ARTERIAL OXYGEN TENSION DURING APNOEA IN PARTURIENT WOMEN

GIRVICE W. ARCHER, JR AND GERTIE F. MARX

SUMMARY

The decrease in arterial oxygen tension, during 60 sec of apnoea with exposure to room air, was studied in twelve healthy parturient women undergoing Caesarean section under endotracheal fluroxene-oxygen anaesthesia. Eight young gynaecological patients, anaesthetized in an identical manner, served as controls. The reduction in oxygen tension was significantly greater in the pregnant women than in the controls and was greatest in women in labour. The results confirm the presence of a markedly increased oxygen consumption at term and emphasize the importance in obstetric anaesthesia of preoxygenation before and of prompt reoxygenation following endotracheal intubation.

Recent studies (Rorke, Davey and Du Toit, 1968; Moir, 1970; Baraka, 1970; Fox and Houle, 1971; Marx and Mateo, 1971) have demonstrated that the maternal arterial oxygen tension during Caesarean section is an important determinant of foetal oxygenation and consequently of the clinical condition of the infant at birth. When women in labour inhaled 33% of oxygen the oxygen tensions and saturations in the maternal and foetal blood were lower than those observed when breathing 66% or more of oxygen. The onset of sustained spontaneous respiration in the newborn was more often delayed when the mothers inhaled 33% of oxygen. The lowest foetal oxygenation and the longest time to sustained respiration occurred when the maternal arterial oxygen tension was below 100 mm Hg (Marx and Mateo, 1971). Maternal arterial oxygen tensions below 100 mm Hg were observed by us following difficult endotracheal intubation despite the administration of a high inspired oxygen concentration in patients in whom surgery had been started prior to insertion of the endotracheal tube. This observation prompted us to study the decrease in arterial oxygen tension during 60 sec of apnoea with exposure to room air in parturient women and non-pregnant controls.

PATIENTS AND METHODS

Twelve healthy full-term pregnant women formed the study group; six of these underwent elective repeat Caesarean section and six were sectioned, following various durations of labour, because of cephalopelvic disproportion. Prophylactic left uterine displacement was instituted by means of right hip elevation with a left-down tilt of the operating table. The controls were eight patients less than 30 years of age undergoing elective tubal ligation. All patients were premedicated with atropine 0.4 mg. Anaesthesia was induced with a sleep-dose of thiopentone (200–250 mg) i.v. followed by suxamethonium (40–60 mg) for tracheal intubation. Thereafter, the patients were ventilated by hand with a circle inflow of 97.5% oxygen and 2.5% (v/v) fluroxene while apnoea was maintained with an infusion of a 0.1% solution of suxamethonium. After 4 min, a radial arterial blood sample was taken. The endotracheal tube was then disconnected from the anaesthetic machine and exposed to room air for 60 sec, at the end of which a second arterial blood sample was taken.

Oxygen tension, carbon dioxide tension and pH were determined in duplicate within 10 min of sampling using Radiometer electrodes and a Radiometer read-out system. The results are expressed as the mean ± 1 standard error. Student's t-test was used for the statistical analyses.

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ARTERIAL OXYGEN TENSION DURING APNOEA

TABLE I. Mean values ± 1 standard error for \( P_{\text{AO}} \), \( P_{\text{ACO}} \) and pH in twelve pregnant women and eight non-pregnant women.

<table>
<thead>
<tr>
<th></th>
<th>Parturient women</th>
<th>Gynaeologic patients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before apnoea</td>
<td>After apnoea (1 min)</td>
</tr>
<tr>
<td>( P_{\text{AO}} ) (mm Hg)</td>
<td>473 ± 34*</td>
<td>334 ± 43*</td>
</tr>
<tr>
<td>( P_{\text{ACO}} ) (mm Hg)</td>
<td>31.4 ± 2.4</td>
<td>40.4 ± 2.7</td>
</tr>
<tr>
<td>pH</td>
<td>7.41 ± 0.02</td>
<td>7.33 ± 0.01</td>
</tr>
</tbody>
</table>

* \( P < 0.05 \)

TABLE II. Mean values ± 1 standard error for \( P_{\text{AO}} \), \( P_{\text{ACO}} \) and pH in six women in labour and six pregnant women who were not in labour.

