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ORIGINAL PAPER

Hospital-at-home care for exacerbations of chronic obstructive pulmonary disease: an observational cohort study of patients managed in hospital or by nurse practitioners in the community

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The Urgent Care Team (UCT) in Sunderland (pop. 293,000) is a unique nurse practitioner service operating a hospital at home 24/7/365 to deal promptly with patients suffering an exacerbation of their COPD (AECOPD). Treatment is according to patient group directions utilising nebulised bronchodilators, doxycycline and prednisolone. To compare the health status and pathophysiology during and two months after an AECOPD in 60 UCT patients (31 male) and 30 hospital-managed patients (16 male). The St. Georges Respiratory Questionnaire (SGRQ), Mahler Baseline Dyspnoea Index (BDI) and MRC dyspnoea score recorded health status. Spirometry, BMI and grip strength were also measured. All patients were reviewed 2–3 months after the AECOPD. Changes from BDI were measured using the Transitional Dyspnoea Index (TDI). Mean FEV_1% predicted was 47%. In the recovery phase the two groups were comparable for all variables. But during their AECOPD hospitalised patients had a significantly lower BDI ($P < 0.05$) and an oxygen saturation ranging from 84 to 93% compared with 87–96% for UCT patients. Paired *t*-tests indicated that on recovery SGRQ activity domain and TDI measures improved in both groups. No deaths occurred during these AECOPDs. A hospital-at-home scheme for AECOPDs can deal with patients who have severe COPD safely. The Mahler TDI appears to be a sensitive index of improvement after an AECOPD. *Chronic Respiratory Disease* 2009; **6**: 69–74

Key words: chronic obstructive pulmonary disease; exacerbations; health-related quality of life; hospital-at-home

Introduction

Chronic obstructive pulmonary disease (COPD) is a slowly progressive disease mainly caused by cigarette smoking and set to become the fifth highest cause of death in the world by 2020.[1] Its course is punctuated by exacerbations and there is no doubt that these become more frequent and burdensome as COPD progresses and prompt treatment may reduce the severity of an exacerbation (AECOPD).[2] An AECOPD is usually accompanied by increased production of more purulent sputum and with worsening of breathlessness many patients traditionally get admitted to hospital for standard treatment with a nebulised bronchodilator, oral steroids and a broad spectrum antibiotic. In recent years clear evidence from randomised control trials[3,4] and systematic review[5] has demonstrated the safety of early discharge of these patients from hospital and patients usually express satisfaction when offered this option.[6] Such schemes have been labelled 'hospital-at-home', but they really represent facilitated discharge, with home visits for a brief follow-up period (up to seven days) from appropriately trained nurses. This type of service development has been widely introduced throughout the United Kingdom because of the substantial reduction of in-patient bed-days and the associated savings for hospitals.

A true 'hospital-at-home', however, would pre-empt admission and thereby produce savings for purchasers of health care. In January 2004 Sunderland Teaching Primary Care Trust (population

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293,000) initiated their Urgent Care Team (UCT) of nurse practitioners to undertake the community management of patients with AECOPD resulting in a 20% reduction in the hospitalisation rate for this condition.

Because the service had already been successfully established in Sunderland, we undertook a further evaluation with an observational cohort study of patients with AECOPD who were either admitted to hospital or managed in the community by the UCT.

Method

This was an observational, comparative study with a primary aim of establishing that the UCT provided a service for patients with COPD whose underlying disease severity was similar to that of those admitted to the hospital. Between March 2004 and July 2006, we recruited patients with an AECOPD who were managed at home or admitted to the hospital in Sunderland. Ethical approval was gained from Sunderland Local Research Ethics Committee (reference no. 04/Q0904/85) and written informed consent was obtained from all study participants.

Inclusion criteria were (1) chronic airflow limitation confirmed by spirometry performed; (2) the episode satisfied the NICE definition of an AECOPD[7] i.e. a sustained worsening of symptoms from their usual state which is beyond normal day to day variations and is acute in onset. Exclusion criteria were (1) presence of an upper limb disability that could alter the results of grip measurements, (2) history of stroke or dementia to preclude spirometry, (3) patients on long term oxygen therapy and (4) use of non-invasive ventilation.

Patients

The community cohort ($n = 60$) was managed by the UCT of nurse practitioners. Patients accessed the team directly by telephone and the target response was for a home visit within 30 min. Many of these patients had previous AECOPDs managed by the UCT because they were directed to deal with frequent exacerbators with multiple admissions to hospital or because they had availed of facilitated discharge following previous AECOPDs. Patients were identified by the UCT as suitable for inclusion and were studied within 24 h. The nurse practitioner treated these patients with nebulised bronchodilators (salbutamol 2.5 mg and ipratropium 500 μg) 4–6 hourly, prednisolone 30 mg daily for 7 days and doxycycline (200 mg immediately and 100 mg daily for 7 days) given according to patient group directions[8] sanctioned by the local authorities. Doxycycline was the antimicrobial of choice based on local sensitivities. The hospital cohort ($n = 30$) was identified in the Admission Unit of Sunderland Royal Hospital and studied within 24 h. Both cohorts were reviewed at home 2–3 months after their AECOPD at a time when their clinical condition was stable.

