Does coupling of uterine contractions reflect uterine dysfunction?

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Abstract

In a cohort analytical study 47 primigravidas in spontaneous normal labour at term were divided into two groups depending on the presence or absence of coupled uterine contractions during active labour. During monitoring with a pressure-tipped intra-uterine catheter, 24 patients developed coupled contractions and 23 had a normal contraction pattern. There were no statistically significant differences between the two groups with regard to maternal age, gestational age, maternal height, fetal weight, head circumference and pelvic size. Patients who developed coupled contractions had a longer duration of labour, a higher uterine activity integral and an increased incidence of caesarean section for failure to progress. Because coupling of uterine contractions may be indicative of dysfunctional uterine activity, and hence a prolonged first stage of labour, failure to progress during labour in these patients should be interpreted with caution in order to avoid the incorrect diagnosis of cephalopelvic disproportion.

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We therefore studied coupled uterine contractions in primigravidas to determine whether this abnormal contraction pattern correlates with progress during labour, with the hypothesis that it may reflect poor co-ordination of uterine contractility.

Patients and methods

Forty-seven primigravidas in active labour at term were selected at random for the study. All patients who had medical or obstetric complications were excluded from the study, as were those referred from outside hospitals. The study was therefore limited to healthy booked primigravidas with cephalic presentations, in whom labour had commenced spontaneously. Active labour was defined as regular painful uterine contractions in patients in whom the cervix was fully effaced and at least 3 cm dilated.

A transducer-tipped (Gaeltoc) intra-uterine catheter connected to a Sonicaid FM 3 R monitor (Sonicaid Ltd, Oxford, England) was used for recording uterine activity. Before insertion the catheter was correctly calibrated and sterilised in a 2% aqueous activated glutaraldehyde solution (Cidex; Arbrook Ltd, Livingstone, West Lothian, Scotland). With the patient in the dorsal position, and observing all aseptic precautions, the membranes were ruptured (if they had not ruptured spontaneously) and the transducer-tipped catheter was inserted and then advanced until the tip reached 30 cm from the cervix. A spiral fetal scalp electrode to monitor the fetal heart rate continuously was also applied. Once the catheter had been inserted patients were nursed in the left or right lateral position. Uterine activity was assessed using the UAI and expressed as kPall5 min. Pulse and blood pressure recordings were taken every 30 minutes. Progress of labour was assessed by vaginal examinations, done every 2 - 4 hours. A partogram was used to record the rate of cervical dilatation. Analgesia consisted of either pethidine 50 mg intravenously every 4 hours or a lumbar epidural block using bupivacaine without adrenaline. Oxytocin was administered when the uterine activity was less than 700 kPa/15 min. Infusion was started at 1 mU/min and doubled every 15 minutes until adequate contractions were obtained or an infusion rate of 32 mU/min was reached; higher rates than this were not used because it has been demonstrated that they have a minimal effect in increasing uterine activity. Caesarean section was performed if, in the presence of uterine activity exceeding 700 kPa/15 min, labour failed to progress over a period of 8 hours in the first stage or there was no descent of the fetal head during the second stage. After birth of the baby the duration of the active phase of labour is a common indication for caesarean section. However, Friedman documented disproportion in only 28.1% of nulliparas with delay during this stage; abnormal uterine contractility was one of the other main causes of delay. If operative deliveries for poor progress could be limited to patients with true cephalopelvic disproportion, numerous unnecessary caesarean sections could be avoided.

Unfortunately the diagnosis of inco-ordinate uterine activity is difficult to make clinically. Although determination of the uterine activity integral (UAI) has been shown to be of value in the scientific adjustment of oxytocin dosage to augment uterine contractions, these studies concentrated on work done by the uterus and not on contraction patterns as such.

A study by Labuschagne et al. demonstrated that irregular uterine contractions during labour occurred more frequently in black than in white women and in addition that the group with irregular contractions had a higher incidence of caesarean section for poor progress. Unfortunately parity was not taken into account, and it is possible that the irregular contractions may have been due to a large number of primigravidas in the study group rather than to a racial factor as such.

