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Peak Expiratory Flow Rate Guided Protocol Did Not Improve Outcome in Emergency Room Asthma

J Abisheganaden, S B Ng, K N Sin Fai Lam, T K Lim

ABSTRACT

Background and Aims of Study: All current international practice guidelines recommend that treatment of acute asthma in the emergency room (ER) should be guided by the peak expiratory flow rate (PEFR). The aim of this study was to assess the efficacy of a PEFR guided protocol in treating ER asthma.

Methods: We compared two different management protocols in adult asthmatics who presented to the ER with acute exacerbations. The routine protocol (RP) assessed and dispensed patients according to overall subjective and clinical response without pre-determined criteria. The peak protocol (PP) used serial measurements of PEFR to guide intensity of bronchodilator treatment and fitness for hospital discharge. On the PP, a threshold PEFR of ⩾ 60% predicted had to be achieved before the patient could be discharged from the ER.

Results: There were 79 patients in the RP group and 70 in the PP group. There was no significant difference between the two groups in baseline PEFR, PEFR after treatment and percentage increase in PEFR with treatment. The PP resulted in a higher hospital admission rate than RP.

Conclusion: We conclude that in the management of acute asthma in the ER, a PEFR guided protocol neither improved overall PEFR response to treatment nor reduced admission rates when compared with current management as it is practised in Singapore.

Keywords: asthma exacerbation, practice guidelines, peak expiratory flow rate, emergency room

Department of Medicine
Alexandra Hospital
378 Alexandra Road
Singapore 159964

S B Ng, MBBS
Medical Officer

K N Sin Fai Lam, MBBCh BAO, FRCPI
Senior Consultant

Department of Respiratory Medicine
Tan Tock Seng Hospital
Moulmein Road
Singapore 308433

J Abisheganaden, MBBS, MRCP (UK), M Med (Int Med)
Senior Registrar

Department of Medicine
National University Hospital
5 Lower Kent Ridge Road
Singapore 119074

T K Lim, MBBS, M Med (Int Med), FAMS
Associate Professor

Correspondence to:
A/Prof T K Lim

INTRODUCTION

Acute spontaneous exacerbations of bronchial asthma is a very common medical emergency and many patients present to the emergency room (ER) for acute therapy. In many hospitals, the ER is being increasingly used as a primary care facility for the treatment of asthma[1]. Some studies have shown that the implementation of ER protocol guided therapy for management of acute asthma could decrease the number of emergency hospitalisations for asthma, reduce intensive care admissions and lower the time spent in the ER for asthmatics[2]. McFadden et al have shown that such an approach yields significant financial benefit while quickly identifying individuals who require hospitalisation[3].

Other studies reviewing the management of patients attending emergency departments have also noted deficiencies in assessment and management, including failure to perform respiratory function measurements, inadequate use of corticosteroids, over-reliance on beta$_2$-agonist bronchodilators, and failure to make adequate follow-up arrangements[4-6].

There have been many practice guidelines published by various national, international and more recently, global expert committees on the assessment and treatment of patients with bronchial asthma in recent years[7-10]. These guidelines would appear to set a 'goal standard' against which we should evaluate the current practice in our own institutions. However, in comparison to what is regarded as the 'gold standard' practice described in consensus guidelines, patients with asthma are still frequently inadequately assessed, under treated and poorly educated about their condition[11-14].

In a previous study of patients with acute asthma treated in the ER of a community hospital, we found that 35% of asthmatic patients who were discharged had a peak expiratory flow rate (PEFR) measurement of less than 60% predicted[15]. These patients were assessed and deployed according to subjective response and clinical signs of airways obstruction, without any particular defining criteria of the PEFR for more intensive treatment or discharge. A strict interpretation of the current guidelines might suggest that these patients were inappropriately discharged, and were candidates for more intensive therapy. Since it is still uncertain whether the use of PEFR guided protocols would improve outcome, we performed this study to evaluate the therapeutic effectiveness of protocol therapy for acute asthma, employing a sequential design in which the influence of an asthma care path on hospital admissions were evaluated.

This paper thus compares the outcome of acute exacerbations of bronchial asthma managed with two different protocols in an ER setting. The first protocol, routine protocol (RP), assessed and dispensed patients according to overall subjective and clinical response. In the second protocol, peak protocol (PP), serial measurements of PEFR were

used to guide intensity of bronchodilator treatment and fitness for hospital discharge. Our observations form the basis of this report.

