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Maternal perception of fetal movements and real-time ultrasound findings

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Introduction

The registration of fetal movements by the mother is traditionally considered to be a useful method of monitoring the fetal well-being [8, 17]. Over the past decade the interest in recording fetal activity has increased both by semiquantitative standardization of maternal perception and by the development and application of new technologies [2, 7, 15].

In the past, the monitoring of fetal motor activity has been based on indirect methods of detection. These methods have included maternal perception [12], electromagnetic pressure sensors [2], observer palpation, strain gauge devices [23], tocodynometric transducers [21] and piezo-electric crystals [18].

Simultaneous monitoring of fetal movements with maternal perception and ultrasound was done by GETTINGER et al. for the first time [3] using one real-time ultrasound transducer. This was later repeated by HERTOGS et al. [4] applying two transducers simultaneously. Beginning in 1981 a prospective study was started in our department with simultaneous assessment of fetal motor activity by real-time ultrasound and maternal perception. A comparison of these two methods is described below.

Materials and methods

Fifty patients in the second half of pregnancy were monitored simultaneously with two ultrasound instruments. Thirty-three patients showed an uncomplicated course of pregnancy, seven suffered from threatened premature labor. The study included also one patient with toxemia, one patient with diabetes mellitus, and eight patients with growth retarded fetuses below the 10th percentile according to THOMSON et al., 1968 [20]. The age of the patients ranged from 18 to 39 years. All patients except nine had a meal before the examination. Thirty-nine examinations were done between 8 and 10 a.m. and 11 examinations between 4 and 6 p.m. The examinations were performed in a semi-recumbent position tilted to the left with a pillow to prevent vena cava occlusion syndrome. The design of monitoring the total fetal motor activity is shown in Fig. 1. This involved the use of two ultrasound instruments: i.e., M 2130 ADR, 3.5 MHz and Superscan 50 ROCHE-bioelectronics, 2.8 MHz. Monitoring also included registration of trunk movements, thoracic movements (breathing movements), movements of the upper and lower extremities, fetal heart frequency, and tocography. One ultrasound transducer with 10.7 cm active length was placed to record cross-sections of the lower thoracic region, the arms, and the trunk. Another transducer with 11.7 cm length likewise was placed to record the legs.

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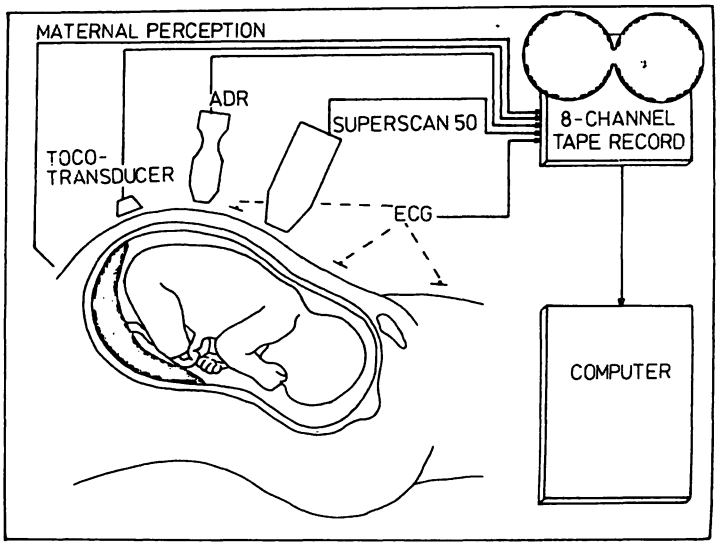

Fig. 1. Scheme of monitoring "total" fetal body movements with two ultrasound transducers and maternal perception of fetal movements simultaneously. In addition to this FHR and also tocographic findings were stored synchronously on a magnetic tape recorder.

Cases with fetal hiccoughs were excluded from the study. Movements were recorded as a single movement when the interval between two movements was less than two seconds. The beginning and the end of each fetal movement was marked by the patients and by the observers – "breathing" movements, body movements, movements of the upper and lower extremities were stored synchronously but separately on magnetic tape – using a push button system. Fetal movements were defined as "gross" movements when movements of the upper and/or lower limbs occurred simultaneously with body movements.

Results

The distribution of all 50 examined patients according to gestational age is shown in Tab. I. We observed 31 nulliparous and 19 multiparous women. In 23 cases the placental location was posterior, in 27 cases mainly anterior of the uterus. The mean weight of all examined patient was 65 kg (50.5 kg to 93.4 kg). In a total registration time of 18 hours 29 minutes 417 fetal body movements and 1,920 movements of the extremities were detected by ultrasound. A total of 2,337 movements (i.e. combined or isolated movements of fetal body and/or the extremities excluding

Tab. I. Number of examined patients according to gestational age (weeks).

