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The implications of introducing the symphyseal-fundal height-measurement. A prospective randomized controlled trial

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Summary. A total of 1639 women attending the antenatal clinic of Gentofte University Hospital, Copenhagen, during 1986–1987 was randomized into a symphyseal fundal (SF)-group and a control group. The women in the SF-group had their fundal height measured from the 29th week until delivery. The measurements were used along with the other usual screening procedures. The SF-measurements were not found helpful in the prediction of small-for-gestational-age infants and no significant differences were found between the two groups regarding the number of interventions, additional diagnostic procedures, or the condition of the newborns.

A major goal of antenatal care is to detect and prevent intrauterine growth retardation (IUGR) by which we mean a condition that will lead to a small-for-gestational-age (SGA) infant. These SGA-infants, generally defined as infants with a birthweight below the 10th centile, have an increased risk of neonatal morbidity, mortality and impaired neurological development (Wennergren *et al.* 1988, Dijxhoorn *et al.* 1987). Even though not all infants in the SGA-group are growth retarded and some infants with appropriate-for-gestational age (AGA) birthweight may be growth retarded, SGA-infants still represent an at risk group. At the present state of the art of obstetrics it has not proven possible to accelerate intrauterine growth in the growth retarded fetus. As these fetuses are more susceptible to perinatal complications, it is of great importance to identify them antenatally and if necessary to terminate the pregnancy.

Several sophisticated technological methods, such as ultrasound and blood velocity measurements, have been adapted for detecting IUGR but they are not available as screening procedures in many hospitals. Around 50% of the SGA-infants are not detected antenatally (Rosenberg *et al.* 1982, Hepburn & Rosenberg 1986).

It has been claimed that measuring the fundal height is a good screening method for IUGR. The method is simple, easy to learn, and does not demand expensive equipment or time.

The predictive values of fundal height measurements have been studied by several investigators (Persson *et al.* 1986, Cnattingius *et al.* 1984 & 1985, Rosenberg *et al.* 1982, Wallin *et al.* 1981, Quaranta *et al.* 1981, Rogers & Needham 1985, Calvert *et al.* 1982, Belizan *et al.* 1978, Westin 1977) and were recommended for clinical use. Only Rosenberg *et al.* (1982) and Persson *et al.* (1986) found the symphyseal-fundal

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measurements (SF-measurements) to be of limited value as a screening method. Until now, however, no prospective controlled trials have been undertaken to assess the effect of introducing the method in antenatal care.

The aim of this study was to assess the influence of SF-measurements on the detection of SGA-fetuses antenatally, on interventions in the pregnancies involved and on fetal outcome. The study was undertaken in an obstetric department, which had not used SF-measurements as a screening procedure previously.

Subjects and methods

We estimated the sample size using the percentage of correct classification of SGA and AGA as a measure of outcome. In order not to overlook a 5% increase in accuracy from the 90% expected in the control group, almost 1000 pregnancies would be needed ($\alpha = 0{\cdot}05$ and $\beta = 0{\cdot}2$). Taking drop-outs into account we considered that we would need all the pregnant women attending our antenatal clinic in one year. The investigation was approved by the local ethics committee. All pregnant women attending the antenatal clinic during 1986 were therefore submitted prospectively to the trial, generally at about 14 weeks gestation. After receiving formal oral and written information 60 women did not want to participate. A further 27 were excluded before the allocation because of uncertain dates of delivery and no ultrasound examination had been conducted before 20 weeks (eight women) or because they had received antenatal care in another hospital (19 women). After the allocation 21 women with twin pregnancies were excluded (12 in the SF-group and nine in the control group) and so were 13 women with uncertain dates of delivery (seven in the SF-group and six in the control group). A further 60 women were excluded after allocation because antenatal care had taken place elsewhere (28 in the SF-group and 32 in the control group) and 36 were excluded because of miscarriage (17 in the SF-group and 19 in the control group).

The remaining 1639 women participated in the trial. They all had regular menstrual cycles with a known last period or had gestational age estimated by ultrasound before 20 weeks. On their first visit to the antenatal clinic the women were randomized into two groups by drawing a sealed opaque envelope containing a project number, which ranged from 1 to 1800. An uneven number resulted in an allocation to the SF-group and an even number to the control group.

