Conclusion

We have shown that the poor perinatal outcome of unbooked pregnancies has more to do with low birth weight than failure to book for antenatal care. Unbooked mothers and their babies should receive the same care as booked patients and should not automatically be placed in a poor prognosis category. The booking status of a mother should not be used as a criterion for the allocation of neonatal intensive care.

The authors thank Professor L Wagstaff and Mrs R Ramontja of the Greater Soweto Maternal and Child Health Project, which is supported by the South African Medical Research Council and the Independent Development Trust, for their assistance, and Dr H Saloojee of the Department of Paediatrics at Baragwanath Hospital, for allowing access to neonatal case files.

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Accepted 18 Oct 1997.

Fetal vibro-acoustic stimulation with a can — a clinical study

G J Hofmeyr, T A Lawrie, M de Jager, A da Ponte

Objective. To assess the usefulness of the can as a fetal vibro-acoustic stimulator in the clinical environment.

Patients and setting. 112 high-risk obstetric patients at Coronation Hospital, Johannesburg.

Method. 161 vibro-acoustic stimulation tests with a can and 159 non-stress tests (NSTs) were performed. The results of the can test were compared with those of the NSTs and with fetal outcome at delivery.

Results. The can test showed poor sensitivity (5/9). Three of the 4 false-negative results were due to placental abruption that occurred subsequent to the can test. The ability of the can test to predict a reactive NST and good fetal outcome was 94% (negative predictive value).

Conclusions. In view of the reasonable negative predictive value, the test should be evaluated further as a screening test at primary care level, where there are few or no cardiotocographic facilities.


Vibro-acoustic stimulation has been shown to decrease the false-positive rate of non-stress tests (NSTs) and equivocal biophysical profiles, and to be comparable to the NST as a predictor of poor fetal outcome when performed within 7 days of delivery. Fetal movement in response to vibro-acoustic stimulation is considered a marker of fetal well-being and Luz recommends that it be used as a screening procedure when cardiotocography is unavailable. However, conventional vibro-acoustic stimulators are not available in most primary care settings. The use of auscultation to detect fetal heart rate accelerations as part of a clinical fetal arousal test has not, to our knowledge, been reported previously.

This article discusses the clinical part of a study to assess the usefulness of vibro-acoustic stimulation with an empty soft-drink can as a predictor of fetal outcome. The similarities between the sound pressure generated by the can and the Corometrics 146 vibro-acoustic stimulator were discussed in an earlier short report in this journal.

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Subjects and methods
A pilot study to determine the feasibility of auscultation for fetal heart rate (FHR) accelerations as part of a clinical fetal arousal test using can stimulation was conducted in 45 patients. On the basis of this experience, the technique of auscultation used in this study was developed.

A cohort of 112 antenatal patients at Coronation Hospital was enrolled in a prospective study between May and November 1996. Participants were high-risk patients of at least 27 weeks' gestation, in whom antenatal FHR testing had been requested. Women were excluded from the study if they were in labour. Age, parity, gestation and the reason for the NST were recorded.

Before the can test was performed, the FHR was auscultated for at least 1 minute with a Pinard stethoscope and a baseline FHR recorded as the number of beats in a 30-second period. The empty soft-drink can was then placed with its base halfway between the symphysis pubis and the umbilicus of the patient and steadied with the middle finger and thumb on the top rim of the can. Cans which give a resonant sound when the opener ring is depressed and allowed to snap back were selected for use. (As discussed, a metallic sound can be eliminated in some cans by moving the opener ring sideways.) The opener ring was then depressed about 0.5 cm with the tip of the index finger and released, allowing it to spring back upwards, thereby emitting a vibro-acoustic stimulus. Auscultation of the FHR was immediately resumed and recorded for the subsequent two 30-second periods. During auscultation, the examiner would lightly rest one hand on the woman's abdomen to feel for fetal movement. An acceleration was considered to have occurred if the FHR in either 30-second period increased by 5 beats or more above the baseline value recorded.

If neither an acceleration nor objective fetal movement were evident after one stimulus, the can test was repeated, with the opener ring flicked twice. Likewise, if there were no response on the second test, it was repeated a third time, with the opener ring flicked three times. The can test was followed by an NST of 20 minutes duration (or of 40 minutes duration if it initially appeared non-reactive).

