13

Reduced Fetal Movements

Julia Unterscheider[1] and Keelin O'Donoghue[2]
[1]*Royal College of Surgeons in Ireland, Rotunda Hospital Dublin,*
[2]*Anu Research Centre, University College Cork, Cork University Maternity Hospital, Ireland*

1. Introduction

Maternal awareness of fetal movements serves as an indicator of fetal wellbeing and its reduction alerts clinicians to pregnancies at risk of complications. A reduction of fetal movements (FM) causes concern and anxiety, both for the mother and obstetrician, and is a common reason for referral to hospital. Decreased fetal movements affect up to 15% of pregnancies (Sergent *et al*., 2005; Heazell *et al*., 2008). Of those women, 85% are concerned about fetal wellbeing and 53% are afraid that the baby might die (Tveit *et al*., 2006). The perception of reduced movements is highly subjective to the mother and has clinical significance as a predictor of adverse pregnancy outcome - therefore any concerns should be taken seriously and assessed appropriately.

Conditions associated with diminished fetal movements are summarised in Table 1 and may vary from serious clinical diagnoses such as intrauterine fetal death, intrauterine fetal growth restriction and oligohydramnios, hydrops fetalis and polyhydramnios to other causes such as fetal sleep, anterior placental location, increased body mass index, maternal smoking, metabolic and endocrine disorders or a busy mother who is simply not concentrating on fetal movements. The most common single cause of stillbirth is intrauterine fetal growth restriction (IUGR). Some reports suggest 11-29% of women presenting with reduced FM carry a small for gestational age (SGA) fetus under the 10th centile (Heazell *et al*., 2005; Sinha *et al*., 2007). Sergent *et al* retrospectively reviewed 160 patients complaining of reduced FM and reported 4.3% of fetuses with severe growth restriction in their cohort (Sergent *et al*., 2005). The clinical significance of reduced FM may be unclear until pathological underlying causes have been excluded. Placental dysfunction has been identified as a key factor in pregnancies affected by diminished FM (Warrander *et al*., 2011). There are a wide variety of investigations available, some of which are not proven to be useful in the detection of a fetus at risk or to promote timely intervention. This can lead to unnecessary investigation of otherwise uncomplicated pregnancies, which results in maternal anxiety, inconvenience and increased obstetric intervention.

The Confidential Enquiry into Stillbirths and Deaths in Infancy (CESDI) under the umbrella of the National Institute for Clinical Excellence (NICE) collected and analysed data of deaths between 20 weeks gestation and one year of life. In their 8th annual report they reviewed 422 stillbirths and found that 45% of them were associated with suboptimal care; 69 cases (16.4%) were related to altered or reduced fetal movements. Concerns were raised over the

failure of (a) the mother to report reduced FM, (b) the clinician explaining the importance of changes in FM to the woman and (c) professionals to act appropriately when decreased FM occur.

Intrauterine fetal death (IUD)
Fetal sleep
Fetal position
Fetal congenital malformation (i.e. neurological, musculo-skeletal)
Fetal anaemia or hydrops
Acute or chronic hypoxia from placental insufficiency leading to
i. Reduced amniotic fluid volume (oligohydramnios) or
ii. Small for gestational age fetus (SGA)/ intrauterine growth restriction (IUGR)
Polyhydramnios
Increased maternal weight
Anterior placental localisation
Maternal sedating drugs which cross the placenta (alcohol, benzodiazepines, barbiturates, methadone, narcotics)
Smoking
Administration of corticosteroids for promotion of fetal lung maturity
A busy mother who is not concentrating on fetal activity
Maternal anaemia, metabolic disorders, hypothyroidism
Acute or chronic feto-maternal haemorrhage

Table 1. Conditions associated with maternal perception of reduced fetal movements (Unterscheider *et al*., 2009)

In February 2011, the Royal College of Obstetricians & Gynaecologists has issued a clinical practice guideline (Green-top Guideline 57) on the management of reduced fetal movements which summarises the current evidence of how to best manage these complicated pregnancies.

This chapter provides a comprehensive overview of the clinical significance, investigation and management of reduced fetal movements in the low risk pregnant population over 24 weeks gestation. It will further provide guidance to the clinician in the critical assessment of these pregnancies to ensure high quality antepartum and intrapartum care, safe delivery and improved perinatal outcomes.

2. Physiology

Mothers usually report fetal movements from around 20 weeks gestation with a peak at 28-34 weeks gestation (Mangesi & Hofmeyr, 2007). Fetal movements have been defined as any discrete kick, flutter swish or roll (Neldam, 1983). Multiparous women may notice movements earlier (16-20 weeks gestation) than primiparous women (20-22 weeks gestation) (Grant *et al*., 1989). FM follow a circadian pattern and are an expression of fetal wellbeing. Fetal movements are usually absent during fetal sleep, periods which usually last 20-40 minutes and rarely exceed 90 minutes (Patrick *et al*., 1982). A recent study confirmed that fetal movements are significantly better in the evening than in the morning (Ozkaya *et al*., 2011). A gradual decline during the third trimester is suggested to be due to improved fetal

coordination and reduced amniotic fluid volume, coupled with increased fetal size (Grant *et al*., 1989). Some ultrasound studies on fetal behaviour show that fetal movements do not become less frequent in the third trimester but that the movements change as coordination improves and a pattern of cycling becomes established.