Measurements

Body weight and standing height enabled calculation of body mass index (BMI–kg/m^2). Muscle strength was measured by using hand dynamometer (Lafayette Instrument Hand Dynamometer) as a surrogate for lean body mass and expressed as % of predicted for age and gender.[9] Spirometry was performed (Vitalograph Alpha) according to ATS criteria[10] and FEV_1 and FEV_1/FVC% were measured. FEV_1 (% predicted) was derived from ERS guidelines.[11] GOLD criteria were used to categorise the severity of COPD in cohorts. We also took account of symptoms patients had at the time of their exacerbation. The MRC dyspnoea score[12] and Mahler's Dyspnoea Index (MDI)[13] were used to assess dyspnoea severity. The MDI is a two stage tool and consists of the Baseline Dyspnoea Index (BDI) and the Transitional Dyspnoea Index (TDI). Its purpose is to improve the subjective assessment of dyspnoea. BDI rates the severity of dyspnoea at a point in time (and was completed at the initial visit) and TDI denotes changes from that baseline (on follow-up 2–3 months later).

The scores in both Mahler indices depend on ratings for three different categories: functional impairment; magnitude of task, and magnitude of effort. At the baseline state, dyspnoea was rated in five grades from 0 (severe) to 4 (unimpaired) for each category. The ratings for each of the three categories were added to form a baseline focal score (range, 0–12). At the transition period, changes in dyspnoea were rated by seven grades, ranging from −3 (major deterioration), to +3 (major improvement). The ratings for each of the three categories were added to form a transition total score (range, −9 to +9).

We also compared the health-related quality of life (HRQL) in these groups for which we used the English version of St. George's Respiratory Questionnaire (SGRQ).[14,15] This tool was completed by all study participants at the time of the AECOPD and at follow-up. The SGRQ is a standardized questionnaire that is designed to be completed without assistance. It is a disease-specific questionnaire, which measures health status and perceived well-being in persons with COPD. It contains 50 items (76 levels) divided into three domains: The 'symptoms' domain deals with the frequency and severity of respiratory manifestations, the 'activity' domain relates to activities that cause or are limited by breathlessness, and the 'impacts' domain covers aspects of social function and psychosocial disturbances that result from respiratory diseases. Scores on the SGRQ range from 0 (no disturbance of HRQL) to 100 (worst quality of life).

The MRC dyspnoea score was documented at each visit. MRC scores range from 1 to 5. MRC grade 5 represents maximum disability with shortness of breath on dressing or undressing resulting in a housebound patient.

Statistical analysis

Demographic and clinical characteristics of the study sample on acute and recovery phase are shown in Table 1. The differences between groups were tested using the unpaired t test and χ^2 depending on the nature of variables. Paired t tests were used for the differences in the acute and recovery phases of exacerbation in community and hospital managed patients. Analysis of data was performed using SPSS Version 14.0.

Results

Acute symptoms defined the onset of each AECOPD. For the UCT group 82% of patients had purulent sputum, 90% had increased cough and 70% had wheezing whereas for the hospital group, all patients had purulent sputum, 70% had increased cough and 63% had wheezing. The delay between initial symptoms and treatment was 2.8 ± 0.9 days (range 2–6 days) for UCT patients and 2.6 ± 0.7 days (range 2–4 days) for hospital managed patients. The demographic data for the two cohorts (Table 1) show they were quite well matched at entry to the study for age, BMI, spirometric impairment, and gender. Handgrip was measured and values were generally low with median value of 73.9% (ranged from 22% to 121%). The main difference between the cohorts was that the hospitalised patients appeared more breathless at the time of their AECOPD. Pulse oximetry indicated that they were more hypoxic while breathing air than UCT patients ($P < 0.01$, Table 1). The Mahler Dyspnoea Index (MDI) in the hospital patients had a lower BDI at entry to the study than the UCT patients (Table 1: 3.4 ± 2.9 vs 2.2 ± 2.7; $P < 0.05$). In the recovery phase, however, both groups had the same degree of breathlessness as assessed with the TDI (3.4 ± 0.5 and 2.2 ± 1.7 for UCT and hospital groups; mean 3.9 for both). Lung function improved with a small but significant increase in FEV_1% predicted recorded for the UCT group and a larger increment for the hospital patients (Table 1) ($P < 0.01$). The MRC grades improved significantly in both groups of patients.