NSTs were assessed independently by a researcher who was blind to the can test result. Criteria for a normal NST pattern included a baseline heart rate of 110 - 160/min, baseline variability of 5 - 15/min and the presence of at least one acceleration of 15/min above the baseline for 15 seconds. NSTs were classified as reactive or non-reactive. There were no 'terminal' NST patterns in this study. Can tests were classified as positive when no FHR acceleration or objective movement was felt, and negative when either FHR acceleration, objective movement or both were felt. Mode of delivery, birth weight, gestation of the baby and the reason for the NST were recorded.

Results
The correlation between the can test and the NST for 159 tests is shown in Table I. Analysis of neonatal outcome was limited to 85 women who delivered within 7 days of the tests; 54% of the women delivered within a day of their last test, 72% within 2 days and 83% with 3 days. The gestation of the fetuses at the time of the tests ranged from 27 weeks to 42 weeks and the reasons for an NST included intrauterine growth impairment (27 cases), pre-eclampsia (37), chronic hypertension (16), decreased fetal movement (4), post-term pregnancy (4), undiagnosed antepartum haemorrhage (6) and polyhydramnios (1).

Table I. Results of the can test versus the non-stress test

<table>
<thead>
<tr>
<th></th>
<th>Non-reactive</th>
<th>Reactive</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ve (abnormal)</td>
<td>10</td>
<td>14</td>
<td>24</td>
</tr>
<tr>
<td>-ve (normal)</td>
<td>9</td>
<td>126</td>
<td>135</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>140</td>
<td>159</td>
</tr>
</tbody>
</table>

Sensitivity = 52%; specificity = 90%; positive predictive value = 42%; negative predictive value = 93%.

Auscultated FHR acceleration without objective fetal movement was detected in 15 of the 63 true-negative and 1 of the false-negative tests.

When the tests were compared, 42% of positive can tests were followed by non-reactive NSTs (positive predictive value) and 93% of negative can tests were followed by reactive NSTs (negative predictive value) (Table I). Of the 9 'false'-negative results, 4 had poor outcomes. In other words, had the can test been used as a screening test, 4 poor outcomes would have been missed.

The ability of a non-reactive NST to predict a poor outcome in this study was 60%. In addition, 10% of cases with a good outcome had a non-reactive NST. A non-responsive can test predicted a poor outcome in only 31% of cases and was no more predictive of poor outcome than the NST alone. The 9 poor outcomes predicted by the can test included 3 babies with a cord pH at birth of < 7.2, 1 baby with a 5-minute Apgar score of 3, 4 stillbirths and 1 early neonatal death within an hour of delivery. All of these patients delivered within 48 hours of the last test.

The percentage of non-reactive NSTs and poor outcomes identified by the can test was 56% (sensitivity) with a positive predictive value of 28% (Table II). However, the ability of the can test to predict a reactive NST and a good fetal outcome was 94%. Specificity (percentage of reactive NSTs and/or good outcomes identified) was 83%.

Table II. Results of the can test versus the non-stress test with regard to fetal outcome

<table>
<thead>
<tr>
<th></th>
<th>Non-reactive NST and poor outcome</th>
<th>Reactive NST and/or good outcome</th>
<th>Total can tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ve (abnormal)</td>
<td>5</td>
<td>13</td>
<td>18</td>
</tr>
<tr>
<td>-ve (normal)</td>
<td>4</td>
<td>63</td>
<td>67</td>
</tr>
<tr>
<td>Total NSTs</td>
<td>9</td>
<td>76</td>
<td>85</td>
</tr>
</tbody>
</table>

Sensitivity = 56%; specificity = 83%; positive predictive value = 28%; negative predictive value = 94%.
Discussion

The can was effective in eliciting a fetal response in 67/85 (79%) of fetuses studied. On the basis of this and our in vitro study, it would seem reasonable to use a can for fetal arousal during electronic FHR testing, if no electronic stimulator is available. The clinical can test failed to predict poor outcomes in 4 of 9 patients. In none of these 4 cases was action to intervene taken on the basis of the NST results, which were non-reactive in the first 3 cases. These 3 patients had placental abruptions in the 48 hours after the can test, 2 of which resulted in stillborn babies. Although Odendaal et al. have shown that 6-hourly FHR monitoring can predict abruptio placentae, this level of surveillance is beyond the scope of many hospitals. In the fourth case polyhydramnios was present, and the NST was reactive, with variable decelerations thought to be due to cord compression. The cord pH at delivery was 7.16 but the baby was clinically well (Apgar scores 8 at 1 minute and 10 at 5 minutes). The poor sensitivity of the can test related mainly to occurrence of placental abruption following the test, a shortcoming common to conventional FHR