

Treatment of acute severe asthma and chronic obstructive pulmonary disease in Danish hospitals. Do national recommendations improve on the quality of the treatment?

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Abstract Studies have demonstrated suboptimal treatment of acute severe asthma and chronic obstructive pulmonary disease (COPD). We examined the quality of treatment in Denmark and the effect of intervention, by publication of recommendations for standardised treatment. All 70 hospitals in Denmark with emergency facilities participated in a telephone questionnaire, examining treatment behaviours among house officers. The survey was repeated 3 years later, after publication of national recommendations for treatment of acute exacerbations of asthma and COPD. The response rate in both surveys was 100%. An insufficient handling of nebulisers, a huge variation in the delivered dose of bronchodilators and a suboptimal use of corticosteroids was found. A significant trend towards more liberal use of oxygen was seen in both asthma (3.2 l min⁻¹ versus 4.8 l min⁻¹, $P < 0.001$) and COPD (1.5 l min⁻¹ versus 1.9 l min⁻¹, $P = 0.047$). Further, a huge difference in treatment behaviours was revealed from this survey. The knowledge among house officers of basic principles of treatment was insufficient. Treatment behaviour was only moderately affected by national publication of detailed recommendations for treatment. This study indicates a need for implementing tools for quality control. © 2002 Elsevier Science Ltd. All rights reserved.

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INTRODUCTION

Studies from several countries have demonstrated suboptimal treatment of acute asthma and chronic obstructive pulmonary disease (COPD) (1–3), but no studies have evaluated the quality of treatment in Denmark and examined if intervention by dissemination of guidelines for standardised treatment can improve the quality.

We performed a study to evaluate the treatment strategy and knowledge among Danish house officers working in the emergency setting and thus engaged with the initial treatment of patients with acute exacerbations of asthma and COPD. The findings were compared to recommendations from commonly used guidelines (4–10) in order to evaluate the actual treatment and to clarify

if standardisation and improvement is needed. Based on the fact that some procedures are carried out by the nursing staff, we expanded the survey to include answers from a selected group of senior nurses working with acute asthma and COPD.

Three years later a follow-up study was performed in order to investigate if a change in treatment behaviour had occurred, as specific interventions in the meantime had been performed with a potential of modifying treatment. The same questionnaire was used in the follow-up study and the results were compared.

METHODS

A telephone survey including all 70 Danish hospitals with emergency departments was performed during the months April through May 1996. We phoned the house officers in charge in the emergency department or in the acute setting with the potential of receiving patients with acute exacerbations of asthma and COPD. We used

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a standardised questionnaire (Table I) on nebuliser therapy, choice and dosage of inhaled bronchodilators, oxygen therapy, intravenous bronchodilators, and corticosteroid treatment. When relevant, the questions were asked separately for asthma and COPD. It was made clear to the house officer on call that the questions concerned the initial treatment within the first few hours upon arrival of a patient with a severe exacerbation in asthma or COPD.

Telephone interview lasted around 30 min and was performed in hours known not to be so busy. The telephone survey was chosen instead of a written questionnaire in order to receive unprepared answers and to optimise the response rate. In Danish hospitals, it is usually the nursing staff who are responsible for the handling of nebuliser therapy whereas the physician, as a minimum, prescribe the medication inhaled. Consequently, a minor telephone survey among the nursing staff was established, including 14 hospitals where questions concerning the handling of nebuliser therapy were asked.

The results from the initial survey were published in 1997 in the weekly bulletin for Danish physicians, along with a recommendation for the treatment of acute severe asthma and COPD (11). The key element was a treatment algorithm with specific recommendations for nebuliser handling, oxygen therapy, inhaled bronchodilators, and corticosteroid therapy. Intravenous bronchodilators were not recommended. The Danish Society of Respiratory Medicine also in 1997 published a guideline on the treatment of COPD (10), providing further focus on the treatment of acute exacerbations. The above nationwide distributed publications were considered as an intervention with the possibility of modifying treatment behaviours and subsequently we examined if this had occurred.

The follow-up study was performed in 1999 from May to June and included all hospitals participating in the first survey. The same questionnaire was used in both surveys. All interviewers (four persons) were trained in asking questions and perceiving answers, in order to minimise inter-personal variation.

