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Maternal Counting of Fetal Movements as an Antenatal Screening Test. Part I: A Review

SUMMARY

The author reviews use of maternal counting of fetal movements as an antenatal screening test. This test appears to be a sensitive indicator of fetal well-being and a useful method for preventing inexplicable stillbirths. Evidence suggests that it should be considered a routine antenatal screening test for all pregnant women, and not just for those at high risk for perinatal morbidity and mortality. Screening should begin at 28 weeks gestation. (*Can Fam Physician* 1988; 34:561–565)

RÉSUMÉ

L'auteur passe en revue l'utilisation du décompte des mouvements foetaux comme test de dépistage prénatal. Il semble que ce test soit un indicateur sensible du bien-être du foetus et une méthode utile pour prévenir la mortinatalité inexplicable. Les constatations suggèrent que ce test de dépistage prénatal devrait être fait systématiquement chez toutes les femmes enceintes et non seulement chez celles à haut risque de morbidité et de mortalité périnatales. Le dépistage devrait débuter à 28 semaines de grossesse.

Key words: fetal movement, antenatal screening, stillbirth

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DESPITE the marked reduction in fetal mortality during the last decade, fetal death still remains a major problem. In many circumstances, such as pre-eclampsia and diabetes mellitus, chronic fetal distress can be predicted. However, many cases of intrauterine death occur in pregnancies considered to be at low risk with apparently normal fetuses.[1]

While, in theory, preventable stillbirths might be kept to a minimum by universally applying antepartum tests of fetal well-being (e.g., non-stress testing, contraction-stress testing, biophysical profile) such an approach is neither practical nor necessarily desirable. On the other hand, the use of maternal perception of fetal movements may well be a simple reliable indicator of well-being, easily employed in a large population.

The purpose of this article is to review maternal perception of fetal movement as a screening test for fetal distress.

Fetal Movement as an Indicator of Fetal Well-Being

One of the first records of fetal movements can be found in the Bible (*Genesis:* 25), when Rebecca, the wife of Izhak, reported: "and the children struggled within her". The first recent description of the significance of daily fetal movement was written by Sadovsky and Yaffe.[2] They examined women who had chronic maternal disease and used fetal-movement counts to detect fetal disease. They suggested that except in the case of very low daily rates of movement, there is no significance to the actual number of movements. Each fetus has its own rhythm and rate of movement. However, a "movement alarm signal", based on a substantially decreased number of movements, may be a harbinger of fetal demise. This movement alarm signal is based on the assumption that before fetal death occurs, there is an interval during which the movements of the hypoxic fetus are reduced or cease altogether. They suggested that the fetal movements be recorded during three intervals throughout the day: one hour in the morning, one hour at noon, and one hour in the evening. The sum of three counts is then multiplied by four to give the "daily fetal-movement record" (DFMR). Sadovsky also studied daily fetal movements in 80 cases of normal and pathological pregnancies.[3] The DFMR was calculated as described above. A majority of women (65) had constant DFMRs, ranging between four and 840/day. Several women showed fluctuations of about 30–40 fetal movements/day. In this latter group 15 women developed movement alarm signals. These alarm signals were manifested by a decrease in fetal movements up to their cessation (while fetal heart beats remained

audible). Fourteen of these 15 patients were high risk; one was low risk.

Fetal death in utero occurred in 10 of the 15 patients who manifested the "-alarm signal". The other five fetuses were delivered alive, vaginally or by Caesarean section, as soon as the movement alarm signal was observed. Of the 10 stillbirths, the authors believed that five infants could have been saved if they had been delivered promptly. The other five were of low birth weight and either not viable or malformed. In the women studied, the movement alarm signal always preceded fetal death. The duration of the movement alarm signal in the cases that were not delivered was one day (eight cases), two days (one case), and 12 days (one case).

Following this study, Sadovsky and Polischuk[4] studied 30 pregnant women in their third trimester in whom fetal movements were reduced up to cessation for at least 12 hours. The fetal heart rate tracing, 12–48 hours after cessation of fetal movements, was pathological in 21 cases and normal in 9 cases. The most frequent pathological fetal heart-rate changes were loss of beat-to-beat variability and variable decelerations. This finding suggested that fetal heart-rate tracings (non-stress tests) should be used as an adjunct to fetal-movement recording.

