Chronic obstructive pulmonary disease in the elderly: evaluation and management

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ABSTRACT
Chronic obstructive pulmonary disease (COPD) is a leading cause of mortality and morbidity in older adults worldwide. It can be exacerbated by other chronic and acute health problems (myocardial infarction, angina, osteoporosis, respiratory infection, depression, diabetes, and lung cancer). Although the prevalence of COPD in the elderly is high, it is often undiagnosed and thus undertreated. Diagnosis is primarily based on physiological airflow limitation using spirometry. Controversies exist as to the range of predicted normal values in the elderly, in whom its clinical presentation may be complicated by other comorbidities. Many non-pharmacological and pharmacological interventions are available for managing COPD. However, polypharmacy may pose a challenge to the management of COPD, as it can interfere with compliance to optimal therapy. This article highlights the evaluation of COPD in the elderly and its management.

Key words: Aged; Disease management; Medication therapy management; Pulmonary disease, chronic obstructive

INTRODUCTION
Chronic obstructive pulmonary disease (COPD) is characterised by the slowly progressive impairment of airflow such that symptoms are usually not exhibited until the age of 55 years, and mortality usually occurs after the age of 65 years. Manifestations of COPD include dyspnoea, poor exercise tolerance, chronic cough with or without sputum production, wheezing, respiratory failure, and cor pulmonale. Exacerbations and concomitant chronic diseases may increase symptom severity, especially in the elderly, in whom COPD is a common chronic condition. It is associated with significant morbidity and mortality and is the fourth leading cause of death in the world. By 2020, the disease is expected to be the third leading cause of death worldwide. The Global Initiative for Lung Disease (GOLD) guideline has defined COPD as a preventable and treatable disease with significant extra-pulmonary effects that may contribute to its severity in individuals. Its pulmonary component is characterised by irreversible airflow limitation, which is progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases. Despite the increasing burden of COPD in older people, underdiagnosis and undertreatment is common.

GLOBAL INITIATIVE FOR LUNG DISEASE GUIDELINES
The degree of airflow obstruction is an important prognostic factor in COPD and the basis for the GOLD redundant classification (Table 1). A multifactorial index—the BODE index (for body mass index, obstruction, dyspnoea, and exercise capacity)—is a better predictor of mortality than pulmonary function alone. The BODE index discriminates mortality better than FEV1 alone. Scores range from 0 to 10 (most impaired) and are
stratified into 4 stages:

Stage I (mild COPD): it is characterised by mild airflow limitation (FEV1/FVC, <0.70; FEV1, >80% predicted) with or without symptoms.

Stage II (moderate COPD): it is characterised by worsening airflow limitation (FEV1/FVC, <0.70; FEV1, 50-80% predicted) with dyspnoea on exertion and cough and sputum production may be present. Patients usually seek medical attention because of symptoms or an exacerbation.

Stage III (severe COPD): there is further worsening of airflow limitation (FEV1/FVC, <0.70; FEV1, 30-50% predicted), increased shortness of breath, reduced exercise capacity, and repeated exacerbations.

Stage IV (very severe COPD): there is severe airflow limitation (FEV1/FVC, <0.70; FEV1, <30% predicted or FEV1 of <50% predicted with respiratory failure or signs of right heart failure). Clinical signs of cor pulmonale are raised jugular venous pressure and pedal oedema.

In the recent revision of the GOLD strategy, the concept of spirometric stages is replaced by spirometric grades because the level of FEV1 alone incompletely predicts disease status. A composite measure of the level of symptoms and frequency of exacerbations is added to FEV1 to categorise patients into 4 groups:

Group A (low risk, fewer symptoms) includes patients with an FEV1 of >50% (grade 1 or 2) and low level of symptoms based on the COPD Assessment Test (CAT) score of <10, or the modified Medical Research Council (mMRC) Dyspnea Scale score of <2, and 0 to 1 exacerbations in the previous year.

Group B (low risk, more symptoms) includes patients with an FEV1 of >50% and 0 to 1 exacerbations in the previous year but symptomatic with a CAT score of >10 or a mMRC Dyspnea Scale score of >2.

Group C (high risk, fewer symptoms) includes patients with an FEV1 of <50%, a CAT score of >10 or a mMRC Dyspnea Scale score of >2, but with ≥2 exacerbations in the previous year.

Group D (high risk, more symptoms) includes patients with an FEV1 of <50%, a CAT score of >10 or a mMRC Dyspnea Scale of >2, and ≥2 exacerbations in the previous year.