Gestational age (weeks)	⩽ 31	32–34	35–37	38–40
Number of patients	6	10	22	12

fetal "breathing") could be detected sonographically. Most of the movements of the extremities (1515/1920 = 79%) were part of "gross" movements of the fetuses. Later analysis of magnetic tape recordings showed alltogether 822 discernable single movements.

A mean of 17.1 mvts/22 min. could be observed with a range of 0 to 60 mvts. There was one case with an intrauterine growth retarded fetus in which no fetal movement activity could be detected during the whole examination time. But there was also one unaffected fetus which showed no movements at all. Tab. II shows the relationship of fetal trunk movements to movements of the extremities. In 86% of all body movements the "gross" body movements were registered sonographically. Isolated movements of the extremities occurred in only 14% (upper extremities) and in 7% (lower extremities) respectively. Of all discernable single movements monitored by ultrasound the mothers registered 37%. A maximum maternal perception of 63% was noted in the group of fetal "gross"

Tab. II. Incidence of body movements, "gross" movements (i.e. movements of fetal body and simultaneous movements of the extremities) and movements of the upper and lower extremities detected by ultrasound examination.

	Number	
All body movements observed	417	100%
Body movements combined with movements of the extremities, i.e. the "gross" movements	361	86%
Body movements without movements of the extremities	56	14%
All movements of the extremities observed	1920	100%
Movements of the upper and/or lower extremities with body movements synchronously	1515	79%
Upper extremities only	270	14%
Lower extremities only	135	7%

Tab. III. Maternal perception of different fetal single movements ("gross" movements, trunk movements and isolated movements of the extremities).

Perception of all single movements (excluding "breathing")	305/822	37%
Perception of "gross" movements	226/361	63%
Perception of isolated trunk movements	18/56	32%
Perception of movements of the upper extremities	40/270	15%
Perception of movements of the lower extremities	21/135	16%

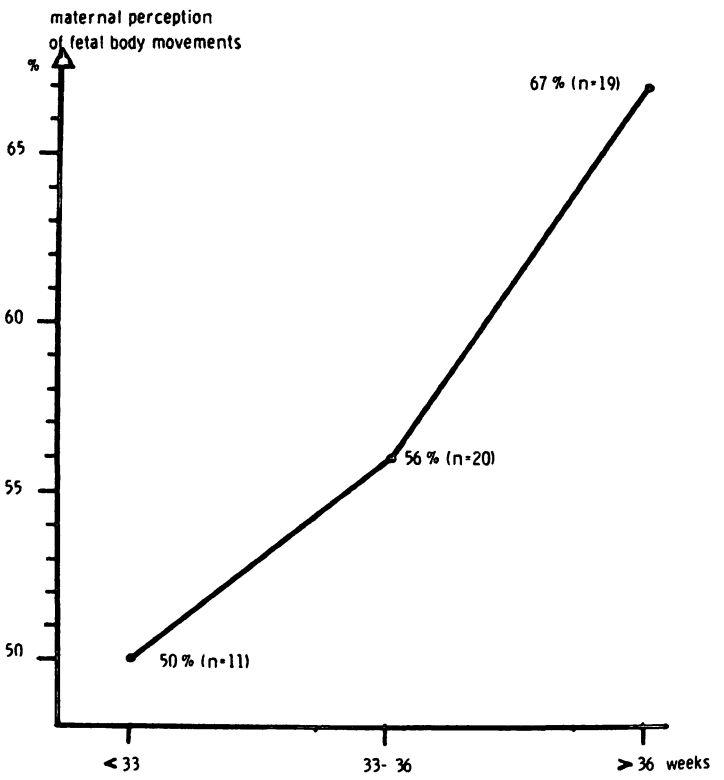

Fig. 2. Maternal perception of fetal body movements and gestational age ($p < 0.01$ between both groups < 33 weeks and > 36 weeks).

movements. Fetal body movements without simultaneous movements of the extremities were felt by the mothers in 32% and isolated movements of the extremities were felt in only 15% (cf. Tab. III).

