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Fetal Movement Assessment

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Maternal perception of fetal movements is the oldest and most commonly used method to assess fetal well-being. While almost all pregnant women adhere to it, organized screening by fetal movements has seen variable popularity among health professionals. Early results of screening were promising and fetal movement counting is the only antepartum testing method that has shown effect in reducing mortality in a randomized controlled trial comparing testing versus no testing. Although awareness of fetal movements is associated with improved perinatal outcomes, the quest to define a quantitative "alarm limit" to define decreased fetal movements has so far been unsuccessful, and the use of most such limits developed for fetal movement counting should be discouraged.
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Fetal Movements as a Sign of Fetal Well-Being

Maternal perception of fetal movements (FM) is the oldest and most commonly used method to assess fetal well-being.[1] In most communities today, it is performed as unstructured screening to which almost all pregnant women adhere. Among women who have delivered a live-born baby, more than 99% agreed with the statement that it was important to them to feel the baby move every day.[2] When they screen themselves as "positive" for decreased fetal movements (DFM), most will present their concerns to their health care provider with the expectation of further evaluations. There is little doubt that normal FM are a highly specific indicator of fetal viability, and conversely, as we discuss elsewhere in this issue of *Seminars in Perinatology*, that women presenting with DFM are at increased risk of perinatal complications, specifically, stillbirth, fetal growth restriction, and associated conditions.

Despite the popularity among women, formal or organized screening of FM has seen very variable popularity among health professionals through the last decades.[1] One in six Australian obstetricians and one in three UK obstetricians believe screening of FM is of no benefit,[3] and many contemporary guidelines for antenatal care actively discourage the use of formal fetal movement counting (FMC).[4,5] The purpose of FMC may be broadly divided into two understandings: on one hand, it may be an organized effort to promote awareness among pregnant women and ensure vigilance to FM on a daily basis, and thus, to support the ongoing screening by subjective perceptions of DFM. Alternatively, a more formal approach to FMC is to implement a structured chart together with specified quantitative "alarm limits," or definitions of DFM. If these "alarm limits" are reached, women are expected to present their concerns regarding DFM to their health care provider. This latter approach to FMC was expected not only to bring along the improved awareness of FM but also to substitute fallible subjective maternal perceptions with objective measures of DFM. Neither of the two implementations of FMC would introduce a "new" screening but only attempt to improve the value of the existing "self-screening" performed by pregnant women. Although the latter un-

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derstanding of formal FMC has been favored in research, the design of the research undertaken has purposely or accidentally been unable to separate these two effects.

In this article we aimed to review the effects of FMC in stillbirth prevention and to discuss which aspects of FMC may be beneficial and which are probably not.

Studies of Stillbirth Prevention by Fetal Movement Counting

There have only been two studies in total populations (all pregnancies) and two studies in mixed low-risk and high-risk populations evaluating the effect of FMC for all versus no FMC. In the total population studies, both were conducted as prospective cohorts with a control period followed by an intervention period. In 1986, Westgate and Jamieson in New Zealand reported a relative risk of stillbirth of 0.76 (0.55-1.04), and 0.56 (0.35-0.90) for stillbirths perceived as avoidable.[6] In 1989, Moore and Piacquadio in the US reported the first part of their study, and in 1990, the final results, with the equivalent risks as 0.42 (0.23-0.76) and 0.25 (0.07-0.88).[7,8] The two studies in mixed populations were both conducted in single institutions. In 1983, Neldam in Denmark published the final results of his randomized controlled trial[9,10] as part of his PhD thesis from 1986.[11] He reported a relative risk of stillbirth, and of avoidable stillbirths, of 0.25 (0.07-0.88) and 0.27 (0.08-0.93), respectively. This is, in fact, the only randomized controlled trial to date of antepartum testing of any kind versus no testing that has reported reduced mortality. However, as the randomization procedure was based on the mother's initial booking number (even or odd numbers), some investigators find the study methodologically flawed.[12] We postulate that the probability of manipulation of the sequence in which pregnant women were referred and booked for antenatal care at the National Hospital of Copenhagen to be exceedingly small. In 1985 Lobb and coworkers in the UK reported the comparison of two units at Liverpool Maternity Hospital with "competing" protocols based on a preexisting difference in protocol, and the unit advocating FMC had the relative risks of 0.92 (0.6-1.35) and 0.86 (0.49-1.52).[13]

Yet, such encouraging results from cohort studies of whole populations and a randomized controlled trial have been overshadowed by negative findings from a study that deserves further discussion. In 1989 Grant and coworkers published a large cluster-randomized controlled trial comparing FMC in a total population versus FMC only for risk pregnancies in the same population.[14] They found no effect of their intervention. Although this was not a study of FMC compared with no FMC, it is without doubt the most referenced and influential[1] publication on FMC and is often misinterpreted as evidence against FMC in guidelines for antepartum care.[4,5] The use of FMC in both arms of the study (for all versus for risk pregnancies), as well as the use of "within hospital" clusters, in which pregnant women in the same community were either urged to perform FMC or informed in writing about their inclusion in a FMC study in which they were not supposed to count FM, must have led to significant contamination between the groups. Overall, perinatal mortality decreased during their study period, falling to 2.8/1000 compared with 4/1000 before the intervention.

In the cluster-randomized trial, the mean time participants used to count their requested 10 FM was 162 minutes, and the "alarm limit" for when to contact health professionals was absence of FM for 1 day or less than 10 FM in 10 hours for two consecutive days. Only 60% of women were compliant with daily counting, and one in two compliant to the alarm limits among the 8.4% that reported DFM.[14] In comparison, Moore and Piacquadio reported the same year that the mean time to count to 10 was 20 minutes with a compliance to counting of 94%, and 15.5% of women reported DFM. In their study, women were instructed to present for further evaluations if they had not perceived 10 FM within 2 hours.[7] This evokes the next question: are these two interventions at all comparable? It is unlikely that both of these methodologies are equally suitable for screening purposes in total populations.

Methods and Alarm Limits for Maternal Fetal Movement Counting

The concept of maternal FMC in the third trimester is based on the presumption that maternal perception of FM accurately reflects fetal activity or at least gross fetal body or limb movements. A range of methodologies from piezo-electric crystals to ultrasound scanning have been used for objective measures of FM, but every method has its limitations and a "gold standard" is difficult to define. In comparison with the ultrasound, the mean proportion of FM perceived by the mother ranges from 37 to 88%,[15-23] and in comparison with other methodologies from 39 to 90%[16,21,24-27]; strong generalized FM were perceived in the higher end of this scale. With respect to generalized FM, there is close agreement between maternal and objective measures of FM, increasing with the number of fetal parts contributing to it.[17-19,23] The one common factor in these studies is that maternal perception of FM was recorded while the mother was lying down and focusing on FM. This is the only situation in which we know that maternal perception of FM has a fair to good correlation with actual fetal activity. Outside such a setting, both the actual frequency of FM as well as the mother's ability to perceive them is affected by many factors such as maternal position,[28,29] activity and exercise,[28,30,31] stress,[32-34] blood sugar,[35,36] caffeine consumption,[37] smoking,[38] and obviously whether she pays attention to FM or not.

Maternal counting while lying down and focusing on FM, preferably at a time of day when she knows that the baby is usually active, is thus the only method known to be a valid approximation to actual fetal activity. Counting while focusing on FM is also the only way women intuitively will perform FMC if they are concerned for DFM. Any "alarm limits," or definitions of DFM, associated with such FMC should

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