The CAT and the mMRC Dyspnea Scale are validated tools that assess symptoms and correlate with the Saint George’s Respiratory Questionnaire, a widely used quality-of-life instrument in COPD research. The CAT is an 8-item questionnaire with scores ranging from 0 to 5 for each question (total range, 0-40) with a score of >10 being abnormal. This test is easier to administer and correlates more strongly with outcome measures in COPD patients than does FEV1. It is adopted in the new GOLD strategy approach to assess severity and grade patients with COPD.

**SPECIAL CONSIDERATIONS IN OLDER PATIENTS**

COPD at any age may have reversible airflow obstruction that can be assessed and treated in a similar manner in both young and elderly patients. This hidden reversible obstructive component must first be suspected before appropriate evaluation and treatment can be initiated. In studies of older patients...
with COPD, only 6 to 12% received bronchodilator therapy even though as many as 40% demonstrated reversible disease.5,6 This suggests that the reversible component of COPD is commonly overlooked in the elderly. In elderly patients with COPD, dyspnoea may be attributed to old age, being out of shape, smoking too many cigarettes, and comorbid illnesses such as ischaemic heart disease, osteoporosis, depression, diabetes, and lung cancer. Thus, COPD patients may be deprived of improvement in their functional status and quality of life and lead to secondary ageing.6

Old age and comorbidity are partly responsible for the misdiagnosis and under treatment of COPD in older adults. There is a disparity between practice guidelines and their implementation. This results in fewer subjects having spirometry and blood gas analysis annually and receiving respiratory medications and ventilatory support.7 Older adults with COPD generally have a poor health status because of chronic comorbidities and limitations in activities of daily living. Up to 25% of population aged >65 years suffer from 2 comorbid conditions, and up to 17% have 3, and >50% of deaths in COPD patients are caused by non-respiratory diseases.8

Diagnostic difficulty in relation to age-related decline in lung function
Ageing causes decline in lung function, which may be due to structural changes to the thoracic cage leading to reduced chest wall compliance, an example being kyphosis. Another reason may be calcification of rib cartilages which stiffen the thoracic cage and impair chest wall expansion as well as the action of the diaphragm.9 Diaphragmatic strength is reduced by 25% in healthy older people compared to young adults.10 The ageing process involves the degeneration of the elastic fibres around the alveolar ducts resulting in air trapping and senile hyperinflation.11 Age is inversely related to respiratory muscle strength and pulmonary function.12 There is no correlation between age and total lung capacity, but functional residual capacity and residual volume increase with age. Small airway calibre may decline progressively with age. Thus, COPD is more prevalent in very elderly populations.13

Diagnostic difficulty in older patients related to spirometry testing
Spirometry is an important part of the diagnostic workup of patients with COPD. It can be performed adequately in most elderly people. However, a proportion of such patients, particularly those aged >75 years do not perform full spirometry reliably owing to impairment of cognitive, ideo-motor, and executive function, all of which affect inhaler technique.14,15 For testing cognitive function, the Mini-Mental State Examination (MMSE) and its intersecting pentagon-copying component (IP) has high specificity but with moderate sensitivity.16 The clock drawing tests (CLOX1 and 2) have an embedded executive and ideo-motor component and are validated for use in elderly patients. The CLOX1 asks the subject to draw a clock face on a paper and hence tests for executive dyscontrol in a novel and ambiguous situation, whereas CLOX2 requires the subject to copy a clock face and hence tests his ability to understand and plan a well-defined action and then carry it out accurately and completely. Patients with a MMSE score of <24/30 or inability to copy overlapping pentagons are rarely able to perform adequate spirometry. The MMSE and copying overlapping pentagons are more useful than CLOX for predicting inability to perform spirometry in old age. Performing spirometry reliably appears to be more dependent on intact global cognitive function and ideo-motor praxis than on executive control function.17

MANAGEMENT
The management of elderly patients with COPD should encompass a multidisciplinary approach. In addition to the assessment of lung ventilatory performance and functional impairment, nutritional status, and mental health should be evaluated. Underlying comorbidities should also be evaluated and treated. Therapy for COPD should start with cessation of tobacco smoking. Smoking cessation rates in the elderly have not declined. This may reflect an underlying reluctance by physicians to counsel and offer smoking cessation therapies to the elderly. In contrast to prolonged oxygen therapy, bronchodilators and corticosteroids do not decrease mortality and are primarily used for symptom relief. In old age, oxygen therapy has a beneficial effect on quality of life and exacerbation rates. The choice of delivery devices for inhaled medications is important; patients should be properly trained to use an inhaler and their dexterity should be assessed frequently. Pulmonary rehabilitation and nutritional supplementation are other important components of
Chronic obstructive pulmonary disease in the elderly