MATERIALS AND METHODS

Patients

All adult asthma patients, 12 years of age and older, who presented to the Accident and Emergency Unit of a community hospital with an acute exacerbation of their illness were eligible for participation in the study. The study was conducted in the ER of the hospital in two similar 3-month periods over two consecutive years. Only patients previously diagnosed to have asthma by their doctors and who were on treatment were recruited into the study during their acute presentation to the ER. Patients with chronic obstructive airway disease (clinical or radiologic diagnosis) and underlying heart disease were excluded.

Routine Protocol (RP)

Patients in the RP group were studied in the first year over a 3-month period (May – July). They were seen immediately on presentation by the medical officers on duty, who clinically assessed them and recorded at least three reproducible PEFR measurements. The data was recorded both in absolute terms and as a percentage of predicted normal for our local population[16].

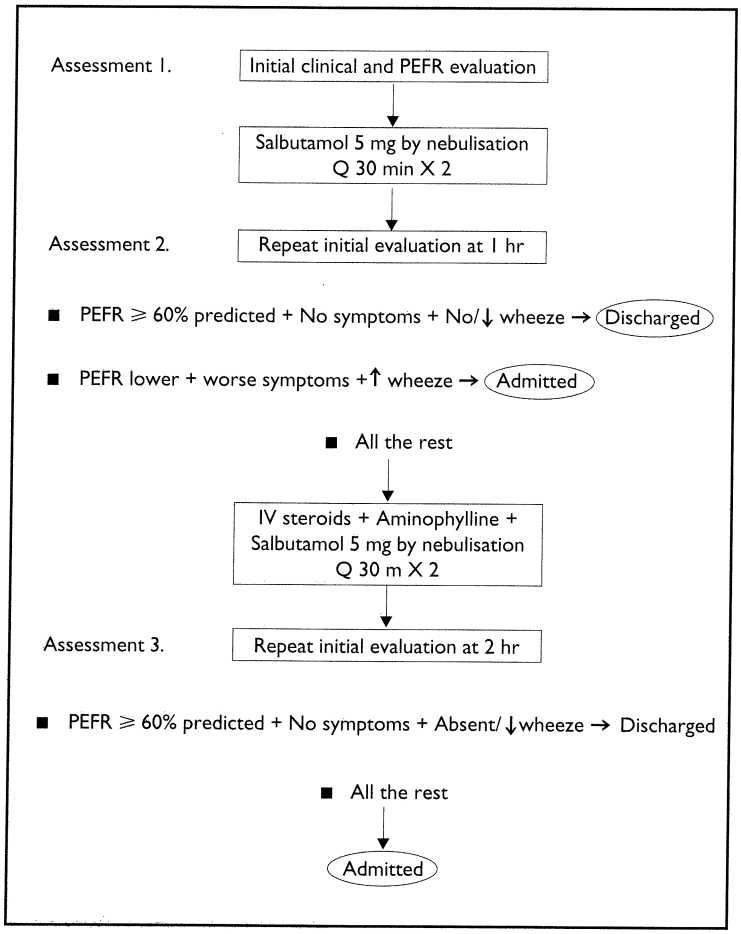

Fig 1 – ER Asthma Protocol

All patients were then randomised into three groups and were treated as follows: with inhaled salbutamol via wet nebulisation (5 – 10 mg), or with terbutaline via Turbuhaler (2.5 mg), or with subcutaneous adrenaline (0.3 mL, 1:1000 dilution, repeated once) and inhaled oxygen. They were controlled for age, sex ratio and baseline PEFR. The medical officers reviewed the same patient again after the treatment and used their clinical judgement to either discharge, admit or continue therapy in the ER for the patients. Peak expiratory flow rates were recorded again before discharge from the ER.

There were no significant differences between these three groups of patients in terms of PEFR response, post-treatment PEFR, outcome or admission rates, and they were all disposed of in the same manner[15]. Thus, this RP group of patients were assessed and deployed according to subjective response and clinical signs of airway obstruction without preset criteria for more intensive treatment or discharge which is currently the usual practice in ERs in Singapore.

Peak Protocol (PP)

This group of asthmatic patients was also studied over a similar 3-month period (May – July), the following year. The care path and decision algorithms used for this group are contained in Fig 1. The medical officers were fully briefed on the PP before starting work in the ER and the basis for the use of peak flow measurements (PEFR) for all patients to guide therapy was explained. Advice was also given about drug administration and the need to consult senior staff when handling difficult cases.

Patients were seen immediately on presentation by the medical officers on duty, who followed the treatment algorithm of the PP. Details of patients' background asthma morbidity and their current exacerbation were documented on the data sheet. This forms the basis of a separate report on the profile of acute asthmatics presenting to the ER in Singapore[17].