<table>
<thead>
<tr>
<th></th>
<th>Parturients in labour</th>
<th>Parturients not in labour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before apnoea</td>
<td>After apnoea</td>
</tr>
<tr>
<td>( P_{\text{AO}} ) (mm Hg)</td>
<td>448 ± 49</td>
<td>302 ± 67</td>
</tr>
<tr>
<td>( P_{\text{ACO}} ) (mm Hg)</td>
<td>26.0 ± 2.2</td>
<td>36.1 ± 2.5</td>
</tr>
<tr>
<td>pH</td>
<td>7.42 ± 0.03</td>
<td>7.33 ± 0.02</td>
</tr>
</tbody>
</table>

RESULTS

The results (tables I and II) demonstrate initial oxygen and carbon dioxide tensions in the expected ranges. During apnoea, the \( P_{\text{CO}} \) increases were of similar magnitude in both groups (a mean increase of 9.0 mm Hg in the pregnant women v. 8.7 mm Hg in the controls). In contrast, the decreases in oxygen tension were significantly (\( P < 0.001 \)) greater in the parturients (mean reduction 139 ± 13 mm Hg) than in the non-pregnant women (mean reduction 58 ± 8 mm Hg). Although the decreases were greater in the women in labour (mean 146 ± 21 mm Hg) than in those undergoing elective section (mean 128 ± 16 mm Hg), this difference was not statistically significant. The pH changes reflected the increases in \( P_{\text{CO}} \).

DISCUSSION

Our study was based on that of Heller, Watson and Imredy (1964), as their findings assured us of the maintenance of safe oxygen tensions during the period of apnoea. The initial oxygen tensions were smaller in the parturient women than in the controls. We believe this to be the result of the increased alveolar-arterial \( P_{\text{o}} \) difference noted with tilting of the pregnant but not the non-pregnant woman (Jassir, Yu and Marx, 1973). During apnoea, both groups of patients had increases in \( P_{\text{CO}} \) which were in the ranges described for the first minute of apnoea (approximately 6 mm Hg secondary to equilibration with alveolar carbon dioxide and 3 mm Hg/min of apnoea) (Frumin, Epstein and Cohen, 1959). In contrast, the decreases in oxygen tension differed significantly. In the controls, they were similar to those reported by Heller, Watson and Imredy (1964), who studied seven non-pregnant surgical patients and found reductions of 62 mm Hg during the first and 73 mm Hg during the second minute of apnoea. The greater reduction in oxygen tension in the parturient women confirms the presence of an increased oxygen consumption at term. Studies in healthy women at various stages of pregnancy revealed an increase in oxygen consumption of 50-60 ml/min above non-pregnant values, an increase of approximately 20% (Bader, Bader and Rose, 1959). During labour, further increases developed ranging from 100 ml/min during the early first stage to 250 ml/min during the second stage (Gemzell et al., 1957).

The results of our study emphasize the importance of preoxygenation prior to endotracheal intubation in parturient women. Furthermore, they demonstrate the necessity of prompt reoxygenation following endotracheal intubation.

REFERENCES


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NORFOLK AND NORWICH INSTITUTE FOR MEDICAL EDUCATION

A Study Day will be held at Norwich on Saturday, 26 October, 1974.

Morning

HALOTHANE, CHLOROFORM AND THE LIVER

Speakers: Professor B. R. Simpson
Dr R. Williams
Professor J. P. Payne

Afternoon

MAJOR ACCIDENTS

Chief Inspector B. Fisher
Dr P. O. Pyle
Dr Jean Horton

Details from the Secretary, Norfolk and Norwich Institute for Medical Education, Norfolk and Norwich Hospital, Norwich, Norfolk NOR 53A.