcomes of hospitalizations for aspiration pneumonia among elderly people in Spain (2003−2013), Eur J Intern Med (2017), http://dx.doi.org/10.1016/j.ejim.2016.12.022