Statistics

The answers from the two surveys (1996 and 1999) were categorised and coded to allow statistic calculations. Differences between surveys were compared with a two-sided chi-square test (frequency distributions) or an independent samples *t*-test (continuous variables). In comparisons of asthma and COPD within the same survey, a two-sided chi-square test or a paired samples *t*-test was used. In all tests, a *P*-value of less than 0.05 was considered as significant.

RESULTS

The response rate was 100% in both surveys and all 70 doctors completed the questionnaire. None of the physicians asked had participated in the initial survey from 1996. Detailed distribution of answers is shown in Table I.

Nebuliser therapy

All hospitals used nebulisers for the delivery of inhaled medication. Physicians were asked about specifications of the nebuliser system used. There was no significant change in knowledge of the specifications from 1996 to 1999 (data not shown).

About half of the house officers suggested oxygen as a propellant gas for nebuliser therapy and the rest used ambient air, a combination of both or did not know what to use. There was no significant difference between asthma and COPD and no change from 1996 to 1999, except for a significant increase in the use of oxygen/ambient air combination for both asthma (1% vs 13%, *P* = 0.006) and COPD (3 vs 13%, *P* = 0.03).

Only one-third of the physicians prescribed an adequate flow (6–8 l) for the nebuliser in both surveys. The remaining suggested inadequate flow (too low or too high) or did not know which flow to use. There was no significant change from 1996 to 1999.

One-third of the physicians prescribed nebuliser therapy "as needed" whereas more than half used fixed intervals. There was a significant increase in the number of physicians who were not aware of the recommended fill volume for the nebuliser from 1996 to 1999 (54 vs 73%, *P* = 0.02).

When repeating the questions on nebuliser therapy among a group of senior emergency room nurses, we also found divergent answers in-between the group and compared to the physicians. Seventy-five percent of the nurses used air as a driving gas in contrast to the physicians where more than half prescribed oxygen. Only 30% of the nurses applied an appropriate flow for the nebuliser.

Inhaled bronchodilators

About two-thirds of the physicians would prescribe a combination therapy with inhaled beta2-agonist and ipratropium bromide, whereas one-third used mono therapy with a beta2-agonist, showing no significant change over time. Dosage of ipratropium bromide remained also unchanged from 1996 to 1999, whereas the mean nominal dose of beta2-agonist was significantly reduced in the same period (3.1 vs 2.6 mg, *P* = 0.019).

TABLE 1. Distribution of answers in per cent separated in groups from questions asked in the telephone survey in 1996 (in bold) and in the follow-up survey in 1999 (normal). Seventy house officers, each representing an emergency care unit, participated. The doses of corticosteroids have been converted into equivalent doses of methyl- prednisolone.

Propellant gas—asthma? (used for nebuliser)	Oxygen = 66% /53%	Air = 21% /19%	Both = 1% /13%	Don't know = 11% /16%
Propellant gas—COPD? (used for nebuliser)	Oxygen = 61% /51%	Air = 23% /21%	Both = 3% /13%	Don't know = 13% /14%
Nebuliser flow?	Adequate ($6-8 \text{ l} \times \text{min}^{-1}$) = 67% /73%	Inadequate (to high or to low) = 33% /27%	Don't know = 1% /17%	
Frequency of nebuliser therapy?	Fixed interval = 66% /64%	As needed = 32% /29%		
Mono therapy or combination therapy?	Mono therapy (beta2-agonist) = 34% /27%	Combination therapy (beta2-agonist + ipratropium b) = 63% /69%	Don't know = 3% /4%	
Beta2-agonist? (used in nebuliser)	Terbutaline = 14% /13%	Sabutamol = 20% /14%	Don't know = 6% /16%	
Dose of beta2-agonist? (salbutamol equivalent)	5 mg = 91% /84%	10 mg = 3% /0%		
Dose of ipratropium bromide?	0.125 mg = 3% /0%	0.25 mg = 8% /3%	0.5 mg = 86% /87%	Don't know = 3% /10%
Oxygen therapy ($\text{l} \times \text{min}^{-1}$)? (between nebuliser therapy) COPD?	≤ 1 = 44% /23%	> 1 and ≤ 3 = 49% /59%	4-6 = 4% /6%	Don't know = 3% /9%
Asthma?	≤ 1 = 9% /4%	> 1 and ≤ 3 = 46% /31%	4-6 = 37% /27%	Don't know = 6% /16%
Use of steroids?	Always = 15% /20%	Often = 60% /57%	Seldom = 24% /19%	Don't know = 0% /3%
Dose of steroid? (prednisolone equivalent)	$< 30 \text{ mg}$ = 15% /4%	30-100 mg = 54% /64%	101-150 mg = 10% /13%	Don't know = 4% /10%
Beta2-agonist infusion? (bolus) (continuous)	Always = 3% /0%	Often = 41% /19%	Seldom = 30% /47%	Don't know = 3% /6%
Iv methylxanthines?	Always = 0% /0%	Often = 71% /46%	Seldom = 17% /44%	Don't know = 3% /2%
			Seldom = 60% /67%	Don't know = 5% /3%

