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Determination of the factors affecting duration of hospitalization in patients with chronic obstructive pulmonary disease (COPD) in Iran

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Abstract

Background: Chronic obstructive pulmonary disease (COPD) is a major cause of morbidity and mortality, and is an important health economic problem. Since 1960, there has been an increase in mortality associated with COPD, especially in men. Acute exacerbations form a major component of the socioeconomic burden of COPD which mainly results in long-term hospitalization. Despite the high number of COPD-related hospitalizations, relatively little is known about the mortality rate and related determinants of patients hospitalized for this acute deterioration in the clinical course of COPD. The aim of this study was to evaluate the factors affecting duration of hospitalization in Iranian patients with COPD.

Methods: This cross-sectional study was performed on 68 COPD patients who were hospitalized in Rasool-e-Akram hospital in Tehran, Iran for the period 2005-2006. During hospitalization, patients' chief complaint, symptoms and signs, results of physical examinations, spirometry, arterial blood gas (ABG) and ICU admission were recorded. Data were analyzed using Independent T-test, One Way ANOVA and Correlation tests.

Results: The patients were 41(60.3%) males and 27(39.7%) females with the mean age of 69.7(SD=13.52) years. The mean duration of hospitalization was 11.82(SD=5.49) days and 3(4.4%) patients died. The family history of pulmonary disease (P=0.018), habitual snoring (P=0.031), and mean baseline arterial PaO_2 (P=0.010, r= -0.361) were determined as factors affecting duration of hospitalization. On the other hand, other factors such as smoking (P=0.992), patient's gender (P=0.735) and spirometric indices did not significantly associate with duration of hospitalization.

Conclusion:The fact that people hospitalized with COPD have a subsequently increased risk of death compared with those not hospitalized suggests the former are an at-risk group and shows the importance of factors affecting duration of hospitalization. Our results show that more attention must be paid on habitual snoring and low arterial pO_2 which may have potential effects on duration of hospitalization in COPD patients.

Keywords: chronic obstructive pulmonary disease (COPD), hospitalization, morbidity.

Introduction

Chronic obstructive pulmonary disease (COPD) is a leading cause of death and disability worldwide and an important economic problem which may lead to a major socioeconomic burden [1]. According to World Bank data, it is expected to move from its status in 2000 as the 4th and 12th most frequent cause of mortality

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and morbidity, respectively, to be the 3rd and 5th leading cause of mortality and morbidity, respectively, and will be fifth among the conditions with a high burden to society in 2020 [1-3]. Hospitalization for acute exacerbations represents a major component of this socioeconomic burden related to COPD [4]. Moreover, about 10% of all hospitalizations are directly or indirectly attributable to COPD [5].

The natural course of COPD is characterized by a progressive decline in pulmonary function and recurrent exacerbations. Acute respiratory failure may ensue, requiring admission to the ICU for assisted ventilation. The prognosis of this group of patients who require admission to the ICU is commonly believed to be grim [6]. Studies [7-18] have reported varying in-hospital mortality rates of 20 to 82% because of differences in disease severity and heterogeneous patient mix.

Despite being the only major disease showing increasing trends and the high number of COPD-related hospitalizations, related determinants of hospitalizations, the short- and long-term outcomes of patients with COPD are not yet precisely understood. Identification of the factors that may influence survival in patients with COPD may enable clinicians to better assess life expectancy. This is extremely important, in that it may help offset the social and economic burden of COPD through the implementation of more individualized and effective treatment strategies, as well as better mobilizing healthcare resources.

Investigations into the factors predicting outcome in COPD patients have included follow-up studies on stable COPD patients and on COPD patients admitted to the intensive care unit (ICU), as well as on patients admitted to hospital with hypercapnic acute attacks.

Among the parameters thought to be related to mortality are forced expiratory volume in one second (FEV_1) [19-21], age [20,21], carbon dioxide arterial tension (Pa,CO_2), arterial oxygenation [17,19], diffusion capacity [19], cardiac status [8,19,20], body mass index (BMI) [22-25], serum albumin level, functional status [26] and the presence of other comorbid states [27]. In a study that directly addressed the long-term outcome for COPD patients admitted to hospital, the in-hospital and 2 years after-discharge mortality rates were found to be 11% and 49%, respectively [26]. One of the most recent studies have also shown that longer hospital stay is an important risk factor for COPD-related mortality [28].

Therefore, the aim of our study was to identify factors affecting duration of hospital stay among COPD patients to assist the clinician in making the difficult decisions of instituting intensive care management in order to allow for better utilization of medical resources.