Decreased FM are regarded as a marker for suboptimal intrauterine conditions, possibly of placental dysfunction and intrauterine stress and should alert the clinician to pregnancies at risk. The fetus responds to chronic hypoxia by conserving energy and the subsequent reduction of FM is an adaptive mechanism to reduce oxygen consumption. It is recognised that an IUD is preceeded by cessation of FM for at least 24 hours (Sadovsky & Yaffe, 1973). Over 55% of women experiencing a stillbirth perceive a reduction in fetal movements prior to diagnosis (Efkarpidis *et al*., 2004).

3. Definition

There is a lack of consensus on how many movements are regarded as normal or abnormal. FM in a healthy fetus vary from 4 to 100 per hour (Mangesi & Hofmeyr, 2007). Maternal perception of fetal movements range from 4-94% of actual movements seen on concurrent ultrasound scanning (Heazell *et al*., 2008). The positive predictive value of the maternal perception of reduced FM for fetal compromise is low, 2% to 7% (Macones & Depp, 1996).

Haezell *et al* recently confirmed that there is little agreement amongst midwives and obstetricians on the definition of reduced FM. Definitions ranged from less than 10 movements in 2 hours (Whitty *et al*., 1991) to 12 and 24 hours. In this study, the maternal perception of decreased movements for 24 hours gained the greatest acceptance and the authors suggest this is currently the most appropriate method to identify reduced FM (Heazell *et al*., 2008; Heazell & Frøen, 2008). Reports on published definitions found most midwives and obstetricians favoured the definition of less than 10 movements in 12 hours (Heazell *et al*., 2008). This concurs with the 1976 definition of Pearson and Weaver who developed the 'count-to-ten kickchart'. Using this kickchart, women record their first 10 movements of each day, and if this is not reached after 12 hours, are advised to seek further assessment (Grant *et al*., 1989; Heazell *et al*, 2008; Person & Weaver, 1976). A recent prospective cohort study showed that the mean time to perceive 10 movements is approximately 10 minutes in normal third trimester pregnancies (Winje *et al*., 2011). Other studies showed that the mean time to perceive 10 movements varied between 21 minutes for focused counting to 162 minutes with unfocused perception of fetal movements (Grant et al., 1989; Moore & Piacquadio, 1989).

There is no evidence that any formal definition of reduced FM is of greater value than subjective maternal perception in the detection of fetal compromise. Therefore maternal perception of reduction or sudden alteration of fetal movements should be considered clinically important. There is currently no universally agreed definition of reduced FM.

4. Current practice

A wide range of investigations are performed for the complaint of reduced FM. Investigations considered include symphyseal fundal height measurement (SFH), cardiotocography (CTG), biophysical score (BPP), fetal weight estimation (EFW), liquor

assessment, umbilical artery (UA) Doppler velocimetry, formal fetal movement counting (kickcharts) and vaginal examination. These investigations may lead to interventions such as a membrane sweep or induction of labour.

An anonymous structured web-based questionnaire recently performed amongst 96 Irish obstetricians (Unterscheider *et al*., 2010) found that there was a lack of guidance in the management of reduced FM with only one third of clinicians having a clinical practice guideline in their institution. Table 2 summarizes the management and assessment methods. Results of this study demonstrated that CTG was the most favoured method of assessing fetal wellbeing (93%) followed by the use of kickcharts (64%), while 54% of obstetricians assessed the fetus with a biophysical score and 52% performed an ultrasound scan to assess liquor volume. Only 34% applied simple SFH measurement and 23% assessed umbilical artery Doppler velocimetry. In the same study, fetal biometry was performed by 20% of obstetricians and the same percentage offered vaginal examination to assess favourability. The minority recommended admission (2%) or induction of labour (4%). The study confirmed that clinicians apply multiple combinations of assessment methods with 98% of doctors performing more than one investigation. This highlights the uncertainty over optimal assessment methods in this common clinical scenario.

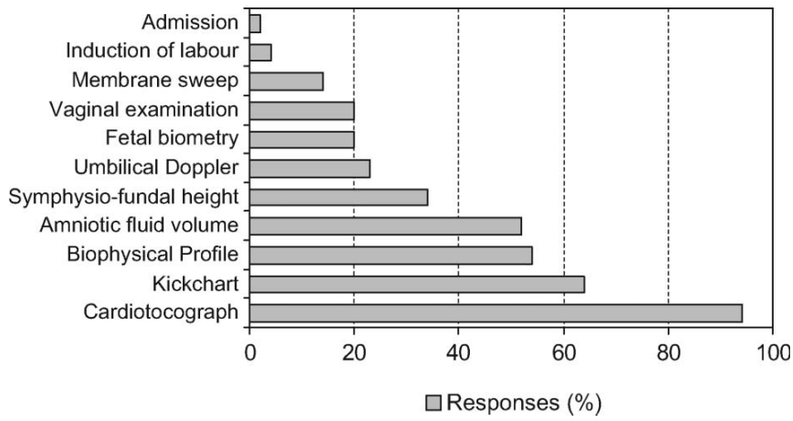


Table 2. Management and assessment methods of reduced fetal movements employed by Obstetricians in Ireland (Unterscheider *et al*., 2010)

Haezell *et al* recently reviewed the current practice in the United Kingdom where most obstetricians (70%) had institutional guidelines available. In contrast to the Irish study they found that only 3% of midwives and 5% of obstetricians were using kickcharts in their routine antenatal care. The majority of respondents in this questionnaire performed CTG and SFH measurement. Further evaluation including fetal biometry, umbilical artery Doppler or full biophysical profile was based on results of CTG, SFH measurement and clinical situation. The most frequently reported management option for both midwives and obstetricians was to consider admission and delivery.