The examining doctor also recorded, whether the patients had wheezing, use of accessory muscles and whether they subjectively improved after the initial therapy. They reviewed the same patient again after the first stage of evaluation and treatment and used serial measurements of PEFR and clinical improvement to guide the intensity of therapy. The initial therapy consisted of 2 doses of aerosolised salbutamol (5 mg each dose) over an hour. The assessments were then repeated after one hour. A decision was then made based upon predetermined criteria whether the patient could be discharged, admitted, or needed further treatment in the ER.

If further treatment was deemed necessary, then the patient would receive intravenous glucocorticoids (IV hydrocortisone 200 mg stat) and repeated aerosolised salbutamol (2 nebulisations of 5 mg each, 30 minutes apart) and was again reassessed in another hour by the same doctor. At the end of this time, the patients were either admitted, or discharged if they met the pre-discharge criteria, which was as follows: patients were to be asymptomatic with diminished

Table I – Comparison in age, sex ratio, baseline peak expiratory flow rate, peak expiratory flow rate after treatment, percentage improvement in peak expiratory flow rate and admission rate between Routine Protocol Group versus Peak Protocol Group

	Routine Protocol Group (n+79) [Mean (SD)]	Peak Protocol Group (n=70) [Mean (SD)]	+p value
Age	36 (± 13)	36 (± 12)	$p > 0.05$
Sex ratio	34M:45F	30M:40F	$p > 0.05$
Baseline PEFR (% predicted)	41.3 (± 14)	42.3 (± 20)	$p > 0.05$
PEFR after treatment (% predicted)	64.6 (± 21)	60.0 (± 23)	$p > 0.05$
* % improvement	41 (± 31)	35 (± 29)	$p > 0.05$
Admission rate (%)	23	37	$p > 0.05$

* Defined by: [(post-PEFR) – (BL-PEFR)/(predicted PEFR) – (BL-PEFR)]%.
Post-PEFR = PEFR after treatment; BL-PEFR = baseline PEFR.

+p = Outcome of unpaired Student's t-test, except for admission rate which was compared using the Chi-squared (χ^2) test.

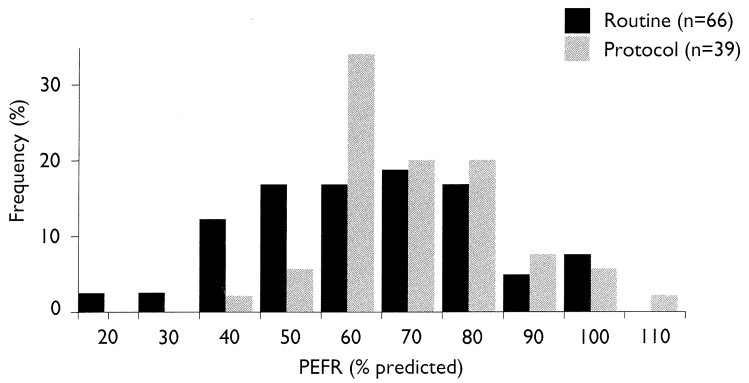

Fig 2 – PEFR at discharge from ER

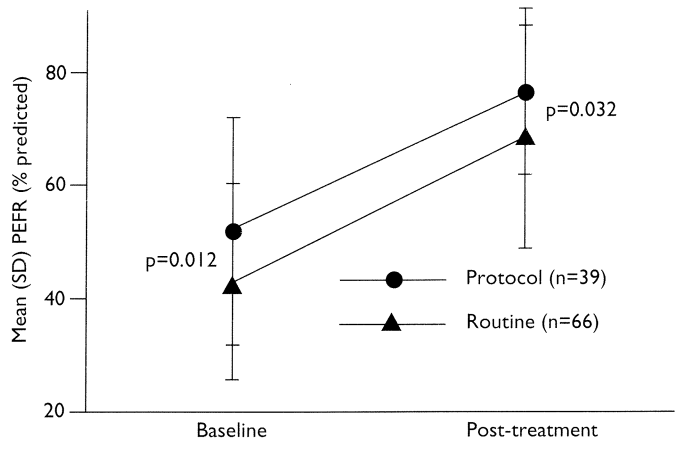

Fig 3 – PEFR in patients discharged from the ER

or absent of wheezing and PEFR was to have equalled or exceeded 60% of predicted percentage. Accessory muscle used, if present originally, was to have been resolved.

Statistical methods

All clinical data is expressed as the mean (± SD). The admission rates between the two groups were compared using the chi-squared (χ^2) test. All other clinical data were compared using Student's t-test. Statistical significance was assumed if $p < 0.05$. The best of three PEFR readings expressed as the percentage predicted was used for statistical analysis.