Methods

Patients and study protocol

This cross-sectional study was performed on 68 COPD patients who were hospitalized in Rasool-e-Akram Hospital in Tehran, Iran for the period 2005-2006. All patients had been admitted for an acute exacerbation of COPD to the pulmonology ward of Rasool-e-Akram University Hospital. Besides its academic function, the Rasool-e-Akram University Hospital has an important function as a regional hospital, therefore this patient population is representative of general pulmonary practices. Patients were included if the following criteria were met: diagnosis of COPD, according to the criteria of the American Thoracic Society (ATS) [29]; and symptoms indicating an acute exacerbation of COPD. An exacerbation was defined by the presence of an increase in at least two of the three following symptoms: dyspnea; cough; and sputum purulence severe enough to warrant hospital admission. Patients were hospitalized for one or more of the following indications: severely increased symptoms; new onset of cyanosis and peripheral edema; confusion; lethargy; coma; use of accessory muscles for ventilation; significant comorbidities; failure to

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respond to initial treatment; judgment that treatment at home is insufficient; acidosis; persistent or worsening hypoxemia and/or severe or worsening hypercapnia and new onset arrhythmias. COPD patients hospitalized for specific (secondary) causes, such as pneumonia, pulmonary emboli, congestive heart failure or lung cancer, as the cause of acute exacerbation were excluded.

Each patient was included only once in the study, even if the patient had been hospitalized more than once. During hospital admission, patients were treated with a standard protocol consisting of the IV administration of corticosteroids (in a standardized dosage of 0.5 mg/kg), theophylline, and nebulized salbutamol and ipratropium bromide as bronchodilating agents. O_2 was titrated according to the results of blood gas analyses.

Moreover, the criteria of discharging the patients were as follows:

-Remission of clinical signs and symptoms

-Normal ABG lasting at least 24 hours

-Need for salbutamol inhaler at a maximum dose of 4 puffs per day

-Having good and appropriate family care at home

-Changing intravenous drugs to oral agents

In addition, all the patients were evaluated and assessed by a single group of pulmonologists.

Prior to the beginning of the study, patients were fully informed of the conduct and consequences of the study and signed a consent form. This study was conducted following approval by the institutional review board and ethics committee and was in accordance with the ethical principles described in the Declaration of Helsinki.

Data collection

Demographic and clinical data were collected for all patients including: age; sex; availability of medical insurance; smoking status and load (pack-yrs); opium consumption and its route, history of snoring, spirometric and arterial blood gas (ABG) analysis at admission, and also last day ABG. In addition, baseline symptoms and chief complaint, results of physical examination and pulmonary auscultation, admission to the ICU and its outcome, and length of hospital stay were also noted for each patient. For the determination of the duration of hospital stay, the date of first admission to the hospital and the exact date of their discharge was used. This information, and time elapsed since hospitalization, were obtained from reviews of personal and official medical documents and by questioning the patients.

Measurements

On hospital admission, arterial blood gas (ABG) levels at rest were assessed by a puncture of the radial artery during room air breathing prior to nasal or mask oxygenation. Additionally, arterial blood gas levels were also assessed on hospital admission and after recovery (immediately before hospital discharge). ABG results were including pH, $PaCO_2$, PaO_2, O_2 saturation and HCO_3^- concentration.

Standard spirometric examination at admission was performed using a Vmax 20c spirometer (SensorMedics Corp., Yorba-Linda, CA, USA), with the spirograms having the largest forced expiratory volume in one second (FEV_1) and forced vital capacity (FVC), selected from at least two technically acceptable spirometric measurements being used in the analysis. If spirometric measurements could not be performed just after admission, they were performed as soon as possible within 24h. For each patient, FEV_1, FVC, FEV_1/FVC and vital capacity (VC) were measured twice, before and after using a bronchodilator. These values were expressed as a percentage of the reference values too.

Statistical analysis

All data are expressed as mean±SD. The distribution of nominal variables was compared

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Variable	Value
Age (year) (mean±SD)	69.73±13.52
Gender (%)	
Female	39.7
Male	60.3
Smoking (%)	65.3
Amount of smoking (pack/yr) (mean±SD)	33.36±17.24
Addiction (%)	30.8
Family history of respiratory disease (%)	11.1
Symptoms (%)	
Dyspnea	79.4
Sputum production	72.1
Cough more than 3 weeks	47.1
Orthopnea	44.1
Cough less than 3 weeks	36.8
Lung sounds (%)	
Crackle	72.7
Wheezing	47
Rhonchi	19.7
Snoring (%)	5.9
ICU admission (%)	7.5
Duration of hospital stay (day) (mean±SD)	11.82±5.49

Table 1. Demographics and main clinical variables of COPD patients (values are expressed as mean±SD).

using the Chi-squared test. In order to compare the mean values of quantitative variables the independent t-test and one-way ANOVA procedures were performed. To better assess the factors that may be related to duration of hospitalization, correlation was also used. A two-sided P value<0.05 was considered to be statistically significant.

