SHORT REPORT

Differential response of wheezes and rattles to anticholinergics

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Computerised breath sounds analysis was used to assess the response of infants with wheeze and rattles to the drug ipratropium bromide. A mean decrease in breath sounds intensity occurred in infants with rattles after five minutes (20.5 dB), but not until 20 minutes in those with wheeze (8.1 dB). This differential response may be related to different underlying pathophysiology.

The incidence of “wheeze” in early childhood appears to have increased over recent years. We have recently shown that many children with “wheeze” in the first year of life do not wheeze but exhibit a type of respiratory sound known as a rattle.¹ Rattles are lower in pitch than wheeze, with a continuous rattling quality and lacking musical features. Characteristically parents are able to feel this noise as a vibration over the baby’s back.

Classical wheeze is characterised acoustically by a sinusoidal waveform with distinct peaks in the power spectrum. Rattles are represented by a more variable, non-sinusoidal waveform with diffuse, irregular peaks in the power spectrum display.² These acoustic characteristics would suggest that the underlying pathophysiology differs in these two conditions. Wheeze is believed to originate from oscillation in large airways in response to small airways obstruction. The underlying mechanisms causing rattles are unclear. They may represent excessive secretions or alterations in airways tone.

The objective of the study was not to assess benefits of treatment with ipratropium bromide, but to use the drug as a tool to investigate the differential response of rattles and wheeze, in order to support the hypothesis that the sounds arise from a different mechanism.

METHODS

Symptomatic infants with wheeze or rattles were recruited from paediatric respiratory clinics, from inpatients admitted with acute viral induced respiratory illness, or from infants with ongoing noisy breathing in the community. Infants with bronchiolitis were not included. Approval for the study was obtained from the local ethics committee and informed consent was obtained from the infants’ parents.

Infants for entry into the study were carefully selected by one of the investigators (MLE) and confirmed using breath sounds analysis by a second investigator (HEE). Only infants with clear characteristics of either wheeze or rattles were selected as we wished only to include typical examples for the purpose of defining the response to ipratropium bromide. Infants with any other lung sounds or a combination of sounds were excluded from the study.

In total, 13 babies were selected: seven with wheeze (four boys, three girls; age range 7–10 months) and six with rattles (two boys, four girls; age range 8–10 months).

Using a contact sensor attached to the right upper area of the chest anteriorly, we recorded lung sounds for a period of

Figure 1 Average sound intensity during expiration at baseline, and 5 and 20 minutes after treatment with ipratropium bromide in the frequency range 150–300 Hz. (A) Infants with rattles; (B) infants with wheeze.

up to one minute. Air flow at the mouth was measured simultaneously using a pneumotachograph and facemask. The acoustic signals were analysed using a Fast Fourier Transformation technique. A customised computer program, RALE (Respiratory Acoustics Laboratory Environment, Pixsoft, Winnipeg) was used for data acquisition, analysis, and display.³ At expiratory flow rates of 0.1 l/s/kg, recordings were analysed for each infant before, and 5 and 20 minutes after administration of 40 µg ipratropium bromide through a spacer device.

We have previously defined the spectral characteristics of wheeze and rattles.² The dominant peak frequencies of both sounds were below 300 Hz. Frequencies less than 150 Hz are largely influenced by interference from the cardiovascular system.⁴ We therefore calculated the average sound intensity for the band of frequency 150–300 Hz.

RESULTS

Figure 1 shows a fall in breath sound intensity during expiration within five minutes of administering ipratropium bromide to the babies with rattles. Mean change from baseline to 5 minutes was 20.5 dB. There was a further mean decrease in intensity from 5 to 20 minutes of 7.3 dB. This pattern of results was consistent for all subjects with rattles.

In the babies with wheeze, there was a slight mean increase in intensity of 0.24 dB observed at 5 minutes; however, there was a mean decrease in average intensity at 20 minutes of 8.1 dB. Most of the overall response was accounted for by three of the subjects. Overall, the infants with wheeze had higher baseline intensity than those with rattles.

DISCUSSION

Using acoustic analysis, we were able to identify a reduction in intensity of both wheeze and rattles in symptomatic infants after inhalation of ipratropium bromide. The magnitude of the change was greater in those infants with rattles. The time course of action appears to be different with a clear reduction in breath sounds intensity evident at 5 minutes in infants with rattles but not until 20 minutes in those with wheeze.

The slow onset of action seen in the infants with wheeze is consistent with the known bronchodilator effects of ipratropium bromide, which peak at approximately 30 minutes.⁵ It is believed that the bronchodilator effects, which are mediated through blockade of cholinergic receptors, predominantly affect larger airways.⁶ The rapid onset of action in infants with rattles would suggest that the improvement is not attributable to bronchodilation and that another mechanism is likely to be involved. It is possible that the response of rattles may have been influenced by coughing or clearance of secretions. Ipratropium bromide can influence both airways secretions and airways tone, and its effect on rattles may be mediated through one of these mechanisms.

Breath sounds analysis provides a non-invasive method for objective assessment of infants. No advice can be made about the treatment of symptoms from this observational study,

which has simply identified a differential response to an inhaled anticholinergic in infants with rattles and wheeze. The response of rattles is earlier than the time course expected for a bronchodilator effect, suggesting that rattles have a different pathogenesis from wheeze. It may be important to highlight the differences between wheezes and rattles for future clinical and epidemiological studies of infants.

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