ORIGINAL ARTICLE

Severity of airflow limitation, co-morbidities and management of chronic obstructive pulmonary disease patients acutely admitted to hospital

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Objective To assess the disease spectrum, severity of airflow limitation, admission pattern, co-morbidities, and management of patients admitted for acute exacerbations of chronic obstructive pulmonary disease.

Design Case series.

Setting An acute regional hospital in Hong Kong.

Patients Adult subjects admitted during January 2010 to December 2010 with the principal discharge diagnosis of chronic obstructive pulmonary disease.

Results In all, the records of 253 patients with physician-diagnosed chronic obstructive pulmonary disease were analysed. The majority were old (mean age, 78 years). The median number of admissions per patient for this condition in 2010 was two. About two thirds (64%) had had spirometry at least once. Mean forced expiratory volume in one second predicted was 55%. Almost 90% had moderate–to–very severe airflow limitation by spirometry. Overall, long-acting bronchodilators (beta agonists and/or antimuscarinics) were being prescribed for only 21% of the patients.

Conclusion Most of the patients admitted to hospital for acute exacerbations of chronic obstructive pulmonary disease were old, had multiple co-morbidities, and the majority had moderate-to-severe airflow limitation by spirometry. Almost half of them (around 46%) had two or more admissions in 2010. Adherence to the latest treatment guidelines seemed inadequate, there being a low prescription rate of long-acting bronchodilators. Chronic obstructive pulmonary disease patients warranting emergency admissions are at risk of future exacerbations and mortality. Management by a designated multidisciplinary team is recommended.

New knowledge added by this study

- Almost 90% of chronic obstructive pulmonary disease (COPD) subjects with spirometry performed had moderate–to–very severe disease when hospital admission ensued.
- About half of these patients had two or more admissions in 1 year.
- Despite the severity of their illness, long-acting bronchodilators were underused by these Hong Kong COPD patients.
- Long-term oxygen therapy and non-invasive ventilation (acute and long term) were used by significant numbers of patients with severe–to–very severe disease.

Implications for clinical practice or policy

- As many COPD patients warranting hospital admissions were already at high risk, preferably they should be managed by a multidisciplinary team in a designated respiratory or COPD ward.
- Patients with a clinical diagnosis of COPD should have confirmatory spirometry.
- Patients with moderate-to-severe COPD disease warrant planned interventions (including use of long-acting bronchodilators) to reduce future exacerbations and hospital admissions.
- COPD patients with hypercapnic respiratory failure are at risk of mortality, and if feasible, should be managed by trained staff in a dedicated team.

Key words
Comorbidity; Pulmonary disease, chronic obstructive; Spirometry

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Introduction

The World Health Organization recognises that non-communicable diseases are the leading causes of death globally. In 2008, there were 57 million deaths, and 36 million (63%) of them were due to non-communicable diseases. Among them, cardiovascular diseases, diabetes, cancer, and chronic respiratory diseases were the principal causes.[1] It was predicted that by 2030, chronic obstructive pulmonary disease (COPD) will become the third commonest cause of death.[2] A territory-wide survey of the burden of lung disease in Hong Kong in 2005 showed that COPD was the second most common respiratory cause of hospitalisation (accounting for 14.6% of admissions and 20.5% of in-patient bed-days).[3] However, the hospitalisation data of that 2005 survey only included the principal diagnosis on discharge. There was no information on the severity of airflow limitation, co-morbidities, admission pattern, or long-term treatments. A recent study of COPD patients in an out-patient setting showed that patients followed up in specialist clinics had more severe airflow limitation than those in general out-patient settings.[4] To our knowledge, there was no local study of the characteristics of COPD patients admitted to hospital for acute exacerbations.

Thus, the aim of this study was to assess the characteristics, spirometry data, and admission pattern of COPD patients discharged from an acute regional hospital in Hong Kong, and to correlate the severity of airflow limitation with the treatments offered. We hope that such information could help future planning of service delivery and allocation of health care resources to control the burden of COPD in the public health care system.

