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-tip 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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Failure to progress in the active phase of labour is a common indication for caesarean section.[1] However, Friedman[2] 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.

However, 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,[3-5] these studies concentrated on work done by the uterus and not on contraction patterns as such.

A study by Labuschagne *et al.*[6] 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.

Cronjé and Van der Westhuizen[7] found that coupling of uterine contractions during labour was most common in primigravidas and was associated with fewer normal vaginal deliveries.

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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 (Gaeltec) 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 full 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 kPa/15 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.[8] 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 second stage, 1-, 5- and 10-minute Apgar scores, birth weights and UAI were recorded. The fetal head circumference was also measured immediately after birth.

After delivery all cardiotocographs were carefully examined for the presence of coupled contractions, defined as 2 or more contractions without any return to the baseline between the contractions on at least 3 occasions (Fig. 1). Since it has been demonstrated that irregularity of uterine contractions remains constant during labour,[6] 2 or more coupled contractions were regarded as representative of the contraction pattern throughout labour.

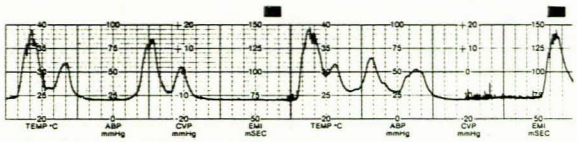

FIG. 1.
Tocograph demonstrating coupling of uterine contractions.

Pelvimetry was performed after delivery using a Siemens Somatom 2 computerised tomograph as described by Federle *et al.*[9] 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 χ^2-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.

TABLE II.
Analgesia and methods of delivery in the two groups

	Coupled contractions ($N = 24$)	Normal contractions ($N = 23$)	Significance
Analgesia			
Epidural	11	3	$P = 0,0293$
Pethidene	10	14	$P = 0,2088$
None	3	6	
Oxytoxin	9	7	$P = 0,8390$
Method of delivery			
Spontaneous	12	19	
Wrigley's forceps	3	2	
Ventouse	2	2	$P = 0,0192$
Caesarean section	7	0	

There were no significant differences between the babies born to the mothers in the two groups (Table IV).

Discussion

By its graphic display of poor cervical dilatation, the partogram helps to detect abnormalities in the progress of labour.[10,11] 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 (cm^2)	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.

TABLE III.
Labour characteristics of patients delivered by caesarean section

	Patient No.						
	1	2	3	4	5	6	7
Total uterine activity (kPa)	2 197	435 100	44 104	33 880	56 766	21 670	36 534
Mean uterine activity (kPa/15 min)	1 156	1 526	1 575	1 613	2 270	1 140	1 304
Oxytocin	No	Yes	Yes	No	Yes	Yes	Yes
Fetal position	LMA	ROA	LOA	LOA	LOP	ROA	LOA
Birth weight (g)	4 000	2 840	3 480	2 820	2 780	3 780	3 010

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

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

	Coupled contractions	Normal contractions	Significance
Birth weight (g)	3 007,75 ± 355,30	2 985,74 ± 532,60	$P = 0,8678$
Head circumference (cm)	32,83 ± 1,08	33,04 ± 1,19	$P = 0,5300$
Apgar score			
1 min	8,33 ± 1,57	8,78 ± 0,85	$P = 0,2338$
5 min	9,41 ± 1,10	9,65 ± 0,57	$P = 0,3653$
10 min	9,91 ± 0,28	9,86 ± 0,34	$P = 0,6099$
Sex			
Male	11	9	
Female	13	14	$P = 0,8653$

dilatation proceeds at less than 1 cm/h.[5,12,13] 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,[4] and the median for the active phase of labour in nulliparas is 1 440 kPa/15 min.[5] 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,[13] a lower figure than the 32 993 kPa in our study group. Our lowest uterine activity levels were also above the 650-700 kPa/15 min regarded as the minimum necessary for normal progress of labour.[5,14] It is therefore unlikely that poor uterine activity could have been responsible for the higher incidence of caesarean sections in our patients with coupled contractions. Height, gestational age, pelvic measurements, and fetal weight and head circumference could not have influenced the outcome of labour, since they did not differ significantly between the two groups.

Although more patients with coupled than with normal contractions received epidural analgesia, it is unlikely that the latter affected uterine activity, because the local anaesthetic solution contained no adrenaline.[15,16] Our numbers were too small to determine the effects of oxytocin or epidural analgesia on coupling of contractions.

Greater cervical dilatation at the onset of labour in the control group (about 1 cm further advanced) may have been responsible for both the shorter duration of monitoring and the lower total uterine activity in this group. However, since a difference of 1 cm in dilatation could mean about an hour's difference in the duration of the first stage of labour, the difference in total uterine activity was more than could be explained by the cervical dilatation alone.

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,[7] 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 Arulkumaran.[5] 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,[5] but we were only investigating one aspect of the uterine contraction pattern.

Pontonnier *et al.*[17] studied the regularity of the rhythm of uterine contractions and found no increase as dilatation progressed. They also found the index of uterine arrhythmia to vary from delivery to delivery, but, contrary to our finding, did not demonstrate an influence on the rate of cervical dilatation. However, it is not clear how they assessed the influence of regularity of contractions. Caldeyro-Barcia *et al.*[18] recorded uterine contractions by simultaneous intra-uterine and external methods in 18 women during normal, prolonged and false labour. They found that activity of the uterus in normal labour was usually synchronous on both sides of the uterus and in the upper and lower segments. Persistent asynchronism was characterised by slow progress. However, it is uncertain whether irregular and asynchronous contractions are similar.

Although Csapo[19,20] published extensively on the physiology of uterine contractions, he concentrated on contractions during pregnancy and the initiation of labour and did not address the implications of irregular contractions.

Stookey *et al.*[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 primigravidas 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.

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