There are no randomised controlled trials addressing the optimal management of reduced FM. All published studies are limited by the variation in definition and outcomes. The main outcome measure of interest, stillbirth, is relatively uncommon with an incidence of 1 in 200 births in developed countries (Stanton *et al*., 2006), therefore large scale studies would be required to answer the question of optimal management.

5. Assessment methods

5.1 Which investigations are beneficial?

5.1.1 Basic Assessment

Every patient who presents with reduced FM over 24 weeks gestation should have the following assessed:

- Detailed history/ duration of the presenting complaint.
- Risk factors in this or the previous pregnancy.
- Maternal blood pressure, pulse rate, temperature and urinalysis.
- Auscultation of the fetal heart or a CTG over 15-20 minutes (Preboth, 2000)
- Clinical examination including abdominal palpation and SFH measurement

5.1.2 Symphyseal fundal height measurement (SFH)

A clinical opinion about the size of the baby including abdominal palpation and the measurement of SFH should be part of every assessment and is helpful in the management of reduced FM. Despite the fact that abdominal palpation only detects 30% of small for gestational age fetuses (RCOG, 2002), SFH measurement has a positive predictive value of 60% and a negative predictive value of 76.8% (Heazell *et al*., 2005). This implies that if the SFH is within normal limits, fetal growth restriction or placental insufficiency is unlikely to be present. Serial SFH measurements have an increased specificity and sensitivity (Heazell *et al*, 2005; Pearce & Campbell, 1987) as the trend in growth is of more value than a single measurement in predicting poor fetal outcome. As 50-70% of fetuses with a birthweight below the 10th centile are constitutionally small (RCOG, 2002), Gardosi *et al* suggested that plotting measurements on customised SFH charts adjusted for maternal weight, height, parity and ethnic group results in increased detection of growth restriction and fewer hospital referrals (Gardosi & Francis, 1999). The SFH mean at 36 weeks gestation on drawn charts is 34-34.8cm (Calvert, Quaranta, Nottingham) which implies that using '*SFH in cm equals gestational age in weeks*' would lead to significant over-diagnosis of SGA fetuses.

We conclude that, in the absence of anything better, the measurement of SFH and its plotting on customised charts is recommended in selecting which patients should undergo further investigation (Unterscheider *et al*., 2009).

5.1.3 Non stress test – Cardiotocography (CTG)

CTG it is widely accepted as the primary method of antenatal fetal monitoring to assess the current status of the fetus (Pattison & McCowan, 2000) but its use is particularly difficult and cannot be recommended before 28 weeks gestation (Preboth, 2000). Between 24 and 28 weeks gestation auscultation of the fetal heart may be sufficient and CTG can be performed. A reactive CTG is defined by two accelerations exceeding 15bpm, sustained for at least 15 seconds in a 20 minute period (Devoe, 1990). Loss of variability is associated with fetal sleep, sedation or central nervous system depression, including fetal acidosis. The absence of accelerations or appearance of decelerations along with a history of reduced FM may indicate fetal hypoxia (Lee & Drukker, 1979) and is associated with fetal demise and Caesarean section delivery (ACOG, 2000). CTG is useful in the detection of acute hypoxia

but is a poor test for chronic hypoxia (Heazell *et al*., 2005). Large scale studies show that CTG does not reduce stillbirth or perinatal morbidity (Pattison & McCowan, 2000). Nevertheless a reactive CTG is significantly more likely to be followed by a normal delivery and a normal perinatal condition than non-reactive tests (Neldam, 1986).

Computerised CTGs are in use in many units in the United Kingdom and suggested to be more reliable, objective and accurate than visual inspection (Dawes *et al*., 1996). Fetal heart rate measurements are automatically calculated by a computer, and compared to reference values (centiles) according to gestation. The use of computerised CTG improves discrimination between normal and questionable records in gestations ranging from 24-42 weeks.

5.1.4 Amniotic fluid index (AFI) or deepest vertical pool (DVP)

There are three ways to assess liquor volume; these include AFI, DVP and subjective assessment. In 1980 Manning & Platt proposed the measurement of the DVP for assessment of fetal wellbeing. This was revised by Phelan in 1987 who suggested that four pockets are better than one. Some studies show that AFI has poor correlation with actual fluid volume and suggest that measuring the DVP is slightly more reliable in assessing liquor volume (Chauhan *et al*., 1997). This finding agrees with a recent Cochrane review on the use of AFI versus DVP which concluded that the DVP measurement in the assessment of amniotic fluid volume during fetal surveillance seems a better choice since the use of the amniotic fluid index increases the rate of diagnosis of oligohydramnios and the rate of induction of labour without improvement in peripartum outcomes (Nabhan & Abdelmoula, 2008). Table 3 shows the reference values for AFI and DVP according to gestation. An AFI less than 5cm is associated with adverse outcome.