緊急入院的慢性阻塞性肺病患者的氣流受限、共病率和治理

目的 研究急性入院的慢性阻塞性肺病患者的疾病譜、氣流受限的嚴重性、入院情況、共病及治理方法。

設計 病例系列。

安排 香港一所收緊急病症的分區醫院。

患者 研究對象為於2010年1月至12月期間入院，而出院時的主要診斷為慢性阻塞性肺病的患者。

結果 共分析了253名由醫生診斷為慢性阻塞性肺病的病人紀錄。大部份患者較年長（平均年齡78歲），在2010年內因慢性阻塞性肺病而入院的中位數為兩次。約三分之二（64%）至少曾經有一次肺功能檢查。預測第一秒用力呼氣量平均為55%。肺功能檢查顯示90%有中度至非常嚴重的氣流受限。253名慢性阻塞性肺病的患者中，只有21%被處方長效支氣管擴張劑。

結論 因慢性阻塞性肺病而須緊急入院的患者大多較為年長、有多種共病，並且肺功能檢查顯示大部份有中度至重度氣流受限。幾乎有一半（約46%）患者在2010年內入院兩次或以上。長效支氣管擴張劑的處方率較低，似乎表示醫生較少依從最新的治療指引。須急性入院的慢性阻塞性肺病患者有相對較大機會再度入院和高死亡率風險。建議須由指定的跨學科團隊處理因慢性阻塞性肺病而須急性入院的患者。

Methods

This was a retrospective descriptive study of adult COPD patients admitted to the Alice Ho Miu Ling Nethersole Hospital (AHNH), a regional acute general hospital, during the period of January 2010 to December 2010. A list of COPD patients was generated from the Hospital Authority Clinical Data Analysis and Reporting System (CDARS), on discharge from the Department of Medicine of the AHNH in the year 2010; each patient had to have a principal diagnosis of "chronic obstructive pulmonary disease" (ICD code 496). Original case notes and the clinical management system (CMS) records of each subject were then reviewed to confirm the diagnostic coding and to exclude non-COPD admissions. Inclusion criteria were: (1) age >40 years; (2) principal discharge diagnosis of COPD; and (3) at least one emergency admission to the AHNH for a COPD exacerbation in 2010. Exclusion criteria were: (1) normal forced expiratory volume in one second/forced vital capacity (FEV_1/FVC) ratio (if available in the case record); (2) doubtful clinical diagnosis of COPD if lung function test was not performed; and (3) other significant co-existing lung disease (eg lung cancer).

When the subjects satisfied all these criteria, demographic data, co-morbidities, number of admissions due to COPD exacerbations, and corresponding treatment modalities pertaining to the last admission in 2010 were retrieved. The pharmacological treatment of COPD and co-morbidities of the study subjects were reviewed. The use of long-term oxygen therapy (LTOT) and acute/long-term non-invasive ventilation (NIV) were recorded. Spirometry data were retrieved from case notes or the CMS, if available. For patients with available spirometry data, the Global initiative for chronic Obstructive Lung Disease (GOLD) criteria of post-bronchodilator FEV_1/FVC ratios of <70% confirmed the presence of airflow limitation.[5] The Statistical Package for the Social Sciences (Windows version 13.0; SPSS Inc, Chicago [IL], US) was used for data analysis. Descriptive statistics (frequency distribution, means, medians, and standard deviations) were derived as appropriate. The study was approved by the Joint Chinese University of Hong Kong–New Territories East Cluster Clinical Research Ethics Committee.