Results

A total number of 68 COPD patients were included in our study. The patients were 41(60.3%) male and 27(39.7%) female with mean age of 69.73 (SD=13.52) years. As listed in Table 1, 60.3% of patients were current smokers with mean smoking amount of 33.36 (SD=17.24) pack/yr. Additionally, 30.8% of patients were also opium addicts.

Evaluating the patients' medical records revealed that 11.1% of them had a family history of respiratory tract diseases; and 5.9% were habitual snorers.

Patients' symptoms and signs are shown in Table 1. As listed, the most common symptoms were dyspnea (79.4%), sputum production (72.1%), cough more than 3 weeks (47.1%), orthopnea (44.1%) and cough less than 3 weeks (36.8%). Moreover, crackles (72.7%) and wheezing (47%) were the most frequent sounds on their lung auscultation.

Out of 68 COPD patients, four (7.5%) were admitted in the intensive care unit (ICU) and three (4.4%) died. The mean duration of hospitalization was 11.82 (SD=5.49) days.

The results of baseline and discharge ABG's are shown in Table 2. The mean values of $PaCO_2$ and PaO_2 were 55.06 mmHg (SD=16.63) and 72.97 mmHg (SD=32.58) on admission, respectively. In addition, the mean baseline pH and O_2 saturation were 7.41(SD=0.10) and 90.45% (SD=10.88), respectively. On the other hand, the mean values of $PaCO_2$ and PaO_2 were

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Variable	Values
Arterial Blood Gas (ABG)	
• On admission	
pH	7.41±0.10
$PaCO_2$ (mm Hg)	55.06±16.63
PaO_2 (mm Hg)	72.97±32.58
$[HCO_3^-]$	33.69±7.43
O_2 Saturation (%)	90.45±10.88
• On discharging	
pH	7.43±0.09
$PaCO_2$ (mm Hg)	51.75±20.73
PaO_2 (mm Hg)	67.01±22.70
$[HCO_3^-]$	36.28±7.51
O_2 Saturation (%)	91.58±6.70
Spirometric indices	
• Before bronchodilator	
FEV_1 (lit)	4.11±2.18
FEV_1 (% predicted)	45.72±3.33
FVC (lit)	3.04±1.28
FVC (% predicted)	59.24±3.66
FEV_1/FVC	60.05±2.76
VC (lit)	4.54±2.79
VC (% predicted)	59.21±3.80
• After bronchodilator	
FEV_1 (lit)	3.15±1.86
FEV_1 (% predicted)	51.75±4.21
FVC (lit)	4.65±2.57
FVC (% predicted)	66.86±3.26
FEV_1/FVC	59.75±2.95
VC (lit)	5.23±3.16
VC (% predicted)	68.73±3.62

Table 2. Results of ABG and spirometric indices of COPD-patients during their admission in the hospital (Values are expressed as mean±SD).

51.75 mmHg (SD=20.73) and 67.01mmHg (SD=22.70) on discharge, respectively. The mean of last pH and O_2 saturation were also 7.43 (SD =0.09) and 91.58% (SD=6.70), respectively.

Spirometry was performed in all COPD patients. The mean value of FEV1, before and after using bronchodilator, was 45.72 (SD=3.33)% and 51.75% (SD=4.21) of predicted, respectively. Moreover, the mean value of FEV_1/FVC, before and after bronchodilator was 60.05% (SD=2.76) and 59.75% (SD=2.95), respectively. Other mean values of different spirometric indexes are shown in Table 2.

Analytical statistics were performed. Family history of pulmonary disease (P=0.018), habitual snoring (P=0.031), and mean baseline arterial PaO_2 (P=0.010, r= -0.361) were determined as factors affecting duration of hospitalization. Statistically significant adverse correlation between baseline PaO_2 and duration of hospital stay is shown in Figure 1. On the other hand, other factors such as smoking (P=0.992), patient's gender (P=0.735) and spirometric indices did not significantly associate with duration of hospitalization (P>0.05).

Discussion

Although many studies have evaluated factors related to the survival and mortality of COPD patients, ours is one of the first to assess factors affecting duration of hospital stay among these patients. The results of our study show that factors such as positive family history of pulmonary disease (P=0.018), habitual snoring (P=0.031), and lower baseline arterial PaO_2 (P=0.010) could potentially lead to longer duration of hospital stay among COPD patients. Some of these factors were previously demonstrated as important risk factors for mortality in COPD patients, too. Moreover, the mortality rate of COPD patients in our study was 4.4%.