The SGRQ data (Table 2) clearly show that both cohorts had very high scores for symptoms, activity and total indicating severe COPD. At recovery

Table 1 Demographics of UCT and hospital patients at acute and recovery phase

	Urgent Care Team N = *60 M/F = 31/29*		*Hospital* N = *30 M/F = 16/14*	
	Acute	*'Baseline'*	*Acute*	*'Baseline'*
Age (years)	72.4 ± 9.0		77.3 ± 6.7	
BMI (kg/m^2)	27.6 ± 8.0	27.1 ± 8.3	26.6 ± 8.1	25.8 ± 6.6
MRC dyspnoea (1–5)	3.9 ± 0.8	3.7 ± 0.7**	3.4 ± 1.0	3.1 ± 0.7*
FEV_1 (L)	0.9 ± 0.4	0.9 ± 0.4	0.9 ± 0.3	1.0 ± 0.3**
FEV_1% pred	46.9 ± 19.8	48.1 ± 21.6*	45.9 ± 19.0	53.5 ± 18.2**
$FEV_1/FVC \times 100$	49.7 ± 14.8	52.1 ± 15.4*	54.0 ± 12.5	53.0 ± 12.1
Handgrip (%)	73.0 ± 20.8	67.3 ± 22.2	72.8 ± 21.2	72.9 ± 19.5
BDI /TDI	3.4 ± 2.9	+0.5 ± 2.5*	2.2 ± 2.7	+1.7 ± 2.7**
Pulse oximetry	91.2 ± 2.3 (range = 87–96)		89.6 ± 2.0* (range = 84–93)	
Charlson Index	0.30 ± 0.5		0.36 ± 0.5	

$FEV_1/FVC \times 100$, forced expiratory ratio; BDI, Baseline Dyspnoea Index; TDI, Transitional Dyspnoea Index; FEV_1 (%pred), forced expiratory volume in one second percent predicted. Data presented as mean ± SD, *$P < 0.01$; **$P < 0.005$. Two sample t test is used for analysis.

Table 2 Quality of life scores (%) in COPD patients managed by UCT and in hospital

	Urgent Care Team (UCT) N = *60*		*Hospital* N = *30*	
	Acute	*Recovery*	*Acute*	*Recovery*
Characteristics	*Mean ± SD*	*Mean ± SD*	*Mean ± SD*	*Mean ± SD*
Symptoms	79.7 ± 14.1	78.6 ± 13.8*	74.8 ± 14.2	71.3 ± 16.7
Activity	90.3 ± 11.1	87.9 ± 12.3**	88.0 ± 16.9	84.5 ± 21.2*
Impact	70.5 ± 14.4	70.7 ± 14.2	66.0 ± 17.5	62.8 ± 20.0**
SGRQ	78.1 ± 11.1	77.2 ± 11.2	73.5 ± 13.3	70.6 ± 17.0*

SGRQ, St. George's Respiratory Questionnaire; UCT, Urgent Care Team. Data presented as mean ± SD, *$P < 0.01$; **$P < 0.005$.

aspects of HRQL score had significantly improved in both groups but no mean change exceeded the clinically significant value of four units.[16] However, for the UCT patients at recovery the decrease of the total SGRQ score did not reach significance ($P = 0.06$) but the improvement in the activity domain was highly significant ($P < 0.05$). Nevertheless the mean scores demonstrate continuing poor health status after recovery.

Table 3 shows details of the Mahler scoring. The hospital cohort was more breathless (BDI 2.2 ± 2.7 vs 3.4 ± 2.9) at baseline i.e. at the time of the AECOPD. However, at recovery, the scores were almost identical in the two groups because of the substantial improvement of 1.6 ± 2.7 units in the hospital group.

Discussion

This study was an opportunistic cohort comparison of two groups of patients whose AECOPD was managed either by admission to hospital or in the community by a team of nurse practitioners, the UCT. The patients entered the study at the time of their exacerbation. This pragmatic approach was adopted rather than an initial establishment of a large cohort in whom exacerbations would not be predictable. Thus, initial measurements are during the exacerbation and baseline data were obtained about two months later when patients would be expected to have recovered to a stable condition.[17] The mode of management was not randomised but dependent on how the patient presented to the care providers. Generally, the hospital group was not aware of the UCT option. An action research project described the outcome of the UCT's involvement as 'the patient's journey has been transformed to deliver personalized, one-to-one care at home … where patients were actively engaged in planning their care, moving them from passive recipients to more active involvement'.[6] In our study the major conclusion is that for such patients a nurse practitioner-based UCT is a safe option, with only one of these 60 patients requiring admission to hospital within 10 days. This was not an intention to treat study and some patients ($n = 4$) declined participation, mainly due to feeling too ill but also because they did not wish to be reviewed at home or felt discomfort when performing spirometry. Consequently, some more severely affected COPD patients might have not been recruited. Recruitment was continued until the study numbers of 60 UCT and 30 hospital patients had been achieved. The smaller number in the hospital group reflected the expectation that recruitment of this group would be a problem due to reduction in hospital admissions attributable to the service provided by the UCT.