Elderly patients with COPD require special attention

Because of the high susceptibility of older people to disease, medication use is extensive and the number taken daily increases progressively with age. Prescribing for older subjects is a complex issue as their behaviour towards medications and their effects vary according to the health of the patient, the route of drug metabolism/elimination, and its intrinsic safety. Five key steps have been identified in prescribing: determine evidence of efficacy in older subjects; assess the likelihood of adverse drug events; discuss the harm/benefit analysis with the patient; decide on the dose, formulation, and delivery of the medication, and monitor the patient very carefully.18 The process of ageing can influence pharmacodynamic responses as well as pharmacokinetics (absorption, distribution, metabolism, and excretion of drugs).

Bronchodilators and anti-inflammatory drugs

These constitute the mainstay of the pharmacological treatment for COPD. Bronchodilators currently used as regular treatment and recommended in the GOLD guidelines include a long-acting anticholinergic (i.e. tiotropium) and long-acting beta agonists (i.e. salmeterol and formoterol). Anti-inflammatory drugs like inhaled corticosteroids are available, including fluticasone propionate, budesonide, beclomethasone dipropionate, flunisolide, triamcinolone, and mometasone.

Tiotropium

Tiotropium is a long-acting antagonist of muscarinic receptors. It undergoes minimal metabolism, as 74% of an intravenous dose is excreted unchanged by the kidneys. After inhalation, 14% of the dose is excreted unchanged in the urine, where it undergoes active tubular secretion; the remainder (presumably non-absorbed drug) is eliminated in the faeces. The renal clearance and urinary excretion of tiotropium is reduced in patients with renal impairment and those of advanced age. Increasing age is associated with reduced renal function. There is no study on the effect of age and severe renal or hepatic impairment on tiotropium pharmacokinetics.19

Beta agonists

Salmeterol and formoterol are commonly used by inhalation. In older patients with COPD or hepatic disorder, the pharmacokinetics of both drugs are not well known. It is interesting to evaluate whether the pulmonary distribution and absorption of the inhaled drugs change in older patients with COPD because of the impaired airway function.20 The beta adrenergic response to beta 2-agonists decreases with increasing age. There are changes in the beta adrenergic system in older people. Ageing is associated with the down-regulation of beta adrenergic receptors, elevated plasma noradrenaline levels, and a reduced cAMP production in response to beta adrenergic stimulation.21 A down-regulation of beta 2–adrenergic receptors may also explain why higher concentrations of these drug are needed to produce a desired effect with increasing age. The response to salbutamol also declines significantly with age.22

Inhaled corticosteroids

Inhaled corticosteroids are widely used in COPD, as they enable the delivery of steroids to the lung, with minimal systemic side-effects. Most of the inhaled dose is deposited in the oropharynx and is then swallowed. Subsequently, the drug is absorbed from the gastrointestinal tract and is subject to first-pass metabolism in the liver. A much smaller fraction of the delivered dose reaches the airways and the systemic circulation if not removed by mucociliary clearance. The pharmacodynamic effects of inhaled corticosteroids are influenced by the local concentration within the airways. Fluticasone propionate has the greatest degree of topical potency, followed by budesonide, beclomethasone dipropionate, flunisolide, and fluticasone.23–25

There is no study evaluating the effects of inhaled steroids in very elderly persons.

Polypharmacy in elderly

Older people are the major consumers of drugs, owing to increasing number of chronic diseases with advancing age. On average, the elderly take 2 to 9 prescription medications daily.26–30 Factors predisposing to such polypharmacy are poorer health, multiple chronic diseases, multiple prescribing physicians, therapeutic advances, expectations of the patient, education, increasing demands for health care, supplemental insurance, and reluctance to discontinue old medications. Polypharmacy increases the risk of inappropriate medications, non-adherence to treatments, morbidity, mortality, and adverse drug reactions.31–33 Inappropriate prescription
in the elderly is an emerging health issue. It entails inappropriate dose, formulation, duration, and drug delivery. It also includes the use of unnecessary drugs, the omission of necessary medicines, and possible drug interactions and adverse effects. A population-based cohort study found that 20% of ambulatory older adults were prescribed at least 1 inappropriate drug per year. Inappropriate medications are detected according to various screening tools for the assessment of the quality and safety of prescriptions, for example the screening tool of older persons’ potentially inappropriate prescription (STOPP) and the screening tool to alert doctors to the right treatment (START) [Table 2].

