

## Short papers

## An open, prospective comparison of $\beta_2$ agonists given via nebuliser, Nebuhaler, or pressurised inhaler by ambulance crew as emergency treatment

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### Abstract

**Background** – The merits of the use of  $\beta_2$  agonists by ambulance crew and best methods of delivery have not been fully explored.

**Methods** – A prospective comparison has been made of treatments applied in three districts in South Wales (200  $\mu$ g salbutamol by pressurised inhaler, 5 mg salbutamol via nebuliser, and 5 mg terbutaline via Nebuhaler) by emergency ambulance personnel to acutely wheezy patients en route to hospital. Pulse rate, respiratory rate, peak expiratory flow rate (PEFR), and breathlessness scored on a visual analogue scale were compared before and after treatment. Data were collected on diagnosis, artificial ventilation, cardio-respiratory arrest, and death.

**Results** – Thirty eight patients received salbutamol inhaler, 51 salbutamol via nebuliser, and 41 terbutaline via Nebuhaler. There were greater reductions in respiratory rate and breathlessness score and more improvement in PEFR in the group receiving nebulised salbutamol than in the other two groups. No patient was ventilated and of the five deaths none was caused by asthma.

**Conclusions** – For wheezy, breathless patients treated en route to hospital by emergency ambulance personnel, 5 mg salbutamol given by an oxygen-driven nebuliser was more effective than either 5 mg terbutaline via a Nebuhaler or 200  $\mu$ g salbutamol via a pressurised inhaler.

(*Thorax* 1995;50:79–80)

Keywords:  $\beta_2$  agonist, emergency, acute wheeze, ambulance.

Benefit was reported in most of the 559 patients treated for acute wheezing with nebulised salbutamol by ambulance crew over four years in the Lothian district of Scotland,<sup>1</sup> findings confirmed objectively in a recent prospective study.<sup>2</sup> Little is known about the results of management of wheezing

patients by ambulance crew in other districts and, in particular, about the optimum means of delivering inhaled bronchodilator to such patients. A different method is practised in each of three adjoining districts in South Wales – namely, pressurised inhaler, Nebuhaler, and nebuliser. We have compared these three methods in acutely wheezy patients attended as emergencies by ambulance crew in these districts.

### Methods

Patients aged >14 years who were thought to have acute asthma by their attending doctor or ambulance crew and who were able to register a reading on a mini-Wright peak flow meter were admitted to the study unless excluded by the doctor at the scene. Informed consent was obtained and the study had ethical committee and Ambulance Medical Advisory Committee approval. The ambulance personnel all received both basic and extended ambulance training (paramedics).<sup>3</sup>

In district A 20 metered doses of terbutaline (Bricanyl inhaler, 0.25 mg per dose) were given over three minutes via a 750 ml Nebuhaler (total dose 5 mg); in district B 5 mg salbutamol (Ventolin Respirator Solution) was given over 3–5 minutes by nebuliser driven by oxygen at 6 l/min; and in district C two metered doses (100  $\mu$ g/dose) of salbutamol were administered from a simple pressurised inhaler. In all three districts oxygen was thereafter delivered via face mask (FIO<sub>2</sub> approximately 50–60%) until arrival at hospital. Medication received during the previous 24 hours was recorded.

Before treatment pulse rate, respiratory rate, peak expiratory flow rate (PEFR), and a subjective assessment of the severity of breathlessness (using a 10 cm visual analogue scale which ranged from “relaxed, breathing normally” to “terrified, extremely breathless”) were recorded on standard forms. Repeat measurements were made 30 minutes later or on arrival at hospital, whichever was sooner. Time spent at the scene and transport time to hospital were also recorded. Forms were returned to the coordinator who later obtained data on

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Patient characteristics and comparisons of changes following treatment (adjusted by baseline values), duration of ambulance aid, age, and sex

	Treatment groups†			p‡
	A (n = 41)	B (n = 51)	C (n = 38)	
Mean (SD) age	46.0 (22.0)	54.9 (19.3)	49.7 (20.0)	NS
Male:female	16:25	27:24	14:24	NS
Mean (SD) duration of ambulance aid (min)	26.0 (8.8)*	35.2 (13.1)	28.6 (12.0)*	<0.01
Mean (SE) change in pulse rate per minute	-8.22 (2.62)	-10.75 (2.79)	-3.10 (2.37)	NS
Mean (SE) change in respiratory rate per minute	-0.30 (1.27)**	-6.73 (1.34)	-2.70 (1.14)*	<0.01
Mean (SE) change in peak expiratory flow rate‡	0.21 (0.053) (123%)	0.36 (0.074) (143%)	0.11 (0.05)** (112%)	<0.05
Mean (SE) change in breathlessness score‡	-0.46 (0.11) (63%)	-0.75 (0.13) (47%)	-0.29 (0.11)** (75%)	<0.05

† Group A: 5 mg terbutaline via Nebuhaler; group B: 5 mg salbutamol via nebuliser; group C: 200 µg salbutamol via pressurised inhaler

‡ Change on natural log scale and mean changes in terms of the final levels as percentages of the initial levels.

§ Significance level for testing hypothesis of equal responses in all treatment groups. NS indicates  $p > 0.05$ . Subsequent pairwise comparisons of treatment groups found no statistically significant differences between groups A and C.

\*  $p < 0.05$ , \*\*  $p < 0.01$  v group B.

diagnosis, artificial ventilation, cardio-respiratory arrest, and death from the patient's consultant and/or hospital notes.

Analysis of variance was applied for age and duration of ambulance aid and the  $\chi^2$  test was applied for sex. An analysis of covariance was performed to compare changes between the second and first measurements (after logarithmic transformation of PEFRs and breathlessness scores), adjusting for baseline value, duration of ambulance aid, age, and sex.

## Results

A total of 130 patients entered the study (table). There was no significant difference between groups A, B, and C in mean age, sex ratio, on-scene time, initial pulse rates, respiratory rates, breathlessness scores, distribution of diagnoses, and treatment received in prior 24 hours. Mean (SD) initial PEFr was lower in patients in groups B (130.4 (80.1) l/min) and C (142.6 (95.5) l/min) than in those in group A (183.8 (129.1) l/min). The total of time spent on the scene plus transport time to hospital was significantly longer in group B. Analysis of covariance showed significant differences in respiratory rate and breathlessness score (table). The reductions were significantly greater in patients in group B than in those in group C, with the intermediate levels in group A not differing significantly from those in group C, and differing significantly from patients in group B in respiratory rate only. The mean increase in PEFr was greater in patients in group B (B, 52 l/min v A, 24.6 l/min v C, 19.1 l/min). The same trends were evident when the patients were subdivided into those with an eventual diagnosis of asthma or of chronic bronchitis/emphysema or of chronic bronchitis/emphysema and asthma. No patient was ventilated. Three patients in group B died in hospital, two in group C, and none in group A; in none was asthma given as cause of death.

## Discussion

Although this was not a randomised controlled trial, it suggests that 5 mg salbutamol given by oxygen-driven nebuliser is more effective than either 5 mg terbutaline via Nebuhaler or 200 µg salbutamol via pressurised inhaler for the treatment of wheezy breathlessness when administered outside hospital by ambulance personnel.

It would have been preferable to have used the same  $\beta$  agonist via the spacer device as was used via the nebuliser and the pressurised inhaler, but we were constrained by existing practices in the districts which also imposed the undesirable feature of comparing two very different doses of salbutamol. The superiority of nebuliser over inhaler is likely to have been related to the larger dose used via the nebuliser. The comparison of the Nebuhaler with the nebuliser may have been biased towards the nebuliser because salbutamol is thought to be more potent than terbutaline,<sup>4</sup> but this possible bias is likely to have been counterbalanced because, dose for dose, the effect of bronchodilator is greater when given by Nebuhaler than when given by nebuliser.<sup>5</sup> As oxygen was used to power the nebuliser, it is likely that patients treated by nebuliser received oxygen for 3–5 minutes more than those treated by Nebuhaler; the extent to which this possible difference might have affected the comparison of improvements in respiratory rates, PEFr values, and breathlessness scores is unknown.

Giving an acutely breathless patient 25–50 separate puffs from a pressurised inhaler is not a practical proposition. It is more convenient to use a spacer device or a nebuliser to deliver such a dose. Our study is the first to report a comparison of such methods of delivery by ambulance personnel in the emergency treatment of the wheezy patient en route to hospital, and indicates that the nebuliser is the preferred option.

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