The push button system was used by the mothers 764 times (the push-button systems were used several times by the mothers during fetal "gross" body movements), indicating correct perception of fetal movements in 536/764 (70%) whereas the push button system was used without sonographically detectable movements of the fetus in 228/764 (30%) instances (cf. also Tab. IV). Most instances of correct maternal perception occurred with synchronous fetal body movements (81%). Of those patients with falsely registered movements, no reason could be ascertained in 47%. Fetal "breathing" was present in 35% and contractions demonstrated by tocography was noted in the remaining 18%. With increasing gestational age the mothers showed a more accurate perception of fetal movements (cf. Fig. 2) ($p < 0.01$ between < 33 weeks and > 37 weeks, chi^2-test). According to parity, multiparous women registered fetal body movements in 73% whereas nulliparous women detected only 51% of fetal body movements ($p < 0.001$, chi^2-test). No difference of maternal perception of fetal movements could be shown with reference to placental location or obesity of the mother.

Tab. IV. Correct positive and false positive maternal perception of fetal movements.

Push-botton system used by the mother (including several perceptions during "gross" movements)	764	100%
Correct maternal perception	536	70%
False positive maternal perception	228	30%
Correct positive perception in relation to body movements with/or without limb movements	435/536	81%
Isolated movements of the upper and/or lower limbs	101/536	19%
False positive maternal perception in relation to contractions	42/228	18%
Fetal "breathing"	80/228	35%
Without detectable reason	106/228	47%

Discussion

The usefulness of maternal perception of daily fetal motor activity has been proposed by many authors [1, 5, 10, 13, 16]. Other methods of recording fetal movements have also been described [6, 11, 14, 15, 19, 23]. The difficulties of

retrospective evaluation of fetal movements by cardiotocography have been pointed out [9]. It was reported that 90% of fetal movements were overlooked. Another group [15] using an electromagnetic device stated that on the average, patients felt 87% of the observed movements. With two highly sensitive piezo-electric sensors they were able to improve the detection rate of fetal movement to 90.4% [18].

The subjective maternal perception was compared with the real-time ultrasound assessment of fetal movements by another study group [3]. There was a significant positive correlation between the number of movements recorded by both methods. One problem with this study was that the 95% confidence limits were rather wide. Additionally, a mean of 57% of fetal movements detected by ultrasound were not perceived by the respective mothers. HERTOGS et al. (1979) [4] were the first to assess "total" fetal motor activity simultaneously with two ultrasound transducers. They compared their findings to maternal perception. In their study the patients perceived a mean of 33% of all movements detected by real-time ultrasound. They showed that the probability of a movement being perceived increased with the number of fetal parts moved. A maternal perception of only 8% for movements of an isolated fetal part to a high of 63% for major movements; i.e., movements of all four fetal extremities was demonstrated. They found no statistically significant differences in maternal perception with regard to parity, gestational age, placental location and obesity of the mother.

In our study a modified examination procedure comparable to that of HERTOGS et al. (1979) [4] was used first. "Total" fetal motor activity was registered by two observers and maternal perception of fetal movements was stored simultaneously. Of all movements detected by ultrasound the mothers perceived a mean of 37%. "Gross" body movements were perceived in 71% whereas isolated movements of the trunk and isolated movements of the extremities were perceived in only 32% and 15% respectively. Thirty percent of the maternally perceived movements were without a sonographically detectable fetal movement. In 18% of false positive maternal assessments, a uterine contraction was registered on the tocographic chart. Another 35% demonstrated fetal "breathing" activity and in 47% the mother used the push button without a detectable reason.

To a great extent our findings are in agreement with the results of HERTOGS et al. [4]. They are contradictive to other data [13] where only one ultrasound transducer was utilized. This may have been due to an unknown number of fetal movements missed by the observer himself. The same author [13] found no false positive reporting of fetal movements by the mothers. This, however, we could not confirm. In our study, besides maternal perception, real-time ultrasonography and tocodynometry were employed to monitor synchronously all combined or isolated fetal movements, "breathing" movements and uterine contractions. It is our opinion that the use of these additional techniques helps to assess maternal perception more reliably and objectively.

In contrast to HERTOGS et al. (1979) [4] we found a higher rate of perception of fetal movements in multiparous patients than in nulliparas ($p < 0.01$). A more accurate perception of fetal body movements was also observed with increasing gestational age ($p < 0.01$). Maternal sensitivity to fetal movements did not seem to depend on maternal age, placental location or obesity. The results of this study suggest that most mothers are reliably reporting "gross" fetal body movements whereas isolated movements of the extremities or the fetal trunk might not be felt by the mothers. Furthermore, fetal "breathing", BRAXTON-HICKS contractions and perhaps passive fetal displacement may lead to false registration of fetal movements by the mother. Psychological as well as physical factors may also increase maternal sensitivity to fetal movements [22]. These factors along with the relatively high rate of false positive perceptions should be considered if the mother's record of daily fetal movements is used as a method of fetal monitoring.