Oxygen therapy

All physicians prescribed a nasal prong for initial oxygen delivery, either single or double channel. None suggested the use of a Venturi mask.

Physicians in both surveys prescribed significantly more oxygen for the asthma patient compared to the COPD patient. A significant trend towards more liberate administration of oxygen was seen in both groups in the follow-up study. The mean oxygen flow used for asthma patients increased from 3.2 l min^{-1} in 1996 to 4.8 l min^{-1} in 1999 ($P = 0.001$). In COPD, the mean oxygen flow rose from 1.5 l min^{-1} in 1996 to 1.9 l min^{-1} in 1999 ($P = 0.047$) (Fig. 1).

Corticosteroids

In both surveys, about 75% of the physicians would routinely use systemic corticosteroids with no significant change over time and the mean dose of corticosteroids was also unchanged from 1996 to 1999. However, fewer physicians prescribed very small doses of corticosteroids in 1999 compared to 1996 (4 vs 15%, $P = 0.03$).

Other treatments

The frequency of prescribing intravenous beta2-agonist, either as a bolus or as an infusion, was significantly reduced from 1996 to 1999. An intravenous bolus was used routinely by 44% in 1996 vs 19% in 1999 ($P = 0.002$). Intravenous infusion was used routinely by 77% in 1996 vs 50% in 1999 ($P = 0.001$).

The use of methylxanthines was found to be unchanged comparing the two surveys with only the minority of the physicians routinely using this drug (5 vs 4%, NS).

DISCUSSION

This study shows that knowledge about the initial treatment of severe exacerbations in asthma and COPD is insufficient among junior house officers engaged in this field. Whereas nebuliser treatment with bronchodilators is a well-established first-line of treatment, the knowledge of the principles and the handling of the nebuliser is very superficial, as is the case among emergency room nurses handling this therapy. In general, the knowledge of corticosteroid therapy, oxygen therapy, and intravenous bronchodilators is more adequate. However, a large variation exists, constituting a possibility of inadequate medical therapy for several patients. Judged by the received answers, it is inevitable that in some situations, patients will receive too little oxygen and insufficient doses of beta2-agonist corticosteroids. Intravenous bronchodilators probably used are more than appropriate, which can be regarded as a minor problem, yet with the possibility of unnecessary side-effects.

We found very few significant changes in treatment habits comparing 1996 and 1999, despite the dissemination of national recommendations on this issue in-between the two surveys. The recommendations were accompanied by a number of informal initiatives, such as pregraduate teaching and a series of departmental lectures for junior doctors and medical students by some of the authors. The follow-up survey showed some improvement regarding oxygen therapy, minor improvements on corticosteroid therapy and a less common use of intravenous bronchodilators. The changes were in agreement with the focus of the published recommendations based on the first survey (II), but it is important to emphasise that treatment behaviour only improved slightly.

The treatment behaviour of physicians is determined by numerous factors such as national recommendations, scientific papers, text books, health information on the Internet, conferences, lectures, departmental instructions, and the learning from senior colleagues. We do not know, however, the relative importance of these factors, which, among others, will depend on the level of experience for the individual doctor. In this survey, we only examined the possible influence of nation-wide distributed and detailed recommendations. This "intervention" is not in any way controlled, as we, in this study-design, have no possibility to control for trends in treatment behaviour caused by some of the other factors.