Cronje and Van der Westhuizen found that coupling of uterine contractions during labour was most common in primigravidas and was associated with fewer normal vaginal deliveries.

Failure to progress in the active phase of labour is a common indication for caesarean section. However, Friedman documented disproportion in only 28.1% of nulliparas with delay during this stage; abnormal uterine contractility was one of the other main causes of delay. If operative deliveries for poor progress could be limited to patients with true cephalopelvic disproportion, numerous unnecessary caesarean sections could be avoided.

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Pelvimetry was performed after delivery using a Siemens Somatom 2 computerised tomograph as described by Federle et al. With the patient in the supine position, an anteroposterior radiograph of the pelvis was done and then the transverse diameter of the pelvic inlet was measured. The computerised tomograph was then used to take an 8 mm axial cut at the level of the ischial spines and the interspinous distance was measured. Lastly a lateral digital radiograph was taken to measure the anteroposterior diameters of the inlet, the midpelvis and the outlet. Scanning factors were adjusted to ensure that the patients were subjected to the lowest possible irradiation during the procedure.

Patients with coupled contractions were then compared with patients with normal contractions. The unpaired Student’s t-test, the χ²-test or Fisher’s test was used to analyse the data. A value of 0.05 or less was regarded as significant.

Informed consent from all patients and approval from the hospital’s ethical committee was obtained.

Results
A total of 47 patients, of whom 24 fulfilled our criteria for coupled contractions, which were usually present throughout labour, were examined. The remaining 23 patients had normal contractions. The characteristics of the patients are shown in Table I.

There were no statistically significant differences in maternal age, height, gestational age or pelvic measurements between the two groups. Cervical dilatation at commencement of monitoring was 4.58 cm in the group with coupled contractions and 5.60 cm in the normal group (P = 0.004).

The mean duration of monitoring was 319 minutes in the patients with coupled contractions and 197 minutes in the patients with normal contractions (P = 0.0039). Duration of the second stage did not differ significantly between the two groups (P = 0.9321).

Total uterine activity (32 993.5 v. 17 284.7 kPa) was significantly higher in the group with coupled contractions (P = 0.0002). Mean activity, expressed in kPa/15 min (1 620.9 v. 1 416.9 kPa/15 min), did not differ significantly. Pelvic measurements were comparable.

Epidural anaesthesia was administered to 11 patients with coupled contractions and 3 with normal contractions. A larger number of patients with normal contractions required no analgesia (Table II). The frequency of oxytocin administration was similar in the two groups. Twelve patients in the coupled contraction group delivered normally, whereas 19 (82.6%) of the other group did so. Seven caesarean sections were performed in the group with coupled contractions, but none was required in the normal group. The total and mean uterine activity of the patients who had caesarean sections are given in Table III. Since the numbers were small, it was not possible to study the effects of oxytocin or epidural analgesia on the contraction pattern.

Discussion
By its graphic display of poor cervical dilatation, the partograph helps to detect abnormalities in the progress of labour. Lack of progress may be due to either incoordinate uterine activity or true cephalopelvic disproportion. Because poor progress is not uncommonly due to inadequate uterine contractions, several studies have recommended oxytocin augmentation when cervical