Mean at term:	AFI 12cm
Polyhydramnios:	DVP ≥ 8cm, AFI ≥ 20cm
Oligohydramnios:	DVP ≤ 2cm, AFI ≤ 5cm
Borderline:	AFI 5-8cm (5% chance of oligohydramnios in 4 days)
Normal:	AFI 8-18cm (0.5% chance of oligohydramnios in 1 week)

Table 3. Reference values for Amniotic fluid index (AFI) and deepest vertical pocket (DVP)

In general, if reduced liquor volume is detected, further evaluation of the fetus is recommended, given the association of oligohydramnios with placental insufficiency, premature rupture of membranes and fetal renal abnormality. Lin *et al* found that oligohydramnios was present in 29% of growth restricted fetuses. An AFI or DVP measurement is also recommended in postdates pregnancies. The 5th centile for AFI at 37 weeks is 8.8cm (Moore) or 6.9cm (Magann).

5.1.5 Fetal biometry

A Cochrane review showed that routine ultrasound after 24 weeks gestation in low-risk pregnancy does not improve perinatal outcome (Bricker & Neilson, 2007). Nevertheless, if reduced FMs are reported, fetal ultrasound assessment for abdominal circumference (AC) or EFW is indicated in cases where SFH measurement suggests SGA. More than 40 formulas to

estimate fetal weight exist, and numerous growth curves have been designed to plot these serial measurements. In late gestation, a single AC measurement is more accurate than head measurement. AC measurements have reported sensitivities of 72.9-94.5% and specificities of 50.6-83.3% and EFW has sensitivities between 33.3-89.2% and specificities of 53.7-90.9% (RCOG, 2002). AC and EFW measurements are better to predict a small for gestational age fetus under the 10th centile than large for gestational age fetuses (RCOG, 2002). Similar to SFH, serial measurements, ideally two weeks apart, are more accurate than single estimates in the prediction of growth restriction. As with SFH measurements they can be plotted on customised centile charts to increase sensitivity and specificity.

In conclusion, fetal biometry assessment should be performed if SFH suggests SGA and if there is suspected oligohydramnios. The most common single cause of stillbirth is intrauterine growth restrition, therefore sonographic assessment is recommended if small fetal size is suspected or if the clinical assessment is limited, i.e. in case of increased maternal body mass index. It should also be considered in second and subsequent presentations or if neither pregnant woman nor clinician are reassured by the initial assessment (Unterscheider *et al*., 2009).

The correlation with placenta derived factors such as reduced first trimester pregnancy associated plasma protein-A (PAPP-A) or placental protein-13 (PP-13) may suggest underlying placental dysfunction in patients with reduced FM. Fetal biometry is recommended in such cases (Warrander *et al*., 2011).

5.2 Which investigations are of limited value in the management of reduced FM in the low risk population?

5.2.1 Umbilical artery (UA) Doppler velocimetry

There is little evidence for the use of UA Doppler velocimetry in the assessment of reduced FM. UA Doppler is of benefit in high-risk pregnancies including the assessment of IUGR pregnancies in order to reduce perinatal mortality (Neilson & Alfirevic, 2000) but has not been shown to be of value as a screening test for detecting fetal compromise in the general obstetric population. Korszun *et al* suggested that adding UA and uterine artery (Ut.A) Doppler velocimetries to conventional CTG in the assessment of reduced FM might be reassuring for the managing clinician. Dubiel *et al* compared CTG with UA Doppler in the assessment of 599 women with low risk pregnancies complaining of reduced FM; CTG and UA Doppler were normal in 93% of patients. The overall perinatal mortality in their study was 3.8%. They found that CTG seemed to be a better predictor of mortality and infant handicap than Doppler velocimetry. Sergent *et al* reported only one highly pathological UA Doppler in their retrospective review of 160 pregnancies affected by reduced FM.

We conclude that UA Doppler is of limited use in the assessment of reduced fetal movements (Unterscheider *et al*., 2009). It is useful in the assessment of the IUGR fetus.

5.2.2 Fetal vibroacoustic stimulation test

A fetal vibroacoustic stimulation test may elicit fetal heart rate accelerations and increased fetal body movements, and may reduce the incidence of non-reassuring CTG and subsequent obstetric intervention (Pearson & Weaver, 1976). A Cochrane review by Tan &

Smyth examining 4,838 participants confirmed that fetal vibroacoustic stimulation reduced the incidence of non-reactive CTGs (RR 0.62, 95% CI, 0.52-0.74) and also reduced the overall mean testing time. The authors concluded that further randomised trials were needed to determine the optimal intensity, frequency, duration and position of vibroacoustic stimulation and also to evaluate the efficacy, predictive reliability, safety and perinatal outcome.