Smoking cessation
Smoking cessation is the most important means of preventing and treating COPD. It slows the progression of COPD and the rate of FEV1 decline. The main interventions to stop smoking are behavioural modification programmes and pharmacologic agents (nicotine replacement products, atypical antidepressants, bupropion). They reduce the severity of nicotine cravings and withdrawal symptoms. A combination of pharmacologic and behavioural approaches and frequent maintenance visits are helpful and enable better smoking cessation rates. Nicotine replacement is available as chewing gums, inhalants, lozenges, patches, and sprays. Treatment regimens include the use of transdermal patches, usually starting at a dose of 21 mg/day for 4 to 6 weeks for at least 8 weeks, with a gradual taper; supplementation with other short-acting nicotine replacement products can be used as needed to alleviate cravings. Sustained release bupropion is also effective, although the likelihood of sustained abstinence among patients with COPD is lower with bupropion than with nicotine replacement. Bupropion can lower the seizure threshold and is contraindicated in elderly patients with seizure disorders, those with liver or renal impairment and when co-prescribed with drugs that cause lowering the seizure threshold (antidepressants, antipsychotics, systemic corticosteroids, theophylline, and tramadol).

Pulmonary rehabilitation
Pulmonary rehabilitation has an important role in improving exercise capacity, dyspnoea, and quality of life. It reduces hospitalisations and health care cost. It is beneficial as adjunct treatment in patients whose symptoms are not responding to drug therapy. It is most effective when delivered as a comprehensive education programme about disease, physical training, psychosocial counselling, and nutritional support.

Mode of therapy
Inhaled bronchodilator therapy is the mainstay of treatment in the management of COPD. Although available in various formulations (metered dose inhaler [pMDI]/dry powder inhaler [DPI] or nebulised), the MDI is the most commonly prescribed. Therapeutic benefit depends on adequate airway drug deposition. Inhaler technique is crucial but sub-optimal in many patient groups, particularly the elderly. Arthritis, weakness, poor manual dexterity, and visual limitations are potential problems affecting inhaler use in the elderly.

More patient-friendly devices such as breath-actuated DPIs have been developed. In general, DPIs require a higher peak inspiratory flow (PIF) than MDIs for effective drug delivery, as a minimum

| Table 2 |
| Inappropriate prescription for patients with chronic obstructive pulmonary disease (COPD): criteria for the screening tool to alert doctors to the right treatment (START) and the screening tool of older persons’ prescriptions (STOPP) |

<table>
<thead>
<tr>
<th>STOPP</th>
<th>START</th>
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<tbody>
<tr>
<td>Drug prescriptions potentially inappropriate in persons aged ≥65 years:</td>
<td></td>
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<tr>
<td>• Theophylline as monotherapy for COPD</td>
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<tr>
<td>• Systemic corticosteroids instead of inhaled corticosteroids for maintenance therapy in moderate-to-severe COPD</td>
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<tr>
<td>• Nebulised ipratropium with glaucoma</td>
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<tr>
<td>Medications for people aged ≥65 years with the following conditions when no contraindication to prescription exists:</td>
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<tr>
<td>• Regular inhaled beta-2-agonist or anticholinergic agent for mild-to-moderate asthma or COPD</td>
<td></td>
</tr>
<tr>
<td>• Regular inhaled corticosteroid for moderate-to-severe asthma or COPD when FEV1 is &lt;50% predicted</td>
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<tr>
<td>• Continuous oxygen at home with documented chronic type 1 (pO2 &lt;8.0 kPa and pCO2 &lt;6.5 kPa) or type 2 (pO2 &lt;8.0 kPa and pCO2 &gt;6.5 kPa) respiratory failure</td>
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inspiratory flow is required to disaggregate and disperse the drug powder in the inhaled air-stream. Data are limited regarding the percentage of patients with COPD who can achieve the minimum PIF to use these devices satisfactorily. In elderly patients with COPD, only 25% generated the minimum recommended PIF for the highest resistance device. Even when in a stable clinical condition, elderly patients with COPD may be unable to gain optimum benefit from their inhaler.42

Nebulisers are frequently used to deliver bronchodilators in elderly patients. Elderly patients are more able to inhale the medications from these devices than from MDIs or DPIs. Drug delivery via an MDI linked to a spacer or nebuliser improves FEV1, FVC, and dyspnoea, equally without effects on heart rate and diastolic blood pressure.43