RESULTS

There were 79 patients in the RP group and 70 in the PP group. The two groups of patients (RP vs PP) were very similar and were comparable in age [mean (SD): 36 (± 13) years vs 36 (± 12) years] and sex ratio (34 M: 45 F vs 30 M: 40 F). Complete serial PEFR were recorded in 74 patients in the RP group and 61 patients in the PP group. The results of objective improvement in lung function were derived from the following PEFR measurements (as a percentage of predicted for our local population): baseline PEFR (BL-PEFR), defined as the initial PEFR recorded at the first presentation, before any treatment was received at the ER; PEFR after treatment (post-PEFR), defined as the PEFR reading after therapy and just before discharge or admission to hospital; and percentage improvement in PEFR, defined by the difference in the above two readings divided by the difference in the predicted PEFR and the baseline PEFR [(post-PEFR) (BL-PEFR) / (predicted PEFR) – (BL-PEFR)]%.

Therapeutic results (RP vs PP) were as follows: there was no significant difference in baseline PEFR [BL-PEFR: 41.3(± 14)% predicted vs 42.3 (± 20)% predicted], PEFR after treatment [post-PEFR: 64.6 (± 21)% predicted vs 60 (± 23)% predicted] and percentage improvement in PEFR [(post-PEFR) – (BL-PEFR) / (predicted PEFR) – (BL-PEFR)%: 41 (± 31)% vs 35 (± 29)%] between the two groups of patients (Table I).

Peak protocol treatment resulted in a greater admission rate than routine protocol treatment [37% (26/70) vs 23% (18/79), not significant on χ^2 testing]. Five (7%) patients in the PP group left the ER against the doctor's advice while none from the RP group did so. These five patients who were required to be admitted according to the protocol, refused admission as they felt better with treatment at the ER and were thus discharged against the doctor's advice.

Fig 2 compares the results of PEFR readings for the two groups of patients at discharge from the ER. Baseline PEFR (% predicted) in the RP group was 42.8% (± 17) and PEFR after treatment (% predicted) was 67.9% (± 19). For the PP group, the corresponding values were 51.7% (± 20) and 75.7% (± 14). The discharge PEFR for the PP group was significantly higher than that for the RP group ($p = 0.032$). However, as shown in Fig 3, the PEFR values

at baseline were also significantly higher in the PP group ($p = 0.012$) and the improvement in PEFR was the same in the two groups ($p > 0.05$).

Thus, the PP resulted in better PEFR at discharge (76% vs 68% predicted; $p = 0.032$) but higher admission rates (37%) when compared with routine management (23%).

DISCUSSION

The patients in both groups were very similar in terms of their illness severity and background demography (age and sex). Although patients in the RP group did not receive the same therapy as a group, they showed no significant difference in PEFR response and clinical outcome within the group. When compared with the PP group, again there was no significant difference in baseline PEFR, PEFR after treatment or percentage improvement in PEFR.

The objective of our study was not to compare the various forms of treatment for acute asthma, but rather, to evaluate whether a peak flow-guided protocol would improve the outcome of patients with acute asthma treated in the emergency room setting, when compared with the current practice which does not involve the routine use of peak flow measurements. The results of the present study demonstrate this as not to be the case.

However, the introduction of specific guidelines for the management of asthma in the ER resulted in some improvements. There was a change in the emphasis on adequate documentation, evaluation and treatment. With the PP, essential features of the history including background asthma activity and morbidity and past experiences of near-fatal asthma were routinely recorded. Peak expiratory flow measurements were taken and repeated in most of the cases, providing an objective documentation of brochodilatory response to treatment.

Patients were held back and given additional doses of nebulised bronchodilator or intravenous hydrocortisone at the ER, and oral prednisolone was prescribed for all discharged patients. The provision of a form for recording and specific guidelines for treatment based on the objective assessment of airflow obstruction thus provided a means to establish standards of care that are consistent with current recommendations[18,19]. The ER doctors also found the protocol helpful in guiding therapy and was especially useful for rapid stepping-up of therapy. In general, the use of a PEFR-guided protocol was well received by the staff of the ER.

The patients treated with the PP had better PEFR at discharge, but they also had significantly better PEFR at baseline (Fig 3). The PP selected for patients who had better lung function at entry for discharge, when compared with the routine group.