5.3 Which investigations are of no value in the management of reduced FM in the low risk population?

5.3.1 Fetal movement counting (count-to-ten kickcharts)

Formal fetal movement counting was first suggested in 1973 by Sadovsky & Yaffe. Sadovsky instructed women to count movements three times a day after meals. Counting movements using kickchart (Cardiff "count to ten" chart) is now more frequently employed. We have recently shown that 64% of obstetricians working in Ireland handed out kickcharts to patients presenting with reduced FM (Unterscheider *et al*., 2010) The use of kickcharts is easy, simple and can be done at home. However, in a large study of 68,000 women, Grant *et al* were unable to demonstrate a reduction in the incidence of antepartum fetal death using formal movement counting. They reported that formal FM counting by 1,250 women prevented, at best, one unexplained antepartum late fetal death and that a random adverse effect was just as likely (Grant *et al*., 1989). The use of kickcharts increased attendences for assessment of fetal wellbeing (15.5% vs 9.8%) and was associated with a 2.6 fold increased obstetric intervention rate (Heazell *et al*., 2005; Whitty *et al*., 1991). Another report demonstrated higher intervention rates (32% vs 21%) and caesarean section rates (24% vs 14%) (Sinha *et al*., 2007).

In October 2003 NICE and the National Collaborating Centre for Women's and Children's Health published their guideline on the routine antenatal care of healthy pregnant women. They came to the conclusion that routine formal FM counting should not be offered. This statement has been renewed in their 2008 guideline. In contrast, the American College of Obstetricians and Gynaecologists supports formal movement counting. In their bulletin on antepartum fetal surveillance they instruct the woman to count 10 movements, preferably after a meal, and to write down the hours this takes (ACOG, 2000). They do not provide a definition of reduced fetal movements or advise a timeframe in which these movements should be achieved, which reflects the dilemma and controversy of the definition and management of reduced FM.

Although formal fetal movement counting is not recommended, women should be educated about the physiology of fetal movements and the need to seek assessment if movements change, decrease or cease given the association with stillbirth and the identification of these concerns in the recent CESDI report.

5.3.2 Biophysical profile (BPP)

The biophysical profile (BPP) combines a CTG with ultrasound assessment of fetal movements, fetal tone, fetal breathing movements and liquor volume. A score of 8-10 confirms fetal well-being. Lalor *et al* recently published their Cochrane review on the use of BPP in high risk pregnancies and report that the available evidence from randomised

controlled trials does not support the use of BPP as a test of fetal wellbeing (Lalor *et al*., 2008). There was no significant difference between the groups in perinatal deaths (RR 1.33, 95% CI 0.60 to 2.98). Combined data from two high-quality trials suggest an increased risk of caesarean section in the BPP group (RR 1.60, 95% CI 1.05 to 2.44, n = 280, interaction test P = 0.03) (Tuffnell *et al*., 1991). Observational studies however suggest that BPP has a good negative predictive value, meaning that fetal death is rare in women in the presence of a normal BPP (Dayal *et al*., 1999).

6. Optimal management of reduced fetal movements prior to and beyond 24 weeks' gestation

Reduced fetal movements prior to 24 weeks gestation should be managed with auscultation of the fetal heart and clinical examination (basic assessment). Between 24 and 28 weeks gestation evidence suggests that fetal heart auscultation is sufficient for assessment, however CTG can be performed. The evaluation of a CTG can be difficult at this early gestation and its interpretation can be improved by computerised CTG applying the Dawson & Redmond criteria. It is essential to carry out a basic assessment including comprehensive stillbirth risk evaluation. If clinical examination is suggestive of small fetal size, ultrasound for fetal biometry, liquor volume and congenital structural abnormalities is recommended.

Beyond 28 weeks gestation, CTG should be part of the assessment of women presenting with reduced FM (refer to section 5.1.3). Figure 1 summarizes the recommended management approach to women presenting with reduced FM after 28 weeks gestation.