TABLE 1. Reasons of exclusion

Reason	No. (%)*
Co-existing lung diseases	
Lung cancer	9 (7)
Asthma	9 (7)
Bronchiectasis or bronchiolitis	16 (12)
Pulmonary fibrosis or restrictive lung disease	12 (9)
Doubtful clinical diagnosis of COPD†	18 (13)
Patients lost to follow-up or being followed up elsewhere	35 (26)
Normal lung function or restrictive lung pattern	9 (7)
Incorrect coding for non-COPD admission	10 (7)
Others	19 (14)

* Among the 129 patients, 122 had one exclusion criterion, 6 had 2 exclusion criteria, and 1 had 3 exclusion criteria

† COPD denotes chronic obstructive pulmonary disease

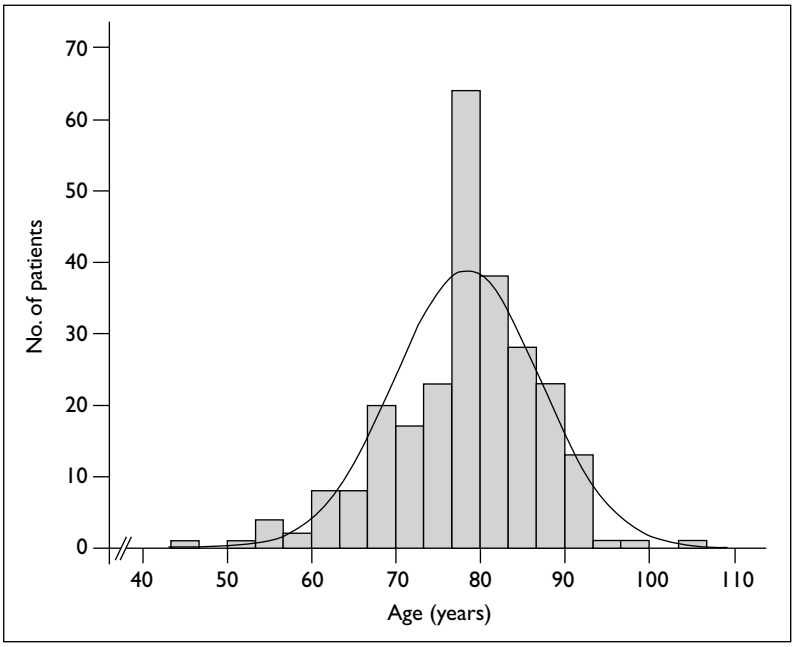

FIG 1. Age distribution of recruited subjects

Results

Within the study period (1 January to 31 December 2010), 382 patients were discharged with a principal diagnosis of COPD. After individual case record review, 129 of these cases were excluded. Patients lost to follow-up after discharge or being followed up in other hospitals/clinics (with incomplete data collection) was the main reason for exclusion (n=35), others being normal or restrictive lung function test findings (n=9). For patients without spirometry data, the clinical diagnosis of COPD was doubtful in 18 of them based on their clinical records. Moreover, 10 patients were admitted due to disease entities other than COPD but incorrectly labelled COPD as the principal discharge diagnosis. Table 1 summarises the reasons of exclusion for these 129 subjects. Thus, 253 subjects were eligible for further analysis.

Demographic data

The median age of the study subjects was 79 years and most (79%) were male. Figure 1 shows the histogram of the corresponding age distribution of the subjects. There were 36 (14%) who were current smokers, 197 (78%) who were ex-smokers, and 20 (8%) who had never smoked. Hypertension was the most common co-morbidity affecting more than half (n=136, 54%) of the subjects, followed by a history of pulmonary tuberculosis (TB) [n=47, 19%) [Table 2].

Admission pattern

The median number of admissions per patient in 2010 was two. Figure 2 shows the frequency distribution of hospital admissions. Almost half (46%) had two or more admissions in 1 year. About 10% of the subjects had four to 12 admissions in 1 year.

Airflow limitation by spirometry

Of the 253 subjects with a principal discharge diagnosis of COPD, around two thirds (n=162, 64%) had spirometry at least once in or before 2010, the remaining 91 (36%) subjects had not had spirometry to evaluate their airflow limitation (Table 3). In those who had had it, the mean FEV_1 was about 1.02 L (standard deviation, 0.43 L) and the mean percentage predicted FEV_1 was 55%. According to the GOLD classification of airflow limitation severity in COPD (based on post-bronchodilator FEV_1 values),[5] 10% of the patients belonged to GOLD stage 1, 42% to stage 2, 37% to stage 3, and 10% to stage 4.