We used the telephone interview in order to get unbiased information from the medical officers in charge and responsible for the actual treatment and care of

patients admitted with acute asthma and COPD. If we had chosen the written interview, we would definitely have had a lower response rate and furthermore the departments would have had time to adjust their answers according to the guidelines, possibly making results less valuable. It was specified that the questions concerned only the management of patients with acute severe exacerbations, which in fact can be perceived quite differently. This may have induced a larger variation in the answers than would have been the case if all doctors were treating the same patient. However, the variation in answers to the question of driving gas flow, which is not related to the severity of the disease, was even as large indicating that the found variation was real.

The comparisons between the initial study and the follow-up study would have been statistically stronger if we had been able to interview the same physician on both occasions. However, this is not feasible among junior doctors and we believe that the individual treatment behaviours to some degree must reflect the "internal consensus" in a department, allowing us to detect a possible change in treatment strategies.

Nebulisers

The exclusive use of nebulisers in Denmark is more based on tradition than on evidence. In a recently published Cochrane review by Cates *et al.*, the metered-dose inhaler with a holding chamber proved at least equivalent to the nebuliser (12). Other studies have indicated the use of a dry powder inhaler as an option in the acute setting (13–15).

When comparing the recommendation from the evidence-based BTS guidelines on nebuliser therapy (16) with the answers from the Danish physicians, we found that the knowledge and handling of nebuliser systems was inadequate—with no major differences comparing the two surveys.

BTS guidelines have pointed out several factors, essential in providing optimal performance of the nebuliser, i.e. the driving gas flow rate and the fill volume. Only one-third of the doctors would prescribe an optimal flow and more than half did not know which fill volume to use. In general, none was aware of the importance of these parameters in any of the surveys.

The administration of life-saving medication by nebulisers demands a correct handling and a misuse of the device by not adhering to specific recommendations from the manufacturers can have a great impact on the performance of the nebuliser resulting in insufficient application of inhaled drug to the patient (17,18). We believe that emergency equipment should be standardized and accompanied by simple and clear instructions and the emergency staff should receive frequent education, aimed towards on optimal efficacy of the devices.

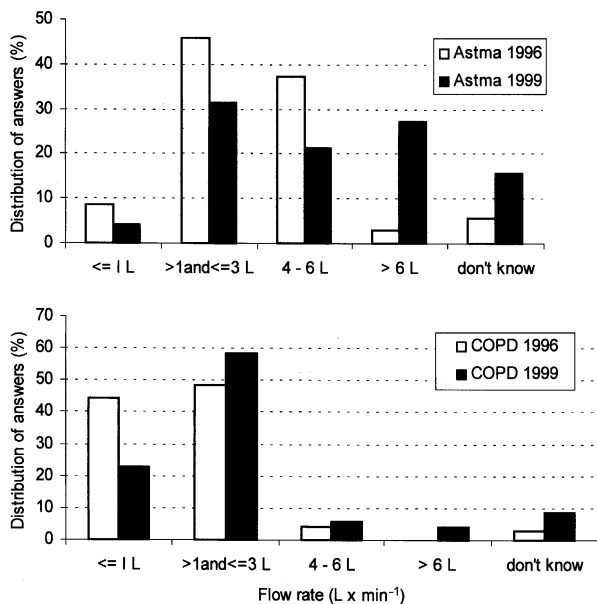


Fig. 1. Prescription of oxygen in acute exacerbations of asthma and COPD comparing 1996 and 1999. The distribution of answers in per cent in each of the categories is shown.

Inhaled bronchodilators

It was generally agreed among the doctors that inhalation therapy with beta-agonists was the first choice in both asthma and COPD—which is in agreement with the commonly used guidelines (4–6;8–10). More than 60% of all doctors prescribed combination therapy with a beta2-agonist and ipratropium bromide according to the guidelines (4,5,8–10). However, the majority of the doctors were not aware of this because they used Bero-dual[®] (a fixed combination of fenoterol and ipratropium bromide) and could not account for the generics when asked.