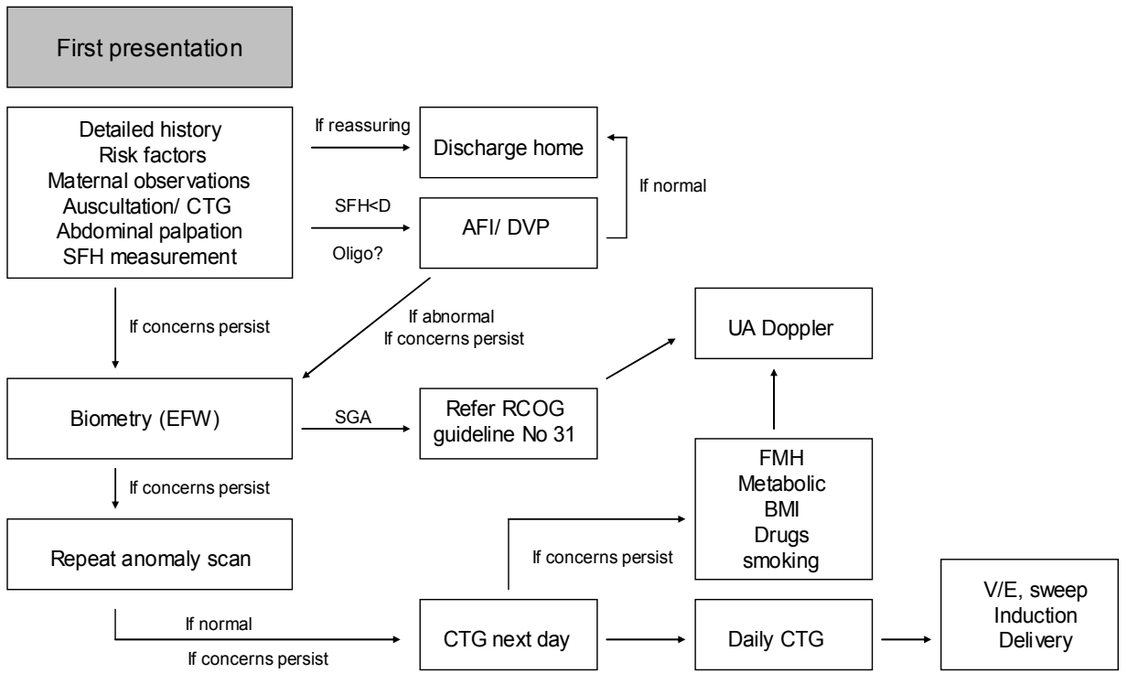


Fig. 1. Reduced fetal movement assessment flowchart (Unterscheider *et al*., 2009)

7. Management of second and subsequent presentations

Up to 5% of women will re-present with reduced FM (Sinha *et al*., 2007). If the perception of reduced FM persists, consideration should be given to other causes such as fetal structural anomalies (4.3%), anaemia or feto-maternal haemorrhage. There is little evidence how to manage these pregnancies, however women who present on two or more occasions with reduced FM are at increased risk of poor perinatal outcome compared with those who attend only once (OR 1.92; 95% CI 1.21 – 2.02) (O'Sullivan *et al*., 2009). A practical approach would be to perform ultrasound assessment to rule out SGA, structural anomalies and oligo- or polyhydramnios and invite the woman for daily CTGs until mother and clinician are reassured. A blood test should ultimately be considered looking for maternal metabolic disorders or feto-maternal haemorrhage. Smoking should be discouraged. If concerns persist in later gestation, induction of labour or delivery can be considered.

8. Reduced fetal movements in multiple gestations

There is little guidance on the assessment and management of reduced FM in multiple gestations but a practical approach would incorporate clinical assessment and CTG followed by sonographic evaluation of chorionicity, biometry, liquor volume and umbilical artery Doppler. Given that fetal biometries are concordant and appropriate for gestational age, there are no structural abnormalities, signs of selective IUGR or twin-to-twin transfusion syndrome (TTTS), the mother can be reassured but careful follow-up should be arranged. Serial sonographic assessment for multiple gestations, more frequently in monochorionic gestations, is recommended.

9. Documentation of reduced fetal movements in maternal records

As in all areas of good clinical practice, meticulous documentation about the history and duration of the presenting complaint, stillbirth risk assessment, examination methods, recommendation for follow-up and advice is essential.

10. Summary and recommendation

Every mother who presents with the concern of reduced or altered fetal movements should be taken seriously. The initial assessment should include a detailed history of the presenting complaint, maternal observations, abdominal palpation, SFH measurement and CTG. If this is reassuring for the mother and clinician, no further evaluation is needed. Amniotic fluid assessment should be added in postdates pregnancies. If the mother re-presents or initial assessment is non-reassuring further tests should be performed; these include amniotic fluid assessment and estimation of fetal weight. Kickcharts are of no value and should therefore not be given out to pregnant women. Biophysical profile scoring has not been shown to be of benefit either, and UA Doppler velocimetry and vibroacoustic stimulation are of limited use in the assessment of reduced FM.

This review describes significant variation in clinical routines reported in the management of reduced FM, which do not correlate well with current information given to pregnant women, the available literature, or expert guidelines. This leads to clinical uncertainty for both pregnant women and healthcare professionals.

This comprehensive review is based on current evidence and experience from expert groups and reflects good clinical practice. For the development of evidence-based guidelines the authors suggest further randomised controlled trials to assess the different suggested management plans. This is likely to be difficult given current established clinical practice and ethical difficulties surrounding trials in pregnancy. Therefore, a sensible approach to the management of reduced FM based on good clinical practice as set out in this chapter seems reasonable.

11. References

American College of Obstetricians and Gynecologists Practice bulletin. (2000). Antepartum fetal surveillance. Clinical management guidelines for obstetrician-gynecologists. *Int J Gynaecol Obstet* 68:175-185.

Bricker L & Neilson JP. (2007). Routine ultrasound in late pregnancy (after 24 weeks gestation). *Cochrane Database Syst Rev*. CD001451.

Chauhan SP, Magann EF, Morrison JC, Whitworth NS, Hendrix NW & Devoe LD. (1997). Ultrasonic assessment of amniotic fluid does not reflect actual amniotic fluid volume. *Am J Obstet Gynecol.* 177(2):291-296.

