

PAPERS AND SHORT REPORTS

Children with asthma: will nebulised salbutamol reduce hospital admissions?

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Abstract

To find out how many children with acute asthma responded to one or two doses of nebulised salbutamol and whether this response could be predicted 100 children were studied prospectively from two district hospitals. Twenty three children needed only one nebulised dose and 19 responded to two. Significant factors differentiating these responders from the remainder were age (24 (63%) of those aged 6 or more responded compared with only six (19%) of those aged 3 or less); regular treatment with a β_2 sympathomimetic; and use of a rotahaler or aerosol. Those requiring more intensive treatment had faster pulse and respiratory rates on admission and one hour after the first nebulised dose. Another useful clinical sign was persistent supraclavicular indraw. Pulsus paradoxus and peak expiratory flow rate were of limited value in the younger children who had worse asthma. Of 29 children receiving intravenous treatment, 18 (62%) were aged 3 or less, whereas only two (7%) were aged 6 or over.

The older children who responded initially to nebulised salbutamol could have been safely reassessed at home, which would have considerably reduced hospital admissions.

Introduction

Hospital admissions for childhood asthma have increased over the past 20 years despite major advances in drug treatment and without any reduction in mortality.^{1,2} Little information is

available about the course of the illness and the response to treatment,³ particularly in infants.⁴

Self referral to the children's ward for acute asthma was started in 1979 in east Berkshire. The intention was to treat children with nebulised salbutamol (ipratropium was not then in regular use) and send those who responded home. In practice, difficulty was experienced in predicting which child could safely continue treatment at home. The object of this study was to find out how many children responded to one or more doses of nebulised salbutamol and to examine whether the response could be predicted.

Patients and methods

The study was carried out prospectively at two hospitals in east Berkshire, covering a population of about 370 000. At a clinic for children with asthma peak expiratory flow rate was regularly measured, and the worst affected children were given nebulisers to use at home. The children and parents also received written instructions about referral for treatment if the regular medication failed to relieve an acute attack.

One hundred children (71 male) had 167 attacks of asthma from June to December 1981. Fifty six were regular outpatient attenders who referred themselves; the remainder were referred by general practitioners and accident and emergency departments. Their ages ranged from 1 to 15 years; 62 were under 6 years old. Children who had already received nebulised salbutamol at home during the current attack were not included.

On admission details of the history, duration, and treatment of the current attack were documented. Physical examination was recorded by the admitting senior house officer. In particular, the amount of supraclavicular indraw, sternomastoid contraction, air entry, and rhonchi were graded and combined to give a clinical score. The presence of pulsus paradoxus was assessed by palpation of the radial artery and measured when possible. The peak expiratory flow rate was recorded in cooperative children.

All the children received salbutamol (2.5 mg for those aged under 5 years, 5 mg for older children) nebulised in 2 ml physiological saline. The clinical variables were reappraised 15-60 minutes later. Intravenous and oxygen treatment were given when appropriate. In the remaining children their regular medication was continued. Hourly pulse and, when possible, peak expiratory flow rate were recorded for eight hours in all children. Most children were re-examined at four hours to determine the need for a second nebuliser. Any child

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whose condition deteriorated was examined earlier, but those in whom the hourly observations were satisfactory who fell asleep were not disturbed. After discharge parents were contacted and details of any deterioration noted. Statistical analysis was by the χ^2 test (with Yates's correction where appropriate).

Results

Children were grouped according to the treatment received. Twenty three needed only one nebuliser treatment; 42 responded to one or two doses; 26 responded to three or more doses; 29 also needed intravenous treatment; and three also needed oral steroids. The children who responded to one or two nebuliser treatments maintained their improvement during at least eight hours' observation; these children were compared with the remainder to identify predictive factors (table I).