**Supplemental oxygen therapy**
Supplemental oxygen for ≥15 hours per day reduces the mortality.44 Medicare guidelines recommend that oxygen therapy should be initiated in stable patients if the resting arterial partial pressure of oxygen is <55 mm Hg or if the oxygen saturation is <88%. Long-term oxygen therapy (>15 hours per day) increases survival in COPD patients with respiratory failure and severe resting hypoxaemia. Supplemental oxygen significantly improves exercise tolerance even in patients in whom desaturation does not occur during exercise.45

Indications for long-term oxygen therapy are: resting $\text{PaO}_2$ of <55 mm Hg, resting $\text{PaO}_2$ of 56 to 59 mm Hg with either right heart failure (e.g. dependent oedema or P pulmonale on electrocardiography) or polycythaemia (haematocrit of 56%). Supplemental oxygen should be adjusted to maintain an oxygen saturation of at least 90%.46

**Nutrition support**
According to the European Society for Parenteral and Enteral Nutrition guidelines,47 enteral nutrition in combination with exercise and anabolic pharmacotherapy may improve nutritional status and function in COPD patients. Frequent small amounts of oral nutritional supplements are preferred in order to avoid postprandial dyspnoea and satiety and improve compliance. Nutritional supplementation may have a role in the management of COPD when provided as part of integrated rehabilitation that incorporates a structured exercise component as an anabolic stimulus.48 Ghrelin is a novel growth hormone–releasing peptide that also induces a positive energy balance by decreasing fat utility and stimulating feeding through growth hormone–independent mechanisms. Plasma ghrelin levels decrease in COPD patients, in contrast to other weight-loss diseases.49 Repeated administration of ghrelin improves body composition and functional capacity, reduces muscle wasting, and enhances sympathetic augmentation in cachectic patients with COPD.50

**Palliative and end-of-life care**
Palliative care aims to prevent and relieve suffering by controlling symptoms and to provide support to patients and families in order to maintain and improve their quality of living. Smoking cessation and long-term oxygen therapy improve survival as well as quality of life in COPD patients. Long-term oxygen therapy (>18 hours per day) increases survival in hypoxaemic COPD patients.51 Non-invasive positive pressure ventilation delivered through nasal or face mask avoids the risks associated with invasive ventilation. It is an alternative to invasive ventilation for symptom relief in end-stage COPD.51 A European survey of respiratory intermediate care reported its frequency of use and its role in almost a third of the patients with poor life expectancy.52 The Society of Critical Care Medicine developed an approach for considering its use for patients who choose to forego endotracheal intubation. As a palliative measure, non-invasive positive pressure ventilation may be appropriate when patients and families have chosen to forego all life support and receive only comfort measures. However, palliative care comes up against important difficulties such as an indefinite beginning of the palliative stage in COPD; insufficient palliative care resources; insufficient communication and insufficient utilisation of palliative care resources. All these can be overcome by long-term oxygen therapy and non-invasive positive pressure ventilation to some extent.

**CONCLUSION**
COPD is a major public health problem that affects a large proportion of the elderly. Its diagnosis is complicated by the fact that many such patients ignore or tolerate their symptoms and do not seek medical attention. Management of COPD should
focus on smoking cessation and implementing both non-pharmacological and pharmacological interventions. Owing to the cumulative risks related to COPD and ageing, several diagnostic and management issues specific to the elderly need to be considered, including pharmacological side-effects, decreased physical and social autonomy, nutritional impairment, and comorbidities. Given the lack of specific data in elderly populations, pharmacological indications are generally the same as in younger populations, but additional precautionary measures are necessary. Elderly COPD patients may have problems with physical coordination and/or may be cognitively impaired and unable to use a MDI or DPI. It is essential to ensure that inhalation device technique is correct, especially when disease worsening is detected, and to undertake efforts to correct the technique or change to a more appropriate device as part of symptom management. Palliative care can be difficult to apply, but can be managed by long-term oxygen therapy and non-invasive positive pressure ventilation. Global COPD management in the elderly requires coordination, best reached in health care network organisations involving medical and/or social professionals. In addition, the course of COPD in elderly patients is often complicated by multiple comorbidities that need to be addressed to optimise treatment outcomes.

REFERENCES

7. Craig BM, Kraus CK, Chewning BA, Davis JE. Quality of care for older adults with chronic obstructive pulmonary disease and asthma based on comparisons to practice guidelines and smoking status. BMC Health Serv Res 2008;8:144.