SF-Group

This consisted of 804 women allocated to have SF-height measurements taken with a metric non-elastic tape, each time they visited their midwife or the obstetrician at the antenatal clinic from 28 weeks gestation. The results were plotted on a reference SF-growth chart and placed in the usual obstetric case record. Thus the method was used as a screening test along with the other usual screening procedures.

The SF-height was measured at least three times in 632 pregnancies (79%), once or twice in 121 (15%), but not at all in 51 pregnancies (6%).

Control group

This consisted of 835 women allocated to have SF-height measurements taken with a fabric tape with no marks. The tape was cut off and was not measured until after the delivery. The SF-height was measured at least three times in 655 pregnancies (79%), once or twice in 138 (16%) but not at all in 42 pregnancies (5%).

The SF-height was measured as described by Westin (1979) with the woman lying in the supine position, her legs straight, the uterus relaxed, an empty bladder and the fetus in a longitudinal position. The measurements were taken along the longitudinal axis of the uterus from the fundus uteri to the upper part of the pubic symphysis. Correction was made for the position of the leading part of the fetus in the pelvis as recommended by Westin (1979).

The reference SF-growth chart was derived from a population of 311 pregnant women from Copenhagen County and is used generally in the county. The 10th centile is taken as the lower limit of normal values and corresponds with the lower limit used by Westin (1977). An SF-curve was considered abnormal if it showed a fall of >20% for at least two consecutive values, or at least two values <10th centile, or the curve was static with at least three consecutive measurements with unaltered values (Wallin *et al.* 1981, Isager *et al.* 1985).

These guidelines were agreed upon by the staff before the trial started, but as we can see retrospectively, they were not always followed.

The usual screening procedures in the obstet-

Table 1. Characteristics before pregnancy in the two groups

Factor	SF-group (n=804) n	(%)	Control (n=835) n	(%)
Parity				
0	431	(54)	438	(52)
1	280	(35)	288	(34)
2	76	(9)	88	(11)
3	12	(1)	14	(2)
>3	5	(0·6)	7	(0·8)
Maternal age (years)				
<20	18	(2)	13	(2)
20–29	431	(54)	466	(56)
30–39	339	(42)	341	(41)
>39	16	(2)	15	(2)
Previous deliveries				
SGA-infants	19	(2)	18	(2)
Birthweight <2500 g (unknown gest.age)	5	(0·6)	4	(0·5)
Perinatal death	7	(0·9)	8	(1)
Smoking				
> 9 cigarettes/day*	160	(20)	156	(19)
Alcohol consumption				
> 5 drinks/day*	6	(0·7)	6	(0·7)
Maternal weight class†				
Slender	294	(36)	315	(38)
Normal	431	(54)	441	(53)
Slight overweight	61	(8)	60	(7)
Severe overweight	16	(2)	16	(2)
Unknown	2	(0·2)	3	(0·4)

*At the first visit to the antenatal clinic.
†Body mass index (National Food Agency of Denmark 1987) in the non-pregnant state.

ric department included measurement of placental lactogen hormone in the 34th week, taking the 2·5 centile as the lower limit of normal (Lindberg & Nilsson 1973); fetal weight estimate from the 29th week, using the 10th centile in the growth chart from the Danish National Board of Health (1976) as the lower limit of normal; maternal weight gain during pregnancy, regarding an average weight gain of <250 g in 4 weeks as suspicious.

If any other diagnostic procedures or treatments were prescribed due to suspicion of IUGR, the pregnancy was categorized as 'suspected IUGR'. Diagnostic procedures indicated for suspected IUGR were ultrasound measurements of biparietal diameter and cardiotocography (a non-stress test).

The newborns were classified as SGA if the birthweight was <10th centile (The Danish National Board of Health, 1976). All compromised infants were transferred to the intensive neonatal ward, situated in another hospital in the county.

For calculation of significance, the χ^2-test was used (limit of significance: $P<0·05$). The 95% confidence intervals are shown in parenthesis.

Results

There were only minor differences between the two groups in characteristics before pregnancy (Table 1), and in the course of the present pregnancy with regard to the prevalence of hydramnios (>1·5 litres) (nine in the SF-group and seven in the control group) and of bleeding (89 in the SF-group and 94 in the control group). Albuminuria occurred in 26 pregnancies in the SF-group and in 24 in the control group. Hypertension, both essential and pregnancy-induced (after 20 weeks), was found in 35 pregnancies in the SF-group and in 33 in the control group.