TABLE I—Children requiring one or two doses of salbutamol compared with remainder

	Responded to one or two doses (n = 42)	Others* (n = 58)	Significance
Mean (SD) age (years)	6.8 (3.1)	4.8 (3.3)	p = 0.001
No of children aged:			
6 and over	24	14	p < 0.01
4 or 5	12	18	
3 or less	6	26	
Maintenance treatment with β_2 sympathomimetic:			
None	7	9	p < 0.05
Intermittent	21	42	
Regular	14	7	
Method of administration:			
Oral	19	40	p < 0.05
Rotahaler or aerosol	16	9	
Pulse rate on admission:			
<130/min	36	29	p < 0.001
>130/min	6	29	
Pulse rate 15-60 min after first nebuliser:			
<130/min	36	29	p < 0.001
>130/min	2	23	
Respiratory rate on admission:			
<40/min	36	30	p < 0.001
>40/min	6	28	
Respiratory rate 15-60 min after first nebuliser:			
<30/min	24	13	p < 0.001
>30/min	14	39	
<40/min	37	39	p < 0.01
>40/min	1	13	
Supraclavicular indraw after first nebuliser:			
Absent	31	25	p < 0.05
Present	6	18	

*Responded to three or more doses; required intravenous treatment in addition; or required oral steroids in addition.

AGE

Age was a highly significant factor: 24 (63%) of those aged 6 or more responded to one or two nebulised doses compared with 12 (40%) aged 4 or 5 and only six (19%) aged 3 or less ($p < 0.01$). There was a highly significant age difference in children who needed intravenous treatment: 18 (62%) were aged 3 or less and two (7%) aged 6 or more ($p < 0.001$).

MEDICATION

Children taking steroids by rotahaler or aerosol responded significantly better than those receiving oral treatment ($p < 0.05$), and those receiving regular treatment were more likely to respond.

CLINICAL ASSESSMENT

Most children showed some clinical response to the first nebuliser treatment (table II). Pulse and respiratory rates were significantly lower in those who received one or two nebulised doses than in the rest both before and after the first nebuliser treatment (table I), but the rates fell in similar numbers between groups. Furthermore, pulse rate fell after the first nebuliser treatment in 12 of the 29 children

TABLE II—Response to first nebuliser recorded within one hour (figures are numbers (%) of children)

	Improvement	No change	Deterioration
Pulse rate*	50 (56)	16 (18)	24 (27)
Respiratory rate*	72 (80)	12 (13)	6 (7)
Combined clinical score*	68 (76)	18 (20)	4 (4)
Peak expiratory flow rate†	31 (84)	5 (13)	1 (3)

*Recorded in 90 children.

†Recorded in 37 children.

who needed intravenous treatment. Thus in individual children a fall in pulse and respiratory rates was of no predictive value.

The four chest signs individually, and combined to give a clinical score, were of no help on admission in predicting outcome. Within one hour after the first nebuliser treatment only the absence of supraclavicular indraw bore any relation to treatment received ($p < 0.05$). Pulsus paradoxus could be measured in only 49 children with a sphygmomanometer. In 88 it was assessed by palpation of the radial artery, but there was no significant difference between groups with either method.

The peak expiratory flow rate was recorded in 43 children (33 aged 6 or more), but the value on admission did not predict the treatment subsequently required. Of the 15 children whose peak expiratory flow rate was 0-25% of the mean for height on admission, eight responded to one or two nebulised doses; only five went on to need steroids. Paired observations of peak expiratory flow rate before and after the first nebuliser treatment were obtained in 37 children. Of these, 31 (84%) improved immediately, but this improvement was not necessarily maintained. Considerable improvement in the peak expiratory flow rate ($>30\%$) was of value but reached significance ($p < 0.05$) only when all admissions in the study were considered (68 observations in 167 admissions).

STEROID TREATMENT

Twenty eight children were treated with combined intravenous steroids and aminophylline, and one with only intravenous steroids. None required ventilation. Of the 38 children aged 6 or more, only two received intravenous and three oral steroids. These older children were monitored for at least six hours after the first nebuliser treatment before intensive treatment began. By contrast 18 of the 32 children aged 3 or less received intravenous steroid treatment.

Symptoms of tremor, vomiting, and irritability were seen in three children aged 2 and under, who received 2.5 mg salbutamol. One child aged 5 was tremulous after 5 mg. All children were kept in hospital for at least eight hours after the first nebuliser treatment. Most children (96) were sent home within 72 hours.

Seventy two children remained well after discharge, but the condition of 12 children deteriorated. Wheezing was reported in 28 (21 continued wheezing 24 hours after discharge), and eight sought further treatment. There was no significant difference between treatment groups. Four children who initially responded to one or two nebulised doses were readmitted, but only one or two further doses were required. None of the seven children readmitted required steroids or intravenous treatment.