Treatment modalities in patients based on spirometry stage

Treatment modalities and admission patterns of patients with or without spirometry data were separately analysed (Table 4). For those with available spirometry data, a higher proportion was prescribed long-acting inhaled bronchodilators (long-acting beta-agonist [LABA] and long-acting muscarinic antagonist [LAMA]) in severe and very severe COPD. However, for those whose spirometry data were not available or had not been performed, considerably fewer were provided a LABA or LAMA. Overall, 21% of all patients (with or without spirometry data) were given a LABA and/or LAMA. Patients with severe–to–very severe COPD were also more likely to receive LTOT, acute NIV, and long-term nocturnal home NIV. In all, 29 (12%) of the patients used acute NIV during their admissions in 2010, 11 (38%) of whom died during the same admission despite its use. Patients with increasing airflow limitation had higher

TABLE 2. Demographics of the patients with chronic obstructive pulmonary disease

Demographics	No. (%) of patients*
Age (years)	
Mean (standard deviation)	78 (9)
Median	79
Age range	45-105
Sex	
Male	199 (79)
Female	54 (21)
Smoking status	
Non-smokers	20 (8)
Ex-smokers	197 (78)
Active smokers	36 (14)
Co-morbidity†	
Diabetes mellitus	31 (12)
Hypertension	136 (54)
Ischaemic heart disease	44 (17)
Congestive heart failure	26 (10)
Old cerebral vascular accident	34 (13)
Old tuberculosis	47 (19)

* Unless otherwise stated
† Some patients had more than one co-morbidity

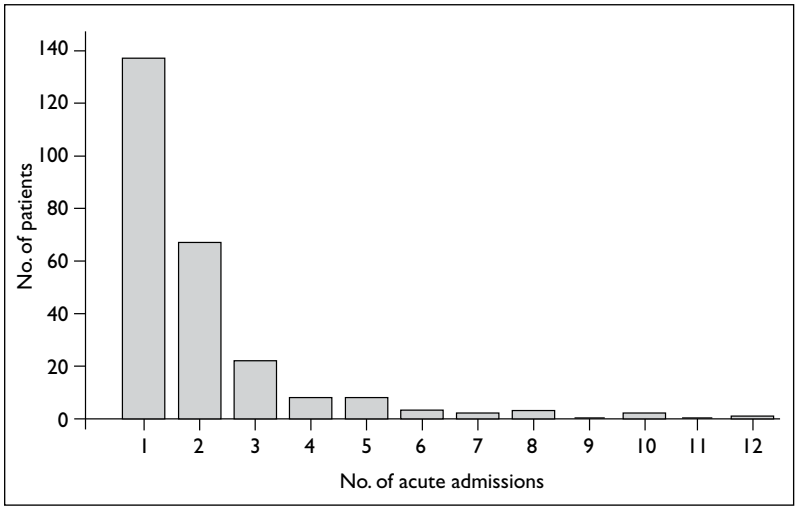

FIG 2. Numbers of exacerbations for which patients were admitted to hospital during the study year

TABLE 3. Spirometry values and severity of airflow limitation among chronic obstructive pulmonary disease subjects with spirometry performed (n=162)*

	GOLD 1	GOLD 2	GOLD 3	GOLD 4
No. (%) of subjects	17 (10)	68 (42)	60 (37)	17 (10)
Mean FEV_1 (L)	1.65	1.19	0.79	0.49
Mean predicted FEV_1 (%)	98.4	64.1	40.9	23.9

* GOLD denotes Global initiative for chronic Obstructive Lung Disease criteria, and FEV_1 forced expiratory volume in one second. GOLD 1 (mild) = FEV_1 ≥80% predicted, GOLD 2 (moderate) = 50% ≤ FEV_1 < 80% predicted, GOLD 3 (severe) = 30% ≤ FEV_1 < 50% predicted, GOLD 4 (very severe) = FEV_1 <30% predicted

numbers of hospital admissions per year. However, because there were larger numbers of patients with moderate (GOLD stage 2) to severe (GOLD stage 3) airflow limitation, not surprisingly 77% of hospital admissions were from this group of patients (excluding patients without lung function result).