An audit of the UCT approach was undertaken and showed that most of their patients had severe COPD with 30% mortality over 24 months. Unfortunately, no audit is available for hospital group.

Table 3 BDI and TDI scores in UCT and hospital patients

	Community (UCT) (n = *60*)		*Hospital (physician)* (n = *30*)	
MDI	BDI	TDI	BDI	TDI
Functional impairment	1.3 ± 1.0	+0.3 ± 0.9	0.8 ± 1.0	+0.9 ± 0.9
Magnitude of task	1.1 ± 1.1	+0.2 ± 0.8	0.7 ± 0.9	+0.3 ± 0.9
Magnitude of effort	1.0 ± 0.8	+0.0 ± 0.8	0.7 ± 0.8	+0.4 ± 0.9
Total	3.4 ± 2.9	+0.5 ± 2.5*	2.2 ± 2.7	+1.6 ± 2.7**

UCT, Urgent Care Team. Data presented as mean ± SD, *$P < 0.05$; **$P < 0.001$.

Thus, it was expected that a UCT cohort would not differ from a hospital cohort. Comparing the two groups reveals some limitations of this study. The hospital group appeared more breathless at presentation with an AECOPD as evidenced by the Mahler BDI whereas the MRC dyspnoea scores were similar. A possible confounding factor for breathlessness may be that patients presenting to the admissions unit at the hospital could be referred to the UCT within 24 h after initial assessment and treatment. Such patients were excluded from our UCT cohort but did not contribute to the hospital cohort. Both the Mahler and MRC dyspnoea scales reflect perceived breathlessness on the part of the patient. However, the small but significant difference in oxygen saturation may be a relevant consideration. Interestingly, the hospital group had a marked improvement in TDI towards the same baseline value (3.9) as the UCT patients (Table 3). Aaron and colleagues have shown that BDI/TDI is responsive over the short recovery (10 days) from an AECOPD.[18] Our data extend this validity to steady-state recovery. However, both our cohorts had worse breathlessness at recovery than Aaron and colleagues found at the time of the exacerbation (mean BDI/TDI of 4.47/2.94) – reinforcing the severity of the COPD in our cohorts. This severity is also supported by the high SGRQ scores (Table 2), indicating that both cohorts had severe clinical impact of their COPD, even after recovery from an AECOPD.

Both groups of COPD patients improved significantly on recovery (after 2–3 months) in terms of physiological measures. Aspects of HRQL improved significantly in both groups of patients in statistical terms but despite obvious symptomatic response to treatment and a return to their usual health status no domain showed a 4% improvement – the conventional magnitude of a clinically significant change.[15] Co-morbidities expressed as the Charlson Index[16] were not differently distributed among our patients so this is not a factor that could have altered the responses about HRQL. We interpret these data as suggesting that review of SGRQ scores after an interval of only 2–3 months may not useful for patients with this degree of severity of COPD (by GOLD criteria more than half of our cohorts belonged to a Grades III and IV, which is in accordance with the findings of Miravitles and co workers.[19] Alternatively smaller changes in SGRQ may be clinically important.

In the UK major savings for purchasers of the health care will only accrue if admissions to hospital are prevented. Facilitated discharge schemes reduce average length of stay but do not avoid a charge for an admission. This study clearly shows that a true hospital-at- home provided solely by nurse practitioners is safe for patients known to have severe COPD and is likely to prove extremely useful in reducing healthcare costs relating to hospitalisation. Despite some of the UCT patients having oxygen saturation recorded as less than 90%, no supplemental oxygen therapy proved necessary. Recently, the UCT has begun to use an Early Warning Score[20] to aid their assessments of patients' criticality. It is of significance that no patient died during this study and that only one UCT patient required hospitalisation within two months of the index AECOPD.

Although we found some improvements in quality of life in both community and hospital managed patients, a major conclusion relates to the value of the Mahler TDI as an indicator of recovery from an AECOPD (in the more breathless hospitalised group). We believe that the Mahler index should be incorporated in any future randomised trial of hospital-at-home care for AECOPDs and that this study clearly supports the appropriateness and safety of such research.

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Competing interests

There is no competing interest from any author of this paper.

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