Gastro-oesophageal reflux and apnoeic pauses during sleep in infancy – no direct relation

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Abstract. We studied the relation of gastro-oesophageal reflux with apnoea during sleep in 24 infants with antecedent respiratory abnormalities and/or proven gastro-oesophageal reflux (GOR), by combined lower oesophageal pH and polygraphic monitoring. GOR, indicated by pH < 4, was confirmed in 24 infants. There were no episodes of prolonged (>20 s) central apnoea (CA). Fifty-six mixed or obstructive breathing episodes were identified in 12 infants (14 studies), of which 28 lasted between 3 and 6 s. Bradycardia (heart rate less than < 80 beats/min for 10 s was not observed. There were 80 falls in transcutaneous oxygen (P tcO2 > 5 mmHg) but only 6 exceeded 10 mmHg and one 20 mmHg. There was no relationship between GOR and obstructive episodes in terms of frequency, duration or temporal occurrence, except in one infant. There were 1276 gross body movements, mainly during active or indeterminate sleep and, of these, 7% were associated with decreases in pH to < 4. Movements occurred during the 60 s period preceding 83% of pH decreases > 1 pH unit compared to only 50% in the 60 s succeeding a pH drop. We conclude that, while GOR and obstructive episodes may co-exist in the patient groups studied, decreases in pH in the lower oesophagus do not usually induce either central or obstructive apnoea, and vice versa. Of the variables monitored, only gross body movements were temporally associated with pH drops, and usually preceded them.

Key words: Gastro-oesophageal reflux – Apnoea – Gross body movements – Sleep – Infants

Introduction

The first reports of an association between gastro-oesophageal reflux (GOR) and severe and recurrent apnoea in infants appeared in 1978 [7, 9]. Subsequent studies have generally confirmed that GOR is a frequent event in infants presenting with apparently life-threatening events (ALTEs) but no consensus has been reached on whether GOR directly precipitates apnoeic episodes [4, 8, 10].

Studies of the relationship of GOR with apnoea have usually been restricted to infants with ALTEs. They have not all included appropriate sensors for documenting sleep phase or for detecting obstructive apnoea, potentially important information for assessing the relation of GOR with cardiorespiratory abnormalities. These limitations prompted us to re-investigate the relation of GOR with cardiorespiratory abnormalities, not only in infants presenting with ALTEs but in others known, or likely, to have both GOR and cardiorespiratory abnormalities. We report here the findings from simultaneous lower oesophageal pH and polygraphic studies, performed during natural sleep at night, on the

Table 1. Clinical details of infants studied

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of infants</th>
<th>Sex (M/F)</th>
<th>&lt;37 weeks</th>
<th>Age (years) Median Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALTE a</td>
<td>9</td>
<td>6:3</td>
<td>1</td>
<td>0.16</td>
</tr>
<tr>
<td>Siblings of previous SID victims b</td>
<td>2 (3)</td>
<td>1:1</td>
<td>0</td>
<td>0.12</td>
</tr>
<tr>
<td>'Events' with spontaneous recovery c</td>
<td>12 (15)</td>
<td>8:4</td>
<td>3</td>
<td>0.17</td>
</tr>
<tr>
<td>Suspected aspiration</td>
<td>1</td>
<td>1:0</td>
<td>0</td>
<td>0.16</td>
</tr>
</tbody>
</table>

a Infants presenting with an "alarming event" associated with apnoea, and alterations in colour and/or tone, terminated by vigorous stimulation or cardio-pulmonary resuscitation. Investigations including an infection screen, chest and upper respiratory tract X-rays, electrolytes, blood sugar and blood gas tensions, ECG and EEG were negative or normal
b 1 sibling had had no symptoms; on direct questioning, the other was reported to vomit, mainly at night
c Presenting symptoms included apnoea and colour changes resolving spontaneously, cyanosis during feeds, choking, coughing with apnoea. Organic causes for these symptoms were excluded as far as possible
SID = sudden infant death; ( ) number of studies

Abbreviations: ALTE = apparent life-threatening event; AS = active sleep; CA = central apnoea; GOR = gastro-oesophageal reflux, IS = indeterminate sleep; OA = obstructive apnoea; P tcO2 = transcutaneous oxygen tension; QS = quiet sleep
relationship between GOR and cardiorespiratory abnormalities.

Methods

Patients

Twenty-four infants were studied on 28 occasions by combined lower oesophageal and polygraphic pH studies. Table 1 gives their clinical details. The study was approved by the Leicester Royal Infirmary Ethics Committee and informed consent was obtained before each study.

Prior to the combined polygraphic and pH studies, 17 of the 24 infants had been studied by radionuclide gastro-oesophageal scanning during a 2-h period immediately after a feed. GOR to upper oesophageal level was present in 14 (ALTEs 5; siblings 2; ‘events’ 6; suspected aspiration 1); 1 (recurrent vomiting) had only GOR to lower oesophageal level, while in 2 (ALTEs) GOR was not detected on scan. The other 7 infants had presented either with ALTEs or less severe ‘events’ with histories similar to those in the groups studied by scan. Thus the 24 infants were selected because of a history of a presumed cardiorespiratory ‘event’ and/or the presence or likelihood of significant GOR. It was anticipated that some of these infants would show both cardiorespiratory abnormalities and GOR during sleep and thus provide an opportunity to elucidate the inter-relationship between the two.

Physiological monitoring

Polygraphic studies were carried out between 2200 and 0500 hours in a quiet dimly lit laboratory (mean ambient temperature 23°C) using previously described monitoring techniques [2]. The infants were studied in natural sleep after their usual evening feed, either breast milk or formula.

Electro-encephalogram, electro-oculogram, submental electro-myogram, electro-cardiogram, nasal airflow (thermocouple), chest and abdominal movement and transcutaneous oxygen tension (PtcO2) were recorded. Lower oesophageal pH was recorded using a micro-glass pH electrode (Radiometer, GK2801C, Radiometer, Copenhagen). Before each study, the pH probe was calibrated in vitro using standard precision buffers (Radiometer – pH 7.383 and pH 1.1). The mean measured pH drift of the probe was 0.01 pH unit/h.

At the start of each study, the pH probe was passed orally and positioned 87% of the length from the mouth to the lower oesophageal sphincter, calculated from the nomogram of Strobel et al. [16]. After the usual night-time feed, electrodes were positioned and each infant was settled to sleep, lightly clothed and unrestrained, usually in the left lateral position. The nasal thermocouple was applied later during a period of quiet sleep. The outputs from the transducers and the pH meter were recorded on an ink-jet recorder (Mingograph, Elema Schonander) running at a paper speed of 1 cm/s while the pH meter was also interfaced to a flat-bed recorder running at 10 mm/min.

Each infant was observed throughout the study and body movements and other interventions were noted on the polygraphic trace.

Analysis of polygraph data

Sleep state. The median length of polygraphic study was 268 min (range 195–369 min) with a median sleep time of 210 min (86–261 min). Each sleep record was divided into successive 30s