An attempt to determine the optimal duration of hospital stay following a severe attack of asthma

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ABSTRACT – The optimal duration of hospital stay following admission for acute severe asthma is difficult to determine. An asthmatic is at particularly high risk of sudden death in the 6–12 weeks after admission, and too early hospital discharge may add to this risk. Thirty patients hospitalised for severe asthma recorded peak flows thrice daily for 8 weeks following discharge. Peak flow charts were reviewed at monthly intervals, and dips were divided into 'minor' (peak flow <75% of the patient's best), 'major' (<50%) and 'catastrophic' (<30%). Fourteen of the 30 patients had major dips (including 4 who had catastrophic dips as well). Four of these 14 patients were readmitted with acute severe asthma during the 8 weeks follow-up period; in contrast, none of the 16 patients without major dips required readmission. The only in-hospital factor that correlated with and was predictive of ($p<0.001$) multiple major dips post-discharge was the peak flow variability in the 24 hours before discharge, defined as [(highest – lowest peak flow)/highest] × 100. Thirteen of the 14 patients with major dips had pre-discharge peak flow variation greater than 20% compared with only 2 of the 16 without major dips. We believe it is unwise to discharge asthmatics from hospital until the diurnal variation in their peak flow is below 20%. Discharging them before this target is reached puts them at increased risk of further severe attacks of asthma requiring re-hospitalisation.

Around 400 severely ill asthmatic patients are admitted each year to the respiratory medical ward in our district general hospital. Whilst the criteria of severity of an attack of asthma requiring admission to hospital are fairly standard [1], those for discharge remain unclear [2]. Prolonged hospitalisation has a potentially adverse effect on patients' health and psyche, and is expensive. Conversely, discharging asthmatics too early may be dangerous, as they are more likely to have to be readmitted with a second attack and are more likely to die suddenly in the 2 months after leaving the hospital [3].

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We could find no study designed to try and establish when patients can safely be discharged following an admission for severe asthma. We do know that asthmatics in hospital with marked diurnal variability in peak flow are more likely to develop life-threatening attacks [4, 5]. In the present study we attempted to establish: (1) whether patients with marked diurnal variability in hospital continued to dip in the 8 weeks post-discharge; (2) whether these 'dippers' were more likely to be readmitted with a second attack of asthma; (3) what, if any, pre-admission or in-hospital factors correlated with the likelihood of frequent major dips post-discharge; and (4) whether this helped us to determine the optimal duration of such admissions.

Patients and methods

Thirty patients aged 15–52 years admitted with severe asthma were studied following discharge from our specialist respiratory medical ward. On admission we recorded age, date of onset of asthma, duration of imperfect control of asthma before admission, duration of severe asthma before admission, regular treatment of asthma before admission, treatment of asthma in the 6 months prior to admission, number of previous hospital admissions, and number of courses of oral steroids in the previous year.

Each patient was treated in hospital with nebulised terbutaline (5 mg 4–6 hourly), humidified oxygen (24–60% via a face-mask), oral prednisolone (30–40 mg daily), or intravenous hydrocortisone (3 mg/kg loading dose, then 0.5 mg/kg /hour by infusion) in 11 of the 30 patients. In addition, 20 patients received intravenous aminophylline (5 mg/kg loading dose, followed by 1 mg/kg/hour infusion).

Peak expiratory flows (PEF) were recorded by an experienced respiratory nurse on admission and four times daily (06.00, 12.00, 18.00, 22.00), before and half an hour after nebulised or inhaled bronchodilator therapy, until discharge. The time taken (in hours or days) for the PEF to rise to 75% of the patient's best, and for the daily variation of PEF

$$\frac{\text{highest PEF} - \text{lowest PEF}}{\text{highest PEF}} \times 100$$

to fall to 20% or less, and the duration of hospital stay (in days) were recorded for each patient.

Patients were discharged when their symptoms had resolved, their chests were clear on auscultation, and their peak flows had returned to normal. Each patient received standard medication post-discharge, which included inhaled terbutaline and inhaled steroids (beclomethasone) in appropriate doses, and a reducing course of oral steroids. In addition, 14 patients were given oral theophylline. On discharge each patient was loaned a peak flow meter, instructed and trained in its correct use, and asked to record PEF thrice daily (on waking, around teatime and before retiring to bed) before and ideally half an hour after bronchodilator therapy, for 8 weeks. Patients were seen at monthly intervals for clinical assessment, review of therapy and analysis of peak flow charts for dips. These were divided into 'minor' dips (defined as PEF <75% of the patient's best), 'major' dips (<50% of best) and 'catastrophic' dips (<30% of best).

Results

Fourteen of the 30 patients ('dippers') had at least one major dip in their PEF in the 8 weeks follow-up period; 4 of these patients also had catastrophic dips. The number of major dips per patient varied from 1 to 49. A 32-year-old woman had 49 major dips and 4 catastrophic dips during the 8 weeks (Fig. 1). In contrast, 16 patients had no major dips at all and were classified as 'non-dippers'.

Four patients were readmitted with a second severe attack before the end of the 8 weeks follow-up period. All belonged to the 'dipper' group. None of the 16 'non-dippers' required readmission.

The only pre-hospital or in-hospital factor which correlated with the likelihood of continued dips after discharge was the diurnal variation in PEF during the 24 hours before discharge. Thirteen of the 14 patients with major dips post-discharge had PEF variation in the 24 hours before discharge of more than 20% compared with only 2 of the 16 'non-dippers' ($\chi^2 = 16.2$; $p<0.001$). The PEF variation in the 24 hours before discharge correlated, with considerable sensitivity (92.8%) and specificity (87.5%), with the likelihood of major dips post-discharge and had a high predictive value (86.7%).