Suspicion of IUGR arose in 10% of the pregnancies in both groups (83 in the SF-group and 85 in the control group). In almost half of these

Table 2. Prediction of SGA-infants in the SF-group compared with the control group

	SF-group (n=804)		Control (n=835)		SF−Control (%) (95% CI)	
Sustained suspicion of IUGR n (%)	42	(5·0%)	49	(6·0%)	−0·6	(−2·9 to 1·6)
SGA-infants n (%)	61	(7·6%)	48	(5·7%)	1·8	(−0·6 to 4·3)
Predictive value of pathological variable	17/42	(40·5%)	23/49	(46·9%)	−6.5	(−27·2 to 14·3)
Predictive value of normal variable	718/762	(94·2%)	761/786	(96.8%)	−2.6	(−4·7 to −0·5)
Sensitivity	17/61	(27·9%)	23/48	(47·9%)	−20·1	(−38·5 to −1·6)
Specificity	718/743	(96·6%)	761/787	(96·7%)	−0·1	(−1·9 to 1·8)
Accuracy	735/804	(91·4%)	784/835	(93·9%)	−2·5	(−5·0 to 0·1)

SGA, small-for-gestational age. SF, symphysis fundal height. IUGR, intrauterine growth retardation.

Table 3. Diagnostic procedures and interventions due to suspicion of intrauterine growth retardation

	SF-group (n=804)		Control (n=835)		SF−Control (%) (95% CI)	
	n	(%)	n	(%)		
Sick-leave	10	(1·2)	12	(1·4)	−0·2	(−1·3 to 0·9)
Hospitalized	15	(1·9)	8	(1·0)	0.9	(−0·2 to 2·1)
Induction of labour	17	(2·1)	21	(2·5)	−0·4	(−1·9 to 1·1)
Caesarean section						
Elective	4	(0·5)	7	(0·8)	−0·3	(−1·1 to 0·5)
Emergency	5	(0·6)	6	(0·7)	−0·1	(−0·9 to 0·7)
CTG (non-stress test)	48	(6·0)	50	(6·0)	−0·02	(−2·3 to 2·3)
Ultrasound (BPD)	59	(7·3)	60	(7·2)	0·2	(−2·4 to 2·7)

No significant differences between the two groups were found (P>0·05).
CTG, cardiotocography. BPD, fetal biparietal diameter.

suspicion was withdrawn before delivery (Table 2), leaving 42 (5%) in the SF-group and 49 (6%) in the control group. Table 2 shows the predictive values, sensitivity, specificity, and accuracy of suspicion or no suspicion of IUGR. The difference between the sensitivities was −20% (95% CI −38·5 to −1·6) and the difference between the predictive values of no suspicion of IUGR was −2·6% (−4·7 to 0·5), favouring the control group.

There were no significant differences between the two groups in respect of diagnostic procedures and interventions due to suspicion of IUGR (Table 3). Neither were there any significant differences in fetal outcome. The number of SGA-infants, perinatal deaths, and infants transferred to neonatal ward were similar in the two groups (Table 4), and the diagnoses from the neonatal ward did not show any significant differences (Table 5). Of the 109 SGA-infants, 23 (21%, 95% CI 13 to 29) were transferred to the neonatal ward, compared with 4% (95% CI 3 to 5) of the AGA infants. Eleven (48%) of the transferred SGA-infants were born before 36 completed weeks.

There were 11 perinatal deaths (Table 4): two infants had major malformations, two had umbilical cord complications and one was found to have a serious placental insufficiency. One infant died 2 days after birth because of thrombosis of the inferior caval vein; five intrauterine deaths were unexplained.