Discussion

In this study most children with asthma responded initially to nebulised salbutamol. Twenty three could have been treated at home or discharged from hospital after one treatment. Forty two needed one or two doses and could have been discharged after only four hours. If our study is representative admissions of children with asthma could be considerably reduced. The results lend support to the views of practitioners who treat children at home with nebulised salbutamol⁵ and paediatricians who provide outpatient treatment without routine admission. We emphasise, however, that this study specifically excluded the few children with severe chronic asthma who used nebulisers regularly at home.

Can children who respond be identified? The strongest determinant of outcome was age. Two thirds of the children

over 6 years responded to one or two nebulised doses. There was a disappointing lack of predictive factors to differentiate between those who responded and those who did not. Even the other significant factors of pulse rate, respiratory rate, and use of rotahaler or aerosol were probably related to age.

When all admissions were considered peak expiratory flow rate was a useful measure of the degree of airway obstruction but was a predictive factor only when a substantial increase occurred after the first nebulised dose. This study has shown, however, that a child aged 6 and over can be safely treated at home with nebulised salbutamol and then reassessed after four hours. No child aged 6 and over who responded initially required intravenous treatment within this period.

Children aged 3 or less are not suitable for home treatment. They need more intensive treatment and are more likely to have faster pulse and respiratory rates, and after the first nebulised dose they may have supraclavicular indraw, a physical sign previously found to be one of the most useful.⁶ Children aged 3 or less made up a surprisingly high proportion of admissions (32%). They were difficult to assess clinically: accurate measurement of pulsus paradoxus was impossible, and peak expiratory flow rate could not be measured. Twenty six (81%) needed more than two nebulised doses, and intravenous treatment was given to 18 (56%). Other studies have found young children to be the most severely ill on admission to hospital⁷⁻⁸ and to constitute a high proportion of deaths from asthma.⁹

Most children were able to manage their asthma at home after discharge. The more intensively managed children did not fare any better than the others. Those who were readmitted responded to nebulised salbutamol without intravenous

treatment. There are obvious advantages of treatment at home or early discharge from hospital: parents are likely to request earlier treatment if admission to hospital is not automatic; early treatment may be more effective; the child is less likely to be overtreated; and hospital beds may be freed.

This study suggests that children aged 6 and over with asthmatic attacks can be safely treated at home initially, with nebulised salbutamol. We advise that non-responders are admitted to hospital within one hour and responders reassessed at home four hours after treatment. Older children admitted to hospital who improve after one or two nebulised doses can be discharged. Ready access to hospital is an essential back up for either method of treatment, and it must be clearly understood who is responsible for the further care of the patient.

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Morbidity and survival in neonates ventilated for the respiratory distress syndrome

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Abstract

In a retrospective analysis the records of all (210) infants ventilated to treat the respiratory distress syndrome over three years were reviewed. A mortality of 19% was found. Intraventricular haemorrhage was associated than a significant increase in mortality in infants of less than 30 weeks' gestation ($p < 0.001$) and was the commonest cause of death. Pneumothoraces developed in one third of babies regardless of gestational age but were significantly associated with an increase in mortality only in infants of 27-29 weeks' gestation. Patent ductus arteriosus was present in 31 infants and was commoner in babies of very low birth weight. The presence of a patent ductus arteriosus was not associated with decreased survival but was significantly related to an increased need for prolonged respiratory support ($p < 0.001$). Thirty six infants developed chronic lung disease, three of whom died.

Comparison with data from earlier studies indicated

a steady improvement over the past decade in outcome for infants ventilated for the respiratory distress syndrome.

Introduction

Artificial ventilation is an essential part of treatment for the respiratory distress syndrome when other forms of respiratory support have failed to achieve satisfactory oxygenation or when apnoea develops. Although ventilation of preterm babies is now common practice and mortality and morbidity remain high, few reports on such ventilation have been published recently. Birenbaum *et al* suggested that mortality might be as high as 38%, with a significant correlation between survival and birth weight,¹ but this was a considerable improvement on the figures of the last major review in 1977, which quoted an overall mortality of 60% in babies ventilated for the respiratory distress syndrome.² The increase in survival has been to a certain degree at the expense of increased morbidity, with the emergence of relatively new complications, in particular bronchopulmonary dysplasia and patent ductus arteriosus. Long term problems may also arise in preterm babies who were ventilated. Field *et al* showed that the duration of ventilation was one of the most important predictors of delay in development in the first year,³ and long term respiratory problems,⁴ such as chest infections requiring admission to hospital, are common, particularly if bronchopulmonary dysplasia develops.

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