Chauhan SP, Sanderson M, Hendrix NW, Magann EF & Devoe LD. (1999). Perinatal outcome and amniotic fluid index in the antepartum and intrapartum periods: A meta-analysis. *Am J Obstet Gynecol.* 181(6):1473-1478.

Confidential Enquiry into Stillbirths and Deaths in Infancy (CESDI). 8th Annual Report. (2001). Maternal and Child Health Research Consortium. London.

Dawes GS, Moulden M & Redman CW. (1996). Improvements in computerized fetal heart rate analysis antepartum. *J Perinat Med.* 24(1):25-36.

Dayel AK, Manning FA, Berck DJ, Mussalli GM, Avila C & Harman CR. (1999). Fetal death after normal biophysical profile score: an eighteen year experience. *Am J Obstet Gynecol* 181: 1231-1236.

Dubiel M, Gudmundsson S, Thuring-Jönsson A, Maesel A & Marsal K. (1997). Doppler velocimetry and nonstress test for predicting outcome of pregnancies with decreased fetal movements. *Am J Perinatol.* 14(3):139-144.

Efkarpidis S, Alexopoloulos E, Kean L, Liu D & Fay T. (2004). Case-control study of factors associated with intrauterine fetal deaths. *Med Gen Med* 6:53.

Gardosi J & Francis A. (1999). Controlled trial of fundal height measurement plotted on customised antenatal growth charts. *BJOG* 106(4):309-317.

Grant E, Elbourne D, Valentin L & Alexander S. (1989). Routine formal fetal movement counting and risk of antepartum late death in normally formed singletons. *Lancet.* 12;2(8659):345-349.

Haezell AE, Sumathi GM & Bhatti NR. (2005). What investigation is appropriate following maternal perception of reduced fetal movements? *J Obstet Gynaecol.* 25(7):648-650.

Haezell AE, Green M, Wright C, Flenady V & Frøen JF. (2008). Midwives and obstetricians knowledge and management of women presenting with decreased fetal movements. *Acta Obstet Gynecol Scand.* 87(3):331-339.

Heazell AE & Frøen JF. (2008). Methods of fetal movement counting and the detection of fetal compromise. *J Obstet Gynaecol.* 28(2):147-154.

Korszun P, Dubiel M, Kudla M & Gudmundsson S. (2002). Doppler velocimetry for predicting outcome of pregnancies with decreased fetal movements. *Acta Obstet Gynecol Scand.* 81(10):926-930.

Lalor JG, Fawole B, Alfirevic Z & Devane D. (2008). Biophysical profile for fetal assessment in high risk pregnancies. *Cochrane Database Syst Rev.* CD000038.

Lee CY & Drukker B. (1979). The nonstress test for antepartum assessment of fetal reserve. *Am J Obstet Gynecol.* 15;134(4):460-470.

Lin CC, Sheikh Z & Lopata R. (1990). The association between oligohydramnios and intrauterine growth retardation. *Obstet Gynecol.* 76(6):1100-1104.

Macones, GA & Depp, R. Fetal monitoring. (1996). In: Wildschut HIJ, Weiner CP, Peters TJ. (editors). When to screen in obstetrics and gynaecology. London: WB Saunders; pp. 202–218.

Mangesi L & Hofmeyr GJ. (2007). Fetal movement counting for assessment of fetal wellbeing. *Cochrane Database Syst Rev.* 24;(1):CD004909.

Manning FA, Platt LD & Sipos L. (1980). Antepartum fetal evaluation: development of a fetal biophysical profile. *Am J Obstet Gynecol.* 15;136(6):787-795.

Moore TR & Piacquadio K. (1989). A prospective evaluation of fetal movement screening to reduce the incidence of antepartum fetal death. *Am J Obstet Gynecol* 160:1075-1080.

National Institute for Clinical Excellence and National Collaborating Centre for Women´s and Children´s Health. (2003). Clinical Guideline CG6 Antenatal care: routine care for the healthy pregnant woman.

Nabhan AF, Abdelmoula YA. (2008). Amniotic fluid index versus single deepest vertical pocket as a screening test for preventing adverse pregnancy outcome. *Cochrane Database Syst Rev.* CD006593.

Neilson JP & Alfirevic Z. (2000). Doppler ultrasound for fetal assessment in high risk pregnancies. *Cochrane Database Syst Rev*. CD000073.

Neldam S. (1986). Fetal movements as an indicator of fetal well-being. *Dan Med Bull* 33:213-321.

O'Sullivan O, Stephen G, Martindale E & HeazellAE. (2009). Predicting poor perinatal outcome in women who present with decreased fetal movements. *J Obstet Gynecol* 29:705-710.

Ozkaya E, Baser E, Cinar M, Korkmaz V & Kucukozkan T. (2011). Does diurnal rhythm have impact on fetal biophysical profile. *J Matern Fetal Neonatal Med*. 23. [Epub ahead of print]

Patrick J, Campbell K, Carmichael I, Natale R & Richardson B. (1982). Patterns of gross fetal body movements over 24-hour observation intervals during the last 10 weeks of pregnancy. *Am J Obstet Gynecol* 142:363-371.

Pattison N & McCowan L. (2000). Cardiotocography for antepartum fetal assessment. *Cochrane Database Syst Rev.* CD001068.