### TABLE I

| Patient and labour characteristics (mean ± SD) in the coupled contractions and the normal contractions groups |
|--------------------------------------------------|--------------------------------------------------|-----------------|-----------------|
| Coupled contractions (N = 24) | Normal contractions (N = 23) | Significance |
| Age (yrs) | 21.04 ± 3.15 | 21.56 ± 3.13 | P = 0.5709 |
| Height (m) | 156.85 ± 7.57 | 157.97 ± 6.68 | P = 0.5928 |
| Gestational age (wks) | 39.79 ± 0.50 | 39.29 ± 1.06 | P = 0.0496 |
| Cervical dilatation on admission (cm) | 4.58 ± 1.21 | 5.60 ± 1.11 | P = 0.0042 |
| Duration of monitoring (min) | 319.3 ± 151.9 | 196.9 ± 122.0 | P = 0.0039 |
| Duration of second stage (min) | 21 ± 12.37 | 20.65 ± 12.92 | P = 0.9321 |
| Total uterine activity (kPa) | 32,993.5 ± 16,044.4 | 17,284.7 ± 9,986.8 | P = 0.0002 |
| Mean uterine activity (kPa/15 min) | 1620.9 ± 388.4 | 1416.9 ± 474.5 | P = 0.1122 |
| Pelvimetry* | | | |
| Available brim area (cm²) | 98.74 ± 9.11 | 101.42 ± 11.36 | P = 0.4739 |
| Anteroposterior pelvic inlet (cm) | 11.08 ± 0.96 | 11.38 ± 0.74 | P = 0.315 |
| Transverse inlet (cm) | 11.33 ± 0.58 | 11.21 ± 0.75 | P = 0.6300 |
| Interspinous distance (cm) | 10.71 ± 0.88 | 10.20 ± 0.70 | P = 0.0861 |
| Anteroposterior midpelvis (cm) | 11.77 ± 0.95 | 11.8 ± 0.88 | P = 0.9296 |

*Computed tomographic pelvimetry was performed on only 18 patients with coupled and 17 with normal contractions.

There were no significant differences between the babies born to the mothers in the two groups (Table IV).
dilatation proceeds at less than 1 cm/h.\textsuperscript{11,12} However, oxytocin augmentation does not prevent poor progress in all patients without cephalopelvic disproportion.

We excluded inadequate contractions in both groups by demonstrating similar mean uterine activity. However, total uterine activity and duration of labour were longer in patients with coupled contractions. Since pelvic and fetal sizes were similar, the prolonged labour was probably caused by inco-ordinate uterine activity. Our results will be discussed along these lines.

Mean uterine activity during spontaneous labour is 1 100 kPa/15 min,\textsuperscript{1} and the median for the active phase of labour in nulliparas is 1 440 kPa/15 min.\textsuperscript{2} In both groups of patients in this study uterine activity exceeded 1 400 kPa/15 min. This indicates that any delay in progress was not due to weak uterine contractions.

Nulliparas with good cervical scores require a total uterine activity of 30 000 kPa for labour to progress favourably,\textsuperscript{14} a lower figure than the 32 993 kPa in our study group. Our lowest uterine activity levels were also the same in both groups. The fetal distress they also not confirmed in this study, since the Apgar scores were the same in both groups. The fetal distress they did not describe how the effects of uterine incoordination were analysed, they concluded that substantial degrees of uterine inco-ordination may be present in normal labour. Our study does not confirm these findings, but we were only investigating one aspect of the uterine contraction pattern.

It is unlikely that administration of oxytocin was responsible for the abnormal uterine action, since the number of patients in each group who received oxytocin was about the same, and in addition coupling of contractions was present before oxytocin administration commenced.

Apart from the study of Cronjé and Van der Westhuizen,\textsuperscript{15} which also indicated that coupling of contractions may be a sign of dysfunctional labour, few reports on this topic could be found in the literature. Degrees of inco-ordinate uterine activity have been described by Gibb and Arulkumar.\textsuperscript{2} These include compound contractions, a double hammock effect, and slow return to the normal baseline pressure. Although they did not describe how the effects of uterine inco-ordination were analysed, they concluded that substantial degrees of uterine inco-ordination may be present in normal labour. Our study does not confirm these findings, but we were only investigating one aspect of the uterine contraction pattern.

TABLE III. Labour characteristics of patients delivered by caesarean section

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total uterine activity (kPa)</td>
<td>2 197</td>
<td>435 100</td>
<td>44 104</td>
<td>33 880</td>
<td>56 766</td>
<td>21 670</td>
<td>36 534</td>
</tr>
<tr>
<td>Mean uterine activity (kPa/15 min)</td>
<td>1 156</td>
<td>1 526</td>
<td>1 575</td>
<td>1 613</td>
<td>2 270</td>
<td>1 140</td>
<td>1 304</td>
</tr>
<tr>
<td>Oxytocin</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Fetal position</td>
<td>LMA</td>
<td>ROA</td>
<td>LOA</td>
<td>LOA</td>
<td>LOP</td>
<td>ROA</td>
<td>LOA</td>
</tr>
<tr>
<td>Birth weight (g)</td>
<td>4 000</td>
<td>2 840</td>
<td>3 480</td>
<td>2 820</td>
<td>2 780</td>
<td>3 780</td>
<td>3 100</td>
</tr>
</tbody>
</table>

LMA = Left mento-anterior; ROA = right occipito-anterior; LOA = left occipito-anterior; LOP = left occipito-posterior.