We found that PP resulted in better PEFR but it did not achieve more effective bronchodilation. In fact more patients were admitted as a result of the PP compared to the RP group. The PP also resulted in more asthmatics being held back in the ER for repeat nebulisations and assessments, as the attending medical officers were required to adhere strictly to the treatment algorithm. The overall result was a higher rate of hospital admission (as all discharged patients needed a pre-discharge PEFR $\geqslant$ 60% predicted), patients requesting for discharge against the ER doctor's advice, and more time being spent on interviewing, counselling and managing asthmatic patients.

In contrast to our study, where the ER doctors followed strictly the protocol and did not make dispensation decisions based on clinical acumen, the recent study by McFadden et al from Cleveland did not adequately evaluate the use of protocol guided therapy. This was evident in that in 48% of cases, the ER doctors did not adhere strictly to the protocol and discharged their patients despite failure to achieve a PEFR > 60%[3]. Thus in many instances in the Cleveland study, there was a failure of the ER physicians to incorporate the objective data generated into their management assessments.

What then is the role of peak flow monitoring in the management of asthma? There have been few controlled studies on the effectiveness of mini peak flow meters in the management of asthma. A controlled study of 68 patients from 25 primary care clinics conducted by the British Thoracic Society showed no significant impact of home peak flow monitoring on peak flow levels and asthma control[20]. Similarly, the Grampian Asthma Study of Integrated Care[21] found that prescribing peak flow meters and giving self management guidelines to all asthma patients was unlikely to improve mortality or morbidity. However, patients whose asthma is severe may benefit from such an intervention.

There is also a controversy over the best test for detecting asthma severity[22]. A recent study suggested that the average minimal morning pre-bronchodilator measurement is the most appropriate[23] while another showed better predictive value using quality control analysis of peak flow charts[24]. Yet other studies have shown that the peak flow derived indices are no better than regular assessment of symptoms[25].

Some guidelines on acute asthma management proposed that the treatment of acute asthma attacks is a complex process that varies as a function of a patient's presenting features[8-10] or one that requires sustained observations in the ER before a disposition can be reached. This is not supported by our data or that of others[2,3]. The immediate prognosis of this condition is not determined by the intensity of the initial symptoms or by the value of the presenting PEFR, but rather, by the acute response to therapy[29-33]. The Cleveland study by McFadden et al[3] showed that shortening the duration of stay in the ER with the use of their protocol did not worsen the outcome. Our data complements their findings by showing that there is little to be gained by prolonging treatment in the ER by strictly adhering to a PEFR guided protocol.

None of the patients received intravenous aminophylline despite the intention to use it in the PP. The reasons given included lack of time in the ER to administer the drug and unfamiliarity with giving the drug as a bolus dose. Another reason was that

most patients were not sure if they had taken oral theophylline recently. Its efficacy in the ER setting was thus not assessed.

It has been implied that glucocorticoids, if given early in the emergency department, may limit the need for admissions[26]. Our observations, like others[27,28], do not support this. In addition to this, a course of oral corticosteroids was given to all patients who were discharged in both groups.

One of the limitations observed from our study was that we did not specifically compare the relapse rates between both groups after discharge from hospital. This was not our intention as we only wanted to study the immediate ER outcomes. We did however, in both groups of patients, perform a telephone survey of a sub-group of patients at day seven after discharge from hospital to determine if there was a relapse. We documented a 10% – 15% relapse rate in the two groups ($p > 0.05$). We do not think that the relapse rates between the two groups would have differed significantly as this depends very much on the efficacy of maintainence and prophylactic treatment, and in all cases, oral steroids were prescribed upon discharge[31,32].

CONCLUSION

In conclusion, we have evaluated the use of a PEFR-guided protocol for the management of asthma within a community hospital emergency department. Despite some problems with the use of the protocol, we found that it resulted in an overall higher standard of care for asthma. It was also useful in the decision making process for borderline cases where the ER doctor was hesitant to discharge the asthmatic patient. In such instances, rapid step up of therapy including the use of intravenous glucocorticoids may be given and the patient reassessed at hourly intervals, using PEFR to guide and document improvement. Such borderline cases may be discharged with an early clinic review if they had clear lungs and were asymptomatic, and provided they did not belong to a high risk group of asthmatics, such as those who had collapsed from asthma in the past, or those who had been intubated previously, or those who were chronically steroid-dependent.

We conclude that, in the management of acute asthma in the ER, a PEFR-guided protocol neither reduces the admission rates nor improves overall PEFR response to treatment when compared with the current routine treatment as practised in Singapore. Patients who were treated according to the PEFR-guided protocol had better PEFR at discharge from the ER as a result of selection for patients with less severe illness at presentation and not more effective bronchodilation. Further studies are needed to define the role of pulmonary function measurement in the management of patients presenting with acute asthma in the ER.

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