Discussion

Patients discharged from hospital when their peak flows are still fluctuating continue to have major and occasionally catastrophic dips in PEF after discharge. The mechanism of the frequent dips is believed to be persisting airway reactivity and bronchial hyperresponsiveness during recovery from an acute asthma attack [6, 7]. Not surprisingly, these major and catastrophic dips were associated with readmission for a subsequent severe attack of asthma.

No previous study has examined the optimal duration of hospital stay after an acute attack of asthma. We have found that the diurnal variation in PEF at discharge correlates sensitively and specifically with the likelihood of major dips post-discharge. In a recent study of deaths from asthma, peak flow had been inadequately monitored during admission in half the patients who died and in a third of the control group who survived their acute asthma attack [8]. In a recent audit of the management of asthma in hospital, peak flow or spirometry monitoring was performed in 73% of patients admitted to wards with an interest in respiratory medicine compared with only 42% of those admitted to general wards without this interest [9]. Peak flows are monitored throughout their admission

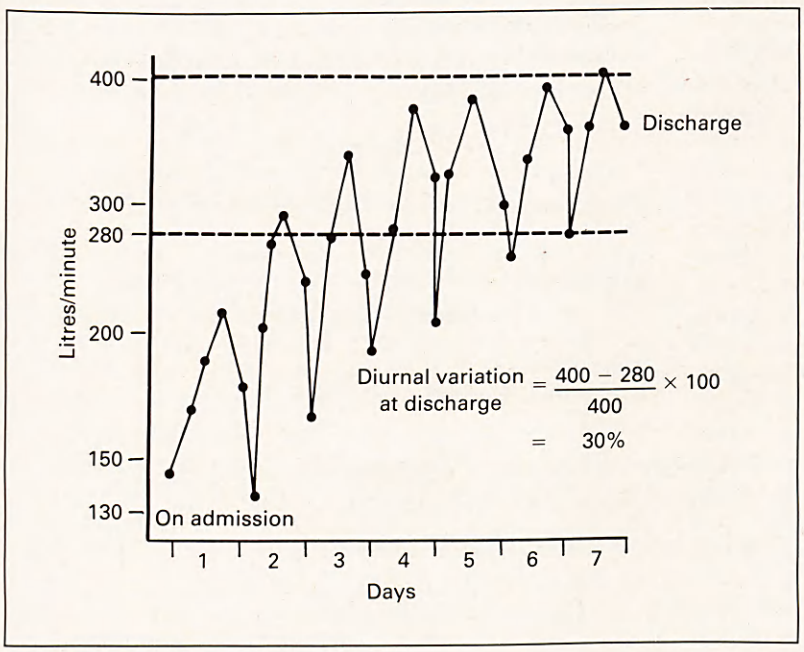

Fig. 1. *Peak flow chart of measurements taken before bronchodilator therapy during a 7-day admission in a 32-year-old woman with asthma. In the 8 weeks following her discharge from hospital her peak flow record revealed 49 'major' dips and 4 'catastrophic' dips.*

in all asthmatics admitted to our specialist respiratory medical ward. We regard this as essential in determining optimal and appropriate treatment [1]. The results of the present study suggest that it is unwise to discharge asthmatics from hospital, despite the pressure on acute beds, until the diurnal variability in the PEF falls below 20%. Discharging them before this target is reached puts them at increased risk of major dips in PEF in the days and weeks following discharge. Further severe attacks of asthma requiring rehospitalisation, or even death [3], may follow.

We now advise all patients discharged from hospital after a severe attack of asthma to record their PEF at home, and we give them detailed written advice, similar to that recently recommended [10], about what to do when their PEF falls below 75%, 50% and 30% of their best value.

References

1. Harrison, B. D. W. (1990) Acute severe asthma. In *Textbook of respiratory medicine* (ed. R. A. L. Brewis, G. J. Gibson and D. M. Geddes). Academic Press/Bailliere Tindall. (In press).
2. Witek, T. J., Schacter, E. N. and Dean, N. L. (1988) A review of the hospital course of asthmatic children and adults. *Annals of Allergy*, **50**, 236–40.
3. British Thoracic Association (1982) Death from asthma in two regions of England. *British Medical Journal*, **285**, 1251–5.
4. Hetzel, M. R., Clark, T. J. H. and Branthwaite, M. A. (1977) Asthma: analysis of sudden deaths and ventilatory arrests in hospital. *British Medical Journal*, **1**, 808–11.
5. Westerman, D. E., Benatar, S. R., Potgeiter, P. D. and Ferguson A. D. (1979) Identification of the high risk asthmatic patient: experience with 39 patients undergoing ventilation for status asthmaticus. *American Journal of Medicine*, **66**, 565–72.
6. Whyte, K. B., Choudry, N. B. and Ind, P. W. (1988) Bronchial reactivity in patients recovering from acute asthma. *Thorax*, **43**, 825.
7. Packe, G. E., Atkinson, A. C., Freeman, W. and Cayton, R. M. (1988) Rate of change in mean peak flow and in diurnal variation in peak flow in patients recovering from acute asthma. *Thorax*, **43**, 825.
8. Eason, J. and Markowe, H. L. J. (1987) Controlled investigation of deaths from asthma in hospitals in the North East Thames region. *British Medical Journal*, **294**, 1255–8.
9. Bucknall, C. E., Robertson, C., Moran, F. and Stevenson, R. D. (1988) Differences in hospital asthma management. *Lancet*, **i**, 748–50.
10. Beasley, R., Cushley, M. and Holgate, S. T. (1989) A self management plan in the treatment of adult asthma. *Thorax*, **44**, 200–4.