In 1976, Pearson and Weaver[5] developed the 12-hour daily fetal-movement count (DFMC) as a test of antepartum fetal well-being. They suggested that the lower limit of normal was 10 fetal movements during the 12-hour period, or 2 standard deviations from the mean. In their study of 61 women, they found that a normal DFMC in a population at risk was associated with a satisfactory outcome. A low DFMC was associated with a high incidence of fetal asphyxia, and where fetal death occurred, fetal movements were noted to have diminished rapidly and stopped 12–24 hours before death.

Movement alarm signals (MAS) provide the physician with at least 12 hours in which to intervene.[6] Fetal heart-rate changes occur anywhere from one to four days after the movement alarm signal. In small-for-dates babies, death is unlikely to occur until fetal movement falls below the threshold (10 movements/12 hours).[7,8] Lower fetal-movement counts may also be associated with maternal cigarette smoking and prolonged pregnancy.[9]

A number of factors seem to influence fetal movement. Smoking and prolonged pregnancy reduce fetal movement, whereas a glucose load tends to cause significant increase in fetal activity.[9,10] The time of day or maternal position may affect fetal activity. Minors and Waterhouse[11] found that fetal movement increased throughout most of the day to reach a peak in the evening. They found that the mothers detected most movement when they were lying, fewer when they were sitting, and fewest when they were standing. Roberts and colleagues[12] defined a circadian rhythm in which fetal trunk movements peaked between 22:00 hours and 01:00 hours. Nevertheless, the efficacy of daily fetal-movement counts is underscored by the fact that at least 87% of all fetal motions can be perceived by the mother. Gestational time is related to fetal movement. Jarvis and colleagues[10] reported that perceived fetal activity is greatest at around 33 weeks gestation. This finding was also suggested by Pearson and Weaver.[5] It may be attributable to a maximal intrauterine volume between the 28th and 32nd weeks. A gradual decrease in the total amount of fetal motion may be expected thereafter.

There is good correlation between maternal perception of fetal movements, fetal movements as documented by real-time ultrasonography, and non-stress testing in both low-risk and high-risk pregnancies.[14–17]

Good correlation between maternal perception of fetal movements and a reactive non-stress test in the prediction of fetal distress in high-risk pregnancies has been demonstrated.[18,19] Timor-Tritsch and colleagues[17] found that fetal movements lasting longer than three seconds were associated with a heart-rate acceleration on the non-stress test in 99.8% of normal pregnant women. Rayburn[14] found that 82% of all movements of fetal limbs visualized by ultrasonography were detected by the patients. All combined motions of the fetal trunk with limbs were perceived by the patients and described as strong movements. Clusters of isolated weak motions of the fetal limbs were less accurately perceived (56%). Rayburn concluded that a woman's perception of fetal movement is both reliable and related to the strength of the lower-limb motion. His patients also felt reassured by the presence of active movement.

In a landmark study, Neldam[18] examined the value of maternal monitoring of fetal movements in 2250 pregnant women. In a randomized clinical trial, half of the patients were allocated to the experimental group and half to the control group. Women in the experimental group were asked to count fetal movements for one hour (two hours after main meals, while lying down). They were instructed to count fetal movements once a week in the morning, at noon, or in the evening until the thirty-second week of pregnancy. Thereafter they were asked to count fetal movements three times a week. The women in the experimental group were asked to call the hospital if they felt fewer than three movements/hour.

The control group was not specifically instructed in counting fetal movements, but the participants were always asked at their regular antenatal visits whether they were feeling fewer fetal movements. In the control group there were eight intrauterine deaths in infants with a weight of more than 1500 grams and without major malformations, but no deaths in the group with maternal monitoring of fetal movements ($p < 0.01$).