In a recent study by Gunen et al [28], the authors found that the in-hospital mortality rate for the patients was 8.3%. The rate of in-hospital mortality for COPD patients hospitalized with acute exacerbation has been reported to be between 2.5% and 30%, depending on the methodology of data collection and the patient population [17,30]. Nonrespiratory organ system dysfunction and hospital days prior to ICU admission have been reported to be the most important predictors of in-hospital mortality,

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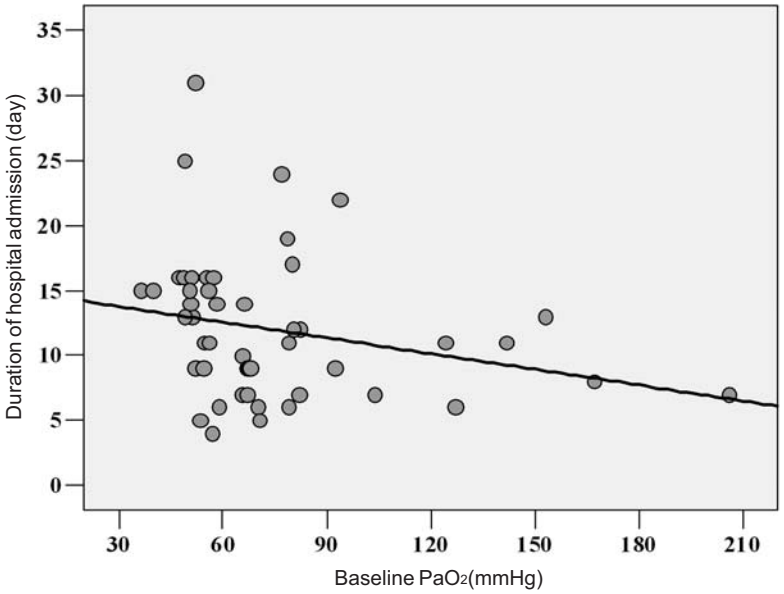


Fig. 1. Statistically significant adverse correlation between baseline PaO_2 and duration of hospital stay (P=0.010, r = -0.361).

with the total in-hospital mortality rate being 24% [17]. Recently, a cross-sectional nationwide study based on a national database reported a relatively low in-hospital mortality of 2.5% and identified older age, male sex, higher income, nonroutine admissions, and more comorbid conditions as independent risk factors [30]. In another study on 2003, Groenewegen et al [27] concluded that Besides $PaCO_2$ and age, which were previously established as predictors of mortality, the long-term use of oral corticosteroids was found to be an important independent risk factor for mortality. They also showed that sex, duration of hospital stay, FEV_1, BMI, comorbidity index, and number of hospital readmissions had no influence on mortality. Sex and FEV_1 were also found not to affect duration of hospitalization in our study.

Gunen et al [28] concluded that in-hospital mortality of COPD patients hospitalized for acute exacerbation was mainly influenced by lower PaO_2 and SaO_2, higher $PaCO_2$, and longer length of hospital stay. Similar to this study, we also found lower PaO_2 as an important factor affecting duration of hospitalization, which also may have a role in mortality.

Almost the same factors were demonstrated as risk factors of long-term mortality of COPD patients, too. A study on long-term survival of seriously ill, hospitalized COPD patients with $PaCO_2 \geq 6.65$ kPa showed that independent predictors for survival were severity of illness, age, prior functional status, BMI, PaO_2/inspiratory oxygen fraction, congestive heart failure, serum albumin level and presence of corpulmonale [26]. The patient selection and flexible margins for cause of hospitalization, however, make it difficult to generalize these results to all COPD patients.

Another important factor for longer duration of hospital stay found in our study is snoring, which is not mentioned in most previous and similar studies.

Numerous investigations have shown that loud habitual snoring may be due to nasal obstruction [31-35]. Nasal obstruction alters airflow dynamics and may lead to open mouth breathing during sleep, which has been shown to increase upper airway collapsibility, decreasing the pharyngeal airway diameter and result-

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ing in obstructive sleep disordered breathing (SDB) [36-38]. During sleep, this can lead to loud snoring and irregular breathing, leading to SDB and its deleterious effects [39]. Additionally, snoring is associated with a spectrum of upper airway resistance and changes of its dimensions. Therefore, snoring may be a sign of more serious airway obstruction which may lead to longer duration of hospital stay and further mortality in COPD patients.

Conclusion

The fact that people hospitalized with COPD have a subsequently increased risk of death compared with those not hospitalized suggests the former are an at-risk group and shows the importance of factors affecting duration of hospitalization. Our results show that more attention must be paid to habitual snoring, positive family history of respiratory disease and probably low arterial PaO_2 which may have potential effects on duration of hospitalization; and also perhaps their short-term and long-term mortality in COPD patients.

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