Summary

Two real-time ultrasound instruments were used simultaneously for comprehensive recording of "total" fetal motor activity in 50 patients in the second half of pregnancy. Synchronously, cardiotocographic findings and maternal perception of fetal movements were stored on magnetic tape. In most cases fetal "gross" movements were perceived by the mothers (mean: 63 %). Isolated movements of fetal extremities were reported by the mother in only about 15 % of all cases. Mothers registered a total of all movements in 37 %. We found a statistically significant difference in the percentage of perceived fetal movements with regard to parity ($p < 0.001$) and with regard to gestational age ($p < 0.01$). With multiparity or an increasing gestational age the body movements of the fetuses were felt more accurately by the mothers. In 30 % of all cases the mothers perceived movements without sonographic confirmation.

The findings of this study suggest that maternal perception of major fetal body movements is accurate in the majority of cases. However, the relatively high rate of false positive maternal perception should be taken into consideration if the maternal record of daily fetal movements is to be used for fetal monitoring.

Keywords: Fetal monitoring, fetal motor activity, maternal perception, real-time ultrasound.

Zusammenfassung

Mütterliche Perzeption der fetalen Bewegungen und Real-Time-Ultraschall-Ergebnisse

Die totale fetale Bewegungsaktivität wurde bei 50 Müttern in der zweiten Schwangerschaftshälfte durch die simultane Untersuchung mit zwei Ultraschallgeräten erfaßt. Zeitsynchron hierzu wurde ein Kardiotokogramm abgeleitet und die mütterliche Perzeption fetaler Bewegungen auf Magnetband gespeichert. In der Vielzahl der Fälle wurden sog. „Gross"-Körperbewegungen durch die Mütter selbst festgestellt (durchschnittlich: 63 %). Dagegen wurden isolierte Extremitätenbewegungen nur in 15 % von den Müttern registriert. Von allen sonographisch nachweisbaren Bewegungen fühlten die Mütter nur 37 %. Statistisch signifikante Unterschiede konnten zwischen nulli- und multiparen Frauen festgestellt werden ($p < 0.001$). Ebenso wurden Fetalbewegungen gegen Ende der Schwangerschaft signifikant deutlicher wahrgenommen als zu Beginn des letzten Schwangerschaftsdrittels ($p < 0.01$). In 30 % betätigten die Mütter das Knopf-Druck-System ohne den sonographischen Nachweis einer fetalen Bewegung.

Diese Ergebnisse zeigen, das sog. fetale Ganzkörperbewegungen zumeist durch die Mütter selbst erkannt werden können. Allerdings sollte die relativ hohe Rate falsch-positiver mütterlicher Registrierungen immer mit berücksichtigt werden falls zur fetalen Zustandsdiagnostik die Registrierung fetaler Bewegungen durch die Mütter verwendet wird.

Schlüsselwörter: Fetale Bewegungsaktivität, fetale Zustandsdiagnostik, mütterliche Perzeption, Real-Time-Ultraschall.

Résumé

Perception maternelle des mouvements fœtaux et données échographiques en temps réel

Deux appareils d'échographie en temps réel ont été utilisés simultanément afin d'enregistrer la totalité de l'activité fœtale motrice chez 50 patientes au cours de la seconde moitié de la grossesse. On a enregistré simultanément sur bande magnétique les données cardiotocographiques et la perception maternelle des mouvements fœtaux. Dans la plupart des cas, les mouvements globaux du fœtus sont perçus par les mères (en moyenne: 63 %). Les mères ne signalent les mouvements isolés des extrémités du fœtus que dans 15 % des cas. Les mères perçoivent 37 % de la totalité des mouvements fœtaux seulement. On a trouvé des différences statistiques significatives entre les pourcentages des mouvements fœtaux perçus en ce qui concerne la parité (p 0,001) et l'âge gestationnel (p 0,01). En cas de multiparité ou à mesuré que l'âge gestationnel progresse, les mouvements fœtaux furent perçus plus distinctement par les mères. Dans 30 % des cas, les mères perçoivent des mouvements sans qu'il y ait confirmation échographique.

Les données de cette étude suggèrent que la perception maternelle des mouvements importants du corps du fœtus est appropriée dans la majorité des cas. Néanmoins, on devrait prendre en compte le pourcentage relativement élevé de faux positifs dans la perception maternelle lorsque l'on utilise l'enregistrement quotidien par la mère des mouvements fœtaux pour la surveillance du fœtus.

Mots-clés: Activité motrice du fœtus, échographie en temps réel, monitoring fœtal, perception maternelle.

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