Mortality

Of the 253 COPD patients, there were 37 (15%) deaths in 2010. The most common cause of death was COPD (57%) followed by pneumonia (22%). One patient died of congestive heart failure and one of ischaemic heart disease.

Discussion

In Hong Kong, COPD is a common cause of hospital admission and in-patient bed-days. However, there was limited information of the characteristics of COPD patients having emergency admissions. Our study yielded the following important findings regarding this issue:

(1) For COPD patients with spirometry data available, the majority (almost 90%) had at least moderate (GOLD stage 2) airflow limitation when they were admitted to hospital, and among them about half had severe (GOLD stage 3) to very severe (GOLD stage 4) disease (Table 3).
(2) Almost half (46%) of the COPD patients had two or more admissions in 1 year.
(3) The majority (77%) of hospital admissions were due to patients with moderate-to-severe airflow limitation (GOLD stages 2 to 3 disease; Table 4).
(4) Patients with severe–to–very severe disease demonstrated increased recourse to acute NIV and home NIV.

According to the latest GOLD statement in 2011,[5] COPD patients are at greater risk if they have severe–to–very severe airflow obstruction and/or more than two exacerbations in 1 year.[6] Since about half of the COPD patients admitted to hospital had severe or very severe airflow obstruction and about half had two or more exacerbations resulting in admissions in 1 year, many of these COPD patients admitted for exacerbations were at high risk. Thus, if possible, it may be more cost-effective to congregate most COPD admissions in a designated area (eg a COPD ward), which is a practice that has already been implemented in some acute medical units in Hong Kong (personal communication). Spirometry plays a crucial role in the diagnosis and risk assessment of COPD patients. Around two thirds (64%) of our subjects had at least one such assessment, but even

TABLE 4. Treatment modalities for chronic obstructive pulmonary disease patients according to GOLD classification*

Treatment modality	GOLD 1 (n=17)	GOLD 2 (n=68)	GOLD 3 (n=60)	GOLD 4 (n=17)	Overall for GOLD 1-4 (n=162)	Spirometry data not available (n=91)
Inhaled SAMA	11 (65%)	57 (84%)	50 (83%)	12 (71%)	130 (80%)	77 (85%)
Inhaled SABA	16 (94%)	67 (99%)	60 (100%)	17 (100%)	160 (99%)	91 (100%)
LABA	1 (6%)	9 (13%)	13 (22%)	10 (59%)	33 (20%)	9 (10%)
LAMA	1 (6%)	2 (3%)	7 (12%)	4 (24%)	14 (9%)	3 (3%)
ICS	9 (53%)	51 (75%)	52 (87%)	16 (94%)	128 (79%)	56 (62%)
Terbutaline sulphate	6 (35%)	27 (40%)	19 (32%)	5 (29%)	57 (35%)	31 (34%)
Oral theophylline	3 (18%)	22 (32%)	29 (48%)	6 (35%)	60 (37%)	33 (36%)
LTOT	1 (6%)†	5 (7%)	21 (35%)	12 (71%)	39 (24%)	18 (20%)
In-patient NIV use ever	1 (6%)	10 (15%)	12 (20%)	8 (47%)	31 (19%)	13 (14%)
Home NIV	0 (0%)	2 (3%)	5 (8%)	5 (29%)	12 (7%)	3 (3%)
Total No. of admissions	26	116	136	50	328	169
Mean No. of admissions	1.5	1.7	2.3	2.9	2.0	1.9

* GOLD denotes Global initiative for chronic Obstructive Lung Disease criteria, SAMA short-acting muscarinic antagonist, SABA short-acting beta agonist, LABA long-acting beta agonist, LAMA long-acting muscarinic antagonist, ICS inhaled corticosteroid, LTOT long-term oxygen therapy, and NIV non-invasive ventilation

† GOLD 1 patient with spirometry performed in 2001 only, developed cor pulmonale later on and was put on LTOT in 2010

this was far from ideal. Spirometry for diagnosis and at regular intervals thereafter should be included as part of the COPD management protocol.