Table 4. Fetal outcome

	SF-group (n=804)		Control (n=835)		SF−Control (%) (95% CI)	
	n	(%)	n	(%)		
Girls	406		403			
Boys	396		430			
Sex unknown	2		2			
Major malformations	13	(1·6)	19	(2·2)	−0·7	(−2·0 to 0·7)
SGA	61	(7·6)	48	(5·7)	1·8	(−0·6 to 4·3)
Apgar score at 1 min						
<4	9	(1·0)	10	(1·0)	−0·1	(−1·1 to 1·0)
<8	96	(12·0)	103	(12·0)	−0·4	(−3·6 to 2·8)
Apgar score at 5 min						
<4	4	(0·5)	4	(0·5)	0·02	(−0·7 to 0·7)
<8	10	(1·0)	11	(1·0)	−0·1	(−1·2 to 1·0)
Umbilical artery blood pH<7·15	25/196		36/201		−5·2	(12·3 to 1·9)
Perinatal deaths	6	(0·7)	5	(0·6)	0·2	(−0·7 to 0·9)
Transferred to neonatal ward	43	(5·4)	42	(5·0)	0·3	(−1·8 to 2·5)

SGA, Small-for-gestational-age.
No significant differences between the two groups were found (P>0·05).

Table 5. The final diagnosis on the 85 infants, transferred to the neonatal ward

	SF-group (n=43)		Control (n=42)		SF−Control (%)
	n	(%)	n	(%)	(95% CI)
SGA	11	(25·6)	12	(28·6)	−3·0 (−22·2 to 16·2)
Dysmature	8	(18·6)	8	(19·0)	−0·4 (−17·3 to 16·4)
Asphyxia	15	(34·9)	8	(19·0)	15·8 (− 3·3 to 35·0)
RDS	10	(23·3)	8	(19·0)	4·2 (−13·4 to 21·8)
Preterm	20	(46·5)	19	(45·2)	1·3 (−20·2 to 22·8)
Aspiration	5	(11·6)	6	(14·3)	−2·7 (−17·1 to 11·8)
Sepsis	5	(11·6)	4	(9·5)	2·1 (−11·2 to 15·4)
Hyperbilirubinaemia	8	(18·6)	7	(16·7)	1·9 (−14·5 to 18·4)
Hypoglycaemia	9	(20·9)	8	(19·0)	1·9 (−15·4 to 19·1)
Malformations	9	(20·9)	5	(11·9)	9·0 (− 7·0 to 25·0)
Seizures	1	(2·3)	2	(4·8)	−2·4 (−10·4 to 5·5)

SGA, Small-for-gestational age. RDS, respiratory distress syndrome.

Discussion

The object of searching for IUGR in antenatal care is, of course, to obtain 'better and bigger babies'. Once IUGR is suspected, our means of correcting this condition are limited and have not been shown to be effective. The available means are intensified surveillance or termination of pregnancy to prevent perinatal death or severely affected infants.

The hypothesis, that introduction of SF-measurements would give a more accurate prediction of SGA-infants in the SF-group, was not proven, with a risk of 20% of overlooking a difference in accuracy of 3% or more. In fact we found better sensitivity and better prediction of the AGA-infants in the group with masked measurements.

There was no difference in the number of pregnancies in which suspicion of IUGR arose, and consequently we did not find more diagnostic procedures and interventions due to suspicion of IUGR in the SF-group.

The introduction of SF-measurements did not influence fetal outcome. With the sample size in this investigation, we had a 20% risk of overlooking a 3% difference in the number of SGA-infants and infants transferred to the neonatal ward, and a risk greater than 60% of overlooking a decrease in perinatal mortality up to 0·1%. Though the SF-measurements were of no diagnostic assistance in the antenatal clinic in this investigation, the lack of statistical significance does not necessarily mean, that SF-measurements have no diagnostic value in themselves.

In the SF-group the SF-measurements may have been influenced by the knowledge of gestational age and fetal weight estimates. Before initiating this trial we plotted the fetal weight estimate against SF-measurements and found no correlation. These values were taken from a retrospective pilot study. Thus, in a clinical setting, the measurements may be influenced by the general impression of the fetus being normal or SGA. If so, masked SF-measurements, as in our control group, should give better predictive values than SF-measurements in the SF-group, if the measurements have any additional value in detecting IUGR. The value of a diagnostic method will depend on the general clinical circumstances into which it is introduced. The beneficial effect of a screening method, such as SF-measurements, on neonatal condition depends not only on the predictive values of the method, but also on the value of the additional diagnostic procedures, the proper reaction to pathological values, and the possibilities of correcting or preventing adverse outcomes.

Even though we have not shown any improvement of the condition of the newborn it may still be important to be able to predict the birth of a SGA-infant as accurately as possible.

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