TABLE IV. Neonatal characteristics of the two groups (mean ± SD)

<table>
<thead>
<tr>
<th>Coupled contractions</th>
<th>Normal contractions</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight (g)</td>
<td>3 007.75 ± 355.30</td>
<td>2 985.74 ± 532.60</td>
</tr>
<tr>
<td>Head circumference (cm)</td>
<td>32.83 ± 1.08</td>
<td>33.04 ± 1.19</td>
</tr>
<tr>
<td>Apgar score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 min</td>
<td>8.33 ± 1.57</td>
<td>8.78 ± 0.85</td>
</tr>
<tr>
<td>5 min</td>
<td>9.41 ± 1.10</td>
<td>9.65 ± 0.57</td>
</tr>
<tr>
<td>10 min</td>
<td>9.91 ± 0.28</td>
<td>9.86 ± 0.34</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>Female</td>
<td>13</td>
<td>14</td>
</tr>
</tbody>
</table>

Stookey et al.\textsuperscript{21} found a high incidence of fetal distress in patients with coupled contractions. This was also not confirmed in this study, since the Apgar scores were the same in both groups. The fetal distress they
described may be due to the fact that their patients had some degree of placental insufficiency. Prolonged contractions, as seen in coupled contractions, increase the period during which the oxygen supply to the placenta ceases and this will have a profound effect on fetal oxygenation if the placental reserve is poor. We selected normal primigravidae for our study, and it is unlikely that any of them had placental insufficiency.

Our study has demonstrated that patients with coupled contractions had a higher incidence of caesarean section for failure to progress despite cephalopelvic disproportion being absent and mean uterine activity being adequate. On the other hand, most of the patients with coupled contractions delivered normally in spite of their prolonged labour. This could mean that allowing labour to continue may eventually result in a vaginal delivery.

REFERENCES


Prevalence of hyaline membrane disease in black and white low-birth-weight infants


Abstract

Previous studies in South Africa and elsewhere have suggested that there are ethnic differences in the prevalence of hyaline membrane disease (HMD). This study compared the prevalence of HMD between black and white infants with birth weights of 1 000 - 1 749 g. A cohort of black and one of white low-birth-weight infants were enrolled at Baragwanath and Johannesburg Hospitals respectively. Black infants were found to have a higher rate of intra-uterine growth retardation. When compared according to either birth weight or gestational age categories, black infants had a significantly lower prevalence of HMD. For example, between 29 and 34 weeks' gestation 36.2% of black and 62.5% of white infants developed HMD (P < 0.001). The reasons for these differences are not clear, however, and require further study.

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The prevalence of respiratory distress caused by hyaline membrane disease (HMD) in pre­mature newborn infants appears to differ according to ethnic group. Previously reported figures from Cape Town have shown lower prevalences in black and mixed race infants than in white infants, as do data from the USA. In addition, there is evidence that the surge in the production of lecithin, which is the major constituent of surfactant, occurs earlier during the third trimester of pregnancies in black African women compared with white women in North America.

Local differences in the prevalence of HMD between white and black infants, when compared only in terms of birth weight, do not take into account the fact that a large number of black infants are growth-retarded. To show a true difference in the prevalence of HMD, it is therefore essential for gestational age to be assessed accurately.

Historically the vast majority of infants admitted to the neonatal unit at Johannesburg Hospital have been white, while those admitted to Baragwanath Hospital have been almost exclusively black. This enabled us to compare the prevalence of HMD by weight and gestation in white and black low-birth­weight infants born at two large hospitals in the Johannesburg area.