In a continuation of his work Neldam[19] carried out a prospective randomized clinical trial involving 3332 pregnant women. Half of the women were assigned to the experimental group and given written information and instructions about fetal-movement counting. These instructions were exactly the same as those given in Neldam's previous study.[18] As before, the women in the control group were not specifically instructed in the method of counting fetal movements, but were always asked whether they felt fewer fetal movements. There were no significant differences between the treatment group and the control group in maternal age, maternal weight gain, or parity; nor were there any significant differences between the treatment and control groups in preeclampsia, chronic hypertension, renal disease, heart disease, pre-term labour, antepartum hemorrhage, multiple pregnancy, hydramnios, diabetes mellitus, previous stillbirth, and post-term pregnancy. Finally, there was no significant difference in the mode of delivery, comparing vaginal deliveries, vacuum extractions, total instrumentation deliveries, and Caesarian sections. In the control group 12 fetuses which weighed

more than 1500 grams and had no major congenital malformations died, compared to three in the experimental group ($p < 0.05$).

The usefulness of fetal-movement monitoring in decreasing perinatal mortality in low-risk pregnancies has recently been confirmed in a case-control study conducted by Westgate.[20] The unexplained stillbirth is an increasing contributor to perinatal mortality, and it is in the detection of this group of at-risk fetuses that fetal-movement monitoring has a central function.

In a retrospective study[21] Rayburn correlated fetal activity with perinatal outcome (Table 1).

Fetal-Movement Monitoring

A variety of methods of maternal monitoring of fetal activity have been proposed. These are illustrated in Table 2.

The movement alarm signal varies considerably from method to method. However, both Sadovsky and colleagues[2] and Pearson and colleagues[5] have shown that the fetal heart continues to beat for 12–48 hours after fetal movements ceased.

The number of daily movements in healthy fetuses may vary from 10 to 1000 movements/day. Movement counts as low as four to 10 per day may be consistent with an uncompromised fetus with no obvious abnormalities, as long as this low-activity level remains constant.[21] The number of movements perceived by the mother will depend on the type of fetal movement. As mentioned earlier, entire fetal body movements and trunk-and-extremity movements are detected more frequently than are isolated extremity movements. The classification of fetal movements is given in Table 3.

In the methods discussed, it has been the policy to instruct the mother to count all fetal movements including strong, weak, sustained, short, rapid, and hiccoughs. No attempt has been made to classify one category as more predictive of fetal well-being than another.

Discussion

The most convincing evidence for the use of maternal counting of fetal movements as an antenatal screening has been presented by Neldam.[18,19] His records represent the only randomized controlled studies that have been undertaken to date. The other studies are descriptive in nature (Table 2). Ideally, screening should begin at the time of fetal viability: that is, at approximately 28 weeks gestation. If screening is begun, it must be continued on a daily basis until the end of pregnancy. This will increase the sensitivity of the test. If a movement alarm signal is noted, or if there is a marked decrease in fetal movements from the previous day, further evaluation should be carried out. Ideally, a significant decrease in fetal movement should be followed by an immediate non-stress test or biophysical profile, if the equipment needed is available, or by referral to a tertiary-care centre if it is not.

Neldam reported[18,19] there was a significant decrease in the number of antenatal deaths recorded in the monitored group. Obviously, not all stillbirths can be prevented by this technique. Acute cord accidents, abruptio placentae and other acute events contribute to perinatal mortality and are essentially non-preventable. Neldam's work suggests, however, that a significant number of stillbirths can be prevented by the use of this screening test in all pregnant women. It would be worthwhile to try to reproduce the data. A national co-operative study with a study design similar to Neldam's could be undertaken in Canada.

The diversity of methods suggested for monitoring and variable definition of 'movement alarm signal' are a source of confusion to physicians. I prefer the method used by Pearson and Weaver[5] for several reasons:

- it provides definite evidence of the change in fetal movements over days and weeks that may be missed if values are simply recorded;
- it allows the patient to carry on with her daily activities without specific periods of lying down and observing counts (thus increasing patient compliance and decreasing the chance of the patient going to sleep while counting the fetal movements); and
- it demands daily recording and suggests further testing after only one day of abnormal movement (in contrast to Neldam's method[19] which might possibly leave a fetus in distress for up to 48 hours).