When adjusting for the relative potency of the different beta2-agonists, we found a difference of a factor of 4 between the nominal doses used in Danish hospitals. When combining this with the difference in nebuliser performance between different brands of nebulisers—which is a factor of 3.5 according to a study by Loffert *et al.* (19)—a consequence could be a difference of a factor of 14 in the delivered dose of beta2-agonist. Such a difference was actually demonstrated in our study.

The mean nominal dose of beta2-agonist decreased significantly by 0.5 mg comparing the two surveys and we have no obvious explanation for this.

Nebuliser treatment with inhaled bronchodilators is well established in Danish hospital units. However, the knowledge on potency, dosage, and frequency of inhaled bronchodilators is sparse and has not increased during a 3-year period. There is a need for standardised treatment procedures in the usage of bronchodilators, securing the patient an acceptable dose of a maybe life-saving drug. The difference in dosages revealed in this study is not acceptable.

Oxygen therapy

The administration of oxygen is one of the key elements in the management of acute severe exacerbations of asthma and COPD (4–7,9,10). All severely obstructed patients are hypoxemic and require oxygen. Studies in COPD have shown that hypercapnia induced by oxygen administration can be reverted in a few minutes by a gradual reduction in oxygen delivery (20) and that respiratory acidosis is infrequent in severely obstructed patients treated with liberal doses of oxygen, aiming at an oxygen-saturation above 90% (21).

Trends in the administration of oxygen therapy have changed comparing the two surveys. The mean dose (flow) of oxygen delivered between inhalations has increased 25% in asthma ($P > 0.005$) and 17% in COPD ($P = 0.047$). In general, Danish physicians seem to have reached the recommended level of oxygen administration in both asthma (4,5) and COPD (8,10).

Corticosteroids

The effect of the administration of corticosteroids in acute exacerbations of asthma and COPD is well documented (22–25). There is no evidence to support a clinically relevant difference in treatment effect between intravenous and oral administration of corticosteroids in asthma, as long as the dose is kept above 30 mg of prednisolone or equivalent in the first 24 h (22). In COPD, the issue of the route of administration to our knowledge has not been investigated, but some information on the initial dosing is available, indicating 125 mg of methyl-prednisolone to be an option (25). Official guidelines are not specific on this matter neither in asthma nor in COPD (4,5,7,8,10).

We were not able to detect any major differences when comparing the use of corticosteroids between 1996 and 1999. About 75% of the doctors in both surveys would routinely use this strategy and the majority would prescribe between 30 and 100 mg of prednisolone. It is not acceptable that one of the four physicians do not initiate corticosteroid therapy at a severe exacerbation of asthma or COPD, and dissemination of detailed instructions on this issue have had no obvious effect on the treatment behaviours.

Intravenous bronchodilators

We found a significant reduction in the regular usage of intravenous beta2-agonists from 1996 to 1999. This trend is well in line with several studies on asthma patients, showing the inhaled route to be superior or at least equivalent to the intravenous route (26) though several official guidelines still approve the latter strategy (5,6). The issue has not been formally investigated in COPD and the official guidelines are diverging in their recommendations (7,10).

The use of methylxanthines in the treatment of acute exacerbation is no longer a routine option verified by the answers from the vast majority of physicians in both surveys. The evidence to support this is strong in asthma (27) but weak in COPD — the latter reflected in different recommendations from official guidelines (7,9,10).

CONCLUSION

A noticeable variation in treatment procedures related to acute exacerbations of asthma and COPD was found in this study. The knowledge among house officers of basic principles of treatment was insufficient. Treatment behavior was only moderately affected by national publication of detailed recommendations for treatment. The new generation of clinical guidelines should be based upon detailed practical issues from the clinical situation taking the principles of evidence-based medicine into account.

Despite the uncontrolled design of this study, it also demonstrates the need for implementing instruments of quality control.

We have proposed a clinical evidence-based guideline using the knowledge gathered from this study aimed towards the practical clinical situation when treating patients with acute severe asthma and COPD. The guideline is published in this issue of Respiratory Medicine.

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