Pearce JM & Campbell S. (1987). A comparison of symphysis-fundal height and ultrasound as screening tests of light-for-gestational age infants. *BJOG.* 94(2):100-104.

Pearson JF & Weaver JB. (1976). Fetal activity and fetal well-being: an evaluation. *BMJ.* 29;1(6021):1305-1307.

Phelan JP, Smith CV, Broussard P & Small M. (1987). Amniotic fluid volume assessment with the four-quadrant technique at 36-42 weeks' gestation. *J Reprod Med*. 32(7):540-542.

Preboth M. (2000). ACOG guidelines on antepartum fetal surveillance. *Am Fam Physician* 62:1187-1188.

Royal College of Obstetricians and Gynaecologists. (2002). The investigation and management of the small-for-gestational-age fetus. RCOG Green-top Guideline No 31.

Royal College of Obstetricians and Gynaecologists. (2011). Reduced Fetal Movements. RCOG Green-top Guideline 57.

Saastad E, Tveit JVH, Bordahl PE, Stray-Pederson B & Frøen JF. (2006). Information and maternal concerns for decreased fetal movements. Proceedings of the Norwegian Perinatal Society Conference.

Sadovsky E & Yaffe H. (1973). Daily fetal movement recording and fetal prognosis. *Obstet Gynecol.* 41(6):845-850.

Sergent F, Lefevre A, Verspyck E & Marpeau L. (2005). Decreased fetal movements in the third trimester: what to do? *Gynecol Obstet Fertil.* 33(11):861-869.

Sinha D, Sharma A, Nallaswamy V, Jayagopal N & Bhatti N. (2007). Obstetric outcome in women complaining of reduced fetal movements. *J Obstet Gynaecol.* 27(1):41-43.

Stanton C, Lawn JE, Rahman H, Wilczynska-Ketende K & Hill K. (2006). Stillbirth rates: delivering estimates in 190 countries. *Lancet*. 6;367(9521):1487-1494.

Tan KH & Smyth R. (2001). Fetal vibroacoustic stimulation for facilitation of tests of fetal wellbeing. *Cochrane Database Syst Rev.* CD002963.

Tuffnell DJ, Cartmill RS & Lilford RJ. (1991). Fetal movements; factors effecting their perception. *Eur J Obstet Gynecol Reprod Biol.* 10;39(3):165-167.

Tveit JV, Saastad E, Børdahl PE, Stray-Pederson B & Frøen JF. (2006). The epidemiology of decreased fetal movements. *Proceedings of the Norwegian Perinatal Society Conference.*

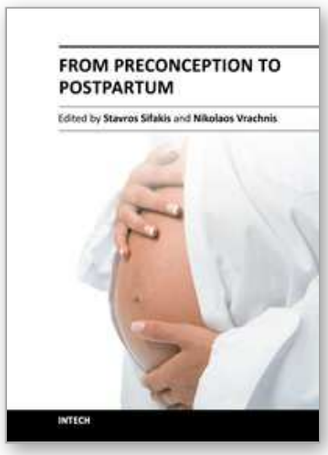
Unterscheider J, Horgan R, O'Donoghue K & Greene R. (2009). Reduced fetal movements. *The Obstetrician & Gynaecologist* 11:245-251.

Unterscheider J, Horgan R, Greene R & Higgins J. (2010). How do Irish Obstetricians manage reduced fetal movements in an uncomplicated pregnancy at term. Results from an anonymous online survey. *J Obstet Gynaecol* 30(6):578-582.

Warrander LK & Heazell AEP. (2011). Identifying placental dysfunction in women with reduced fetal movements can be used to predict patients at risk of pregnancy complications. *Med Hypotheses.* 76(1):17-20.

Whitty JE, Garfinkel DA & Divon MY. (1991). Maternal perception of decreased fetal movements as an indication for antepartum testing in a low-risk population. *Am J Obstet Gynecol*. 165:1084-1088.

Winje B, Saastad E, Gunnes N, Tveit J, Stray-Pedersen B, Flenady V & Frøen J. (2011). Analysis of 'count-to-ten' fetal movement charts: a prospective cohort study. *BJOG*. doi: 10.1111/j.1471-0528.2011.02993.x. [Epub ahead of print]



From Preconception to Postpartum

Edited by Dr. Stavros Sifakis

ISBN 978-953-51-0353-0
Hard cover, 314 pages
Publisher InTech
Published online 23, March, 2012
Published in print edition March, 2012

Obstetrics is evolving rapidly and finds itself today at the forefront of numerous developments. Providing selected updates on contemporary issues of basic research and clinical practice, as well as dealing with preconception, pregnancy, labor and postpartum, the present book guides the reader through the tough and complex decisions in the clinical management. Furthermore, it deepens the scientific understanding in the pathogenetic mechanisms implicated in pregnancy and motivates further research by providing evidence of the current knowledge and future perspectives in this field. Written by an international panel of distinguished authors who have produced stimulating articles, the multidisciplinary readers will find this book a valuable tool in the understanding of the maternal, placental and fetal interactions which are crucial for a successful pregnancy outcome.

InTech Europe
University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China
Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821

IntechOpen