I encourage patients to bring their fetal-kick chart to every prenatal visit after 28 weeks gestation. Thus the fetal-kick chart becomes an integral part of

Table 1
A Predictive Value of Prior Fetal Movement Patterns and Unfavourable Perinatal Outcomes in 1161 High-Risk Pregnancies

	Prior fetal activity pattern			
	Inactive[a]		Active	
Unfavourable perinatal sign	(n = 46, 5%) No.	%	(n = 1 115, 95%) No.	%
Stillbirth	16/46	35	7/1 115	0.6
Abnormal Intrapartum fetal heart-rate pattern	7/30	23	76/ 846	9
Caesarean section for fetal distress	11/30	37	42/ 846	5
5-Min Apgar score <6	22/46	48	66/1 115	5
Severe intrauterine growth retardation	13/46	28	32/1 115	3
Any of the above signs	25/46	54	99/1 115	9

Source: Rayburn (Reference 21).
a. Inactivity was defined as three or fewer perceived fetal movements/hour for two consecutive days.

the prenatal record, and its importance is emphasized to the patient. I ask patients to call me if they have not felt 10 fetal movements by 9 p.m. on any single day. With knowledge of the patient's history and with further careful questioning it can usually be determined whether the patient's report is a reliable estimate of the true fetal activity. If it is, a non-stress test or biophysical profile should be performed immediately. If uncertainty exists, the patient should be instructed to lie down and count the number of movements for one hour. As some authors[11,12] believe that late evening is a time of increased fetal activity, a one-hour count of less than three movements should dictate immediate evaluation by means of a non-stress test or biophysical profile. Thus, if uncertainty exists, two methods of antenatal fetal-movement assessment can be used consecutively.

Table 2
Methods Recommended for the Maternal Recording of Fetal Activity

Authors	Ref. No.[a]	Method of recording	Evidence of Fetal Inactivity	Study Design
Sadovsky and Polishuk	6	30 min. to 1 hr. two to three times daily	< 3 movements/ hr.	Descriptive
Rayburn et al.	15	≥ 1 hr. (when convenient each day)	≤ 3 movements/ hr. for 2 consecutive days	Descriptive
Leader et al.	22	30 minutes, 4 times daily	1 day of no movements or 2 successive days/week in which there are ≤ 10 movements/ hr.	Descriptive
Pearson & Weaver	5	12 hours, 9:00 AM–9:00 PM daily	≤ 10 movements/ 12 hrs.	Descriptive
Neldam	18,19	One 2-hr period, 3 times weekly	≤ 3 movements/ hr.	Randomized, controlled
O'Leary & Andrinopoulos	23	3 half-hour periods	0–5 movements/ 30 min. for each of 3 periods	Descriptive
Harper et al.	16	Three 1 hr. periods daily	Complete cessation	Descriptive

Source: Adapted from Rayburn (Reference 21).
[a] See References, p. 565.

Table 3
Classification of Perceived Gross Fetal Body Motions

Motion	Ultrasound Findings	Duration	Strength	Patient Description
Rolling or rotating	Entire fetal body	Sustained (3–30 sec)	Strong	"Roll-over stretch"
Simple	Trunk and extremity	Short (1–15 sec)	Strong	"Kick, jab, startle"
High frequency	Isolated extremity	Rapid (less than 1 sec.)	Weak	"Flutter, weak kick"
	Chest Wall			"Hiccough"

Source: Rayburn (Reference 21).

When fetal movement is used as a screening test for fetal well-being, it is important for the method to be acceptable and convenient for the pregnant woman. Compliance estimates have ranged from 50% to 83%.[16] In my patients, maternal compliance has been approximately 85%.

In addition, one must consider the potential risk of producing excess maternal anxiety by daily fetal-movement counting. This anxiety could ultimately lead to excess catecholamine production and actually produce fetal distress. In fact, a woman might not react on feeling less movement because of a fear of the consequence of such an observation, even though she has received clear instructions on counting and on the proper response to feeling less movement.

Neldam[19] did not find increased rates of acute Caesarean section, elective Caesarean section, or instrument delivery in his experimental group. However, he did not report the difference in the rate of syntocinon induction between treatment and control groups. This rate may be significantly higher in women who monitor their fetal movements on a daily basis, and is thus a potential risk.

Conclusions

It appears that the potential benefits of daily fetal movement monitoring to both high- and low-risk patients outweigh the potential risks. However, Neldam's studies[18,19] are the only randomized, controlled trials yet undertaken. Verification by further randomized, controlled trials would be useful. ◉

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