Our hospitalised patient group commonly had associated co-morbidities like hypertension (54%), old TB (19%), ischaemic heart disease (17%), and diabetes mellitus (12%). Moreover, the presence of such chronic co-morbidities in COPD patients is known to have a significant impact on prognosis,[6,7] in which systemic inflammation may be a possible common link with other diseases.[7,8] Indeed, in advanced stage of COPD patients, there is a higher prevalence of diabetes, hypertension, and cardiovascular disease.[9] In hospitalised patients, and especially the elderly (as in our cohort), worsening heart failure is a significant differential diagnosis of COPD. In COPD patients, therefore, heightened awareness is necessary when it comes to the diagnosis and management of co-morbidities.[5]

A history of pulmonary TB (obtained from 19% of our patients) was the second most common associated co-morbidity. Endobronchial involvement can lead to bronchial obstruction and fibrosis, while lymphadenopathy can cause extrinsic bronchial compression of the airways.[10] A history of pulmonary TB increased the risk of COPD about 4-fold in men and nearly 2-fold in women, even after adjustment for age, gender, education, ethnic origin, smoking status, exposure to dust and smoke, and respiratory morbidity in childhood.[11] As pulmonary TB remains a common disease in Hong Kong, it may be a significant contributor to airflow obstruction in COPD.

Appropriate pharmacological therapy is essential in the management of COPD. Large clinical trials have already documented the benefit of long-acting bronchodilators, in terms of lung function, health status, hospitalisation, exacerbation rates, and mortality.[12-15] In the present study, the overall use of LABA and LAMA were only about 17% and 7%, respectively. This inappropriately low prescription rate of long-acting bronchodilators had also been demonstrated in a previous local study.[4] In an international, multicentre study reviewing the geographic differences in management of COPD patients, LAMA (tiotropium) usage was 36% and combined use of LABA and inhaled corticosteroids (ICS) was 46% globally.[16] In Hong Kong, the usage of LAMA was less than 2% and combined LABA/ICS was only 13%.[16] The higher exacerbation rate in Hong Kong might be related to the lower prescription rates for LAMA and/or LABA/ICS drugs. Thus, adherence to treatment guidelines appears insufficient, and may be partly related to cost concerns. Additional funding for the prescription of long-acting bronchodilators was successfully sought from the Government of the Hong Kong Special Administrative Region in 2011. A follow-up study of usage rates of long-acting bronchodilators in Hong Kong post-2011 may therefore be of interest.

Acute NIV is indicated in COPD patients with hypercapnic respiratory failure (in addition to optimal pharmacotherapy and controlled oxygen supplementation), as it can reduce mortality, intubation, ventilator-associated complications, and hospital stays.[17] A local study showed that after acute NIV use within 1 year, around 80% of the patients were readmitted, 63% had another life-threatening event, and half of them had died.[18] A recently published national audit of clinical care for

consecutive COPD admissions in the UK showed that 12% received ventilatory support and 20% had respiratory acidosis on admission.[19] In this study, 29 (12%) of our patients used NIV acutely during their admissions in 2010; 11 (38%) of them nevertheless died during the same admission. The care of these very-high-risk patients on NIV in a dedicated area with a multidisciplinary team of trained staff is therefore recommended. They may also warrant arrangements for post-discharge long-term nocturnal home NIV.[20,21]

Conclusion

Patients with COPD admitted to a regional district hospital were old and had various medical co-morbidities. About half of them had two or more COPD admissions in 1 year. Approximately 90% of them had moderate–to–very severe disease (GOLD stages 2 to 4). Many of the COPD patients were at high risk of morbidity and mortality when admitted for acute exacerbations, for whom it would be cost-effective to undertake management in a dedicated ward. For these high-risk patients with poor lung function and repeated hospital admissions, international guidelines recommend a multidisciplinary approach and appropriate pharmacological treatment so as to control symptoms and reduce exacerbations.[5]

Declaration

In June 2012, the data presented in this study were submitted in another format to the Specialty Board of Respiratory Medicine for the Exit examination of Dr LH Au.

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