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 µg 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, cardiorespiratory 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 µg salbutamol via a pressurised inhaler.

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, findings confirmed objectively in a recent prospective study. 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 the 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).1

In district A 20-metered doses of terbutaline (Bri-canyl 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 1/min; and in district C two-metered doses (100 µg/dose) of salbutamol were administered from a simple pressurised inhaler. In all three districts oxygen was thereafter delivered via face mask (FiO2 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 soonest. Time spent at the scene and transport time to hospital were also recorded. Forms were returned to the coordinator who later obtained data on
Patient characteristics and comparisons of changes following treatment (adjusted by baseline values), duration of ambulance aid, age, and sex

<table>
<thead>
<tr>
<th>Treatment group†</th>
<th>A (n = 41)</th>
<th>B (n = 51)</th>
<th>C (n = 38)</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (SD) age</td>
<td>46-0 (22-0)</td>
<td>54-9 (19-3)</td>
<td>49-7 (20-0)</td>
<td>NS</td>
</tr>
<tr>
<td>Male/female</td>
<td>16:25</td>
<td>27:34</td>
<td>14:24</td>
<td>NS</td>
</tr>
<tr>
<td>Mean (SD) duration of ambulance aid (min)</td>
<td>26:0 (8:8)*</td>
<td>35:2 (13:1)</td>
<td>28:6 (12:0)*</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Mean (SE) change in pulse rate per minute</td>
<td>-8:22 (2:62)</td>
<td>-10:75 (2:79)</td>
<td>-3:10 (2:37)</td>
<td>NS</td>
</tr>
<tr>
<td>Mean (SE) change in respiratory rate per minute</td>
<td>-0:30 (1:27)**</td>
<td>-6:73 (1:34)</td>
<td>-2:70 (1:14)**</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Mean (SE) change in expiratory flow rate</td>
<td>0:21 (0:053)</td>
<td>0:36 (0:074)</td>
<td>0:11 (0:05)**</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Mean (SE) change in breathlessness score</td>
<td>(123%)</td>
<td>(143%)</td>
<td>(112%)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td></td>
<td>(63%)</td>
<td>(47%)</td>
<td>(75%)</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

† Group A: 5 mg terbutaline via Nebulizer; 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 statically significant differences between groups A and C.
* \( p < 0.05 \), ** \( p < 0.01 \) \( v \) group B.

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 Nebulizer 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 Nebulizer with the nebuliser may have been biased towards the nebuliser because salbutamol is thought to be more potent than terbutaline, but this possible bias is likely to have been counterbalanced because, dose for dose, the effect of bronchodilator is greater when given by Nebulizer than when given by nebuliser. 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 Nebulizer, but 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 on route to hospital, and indicates that the nebuliser is the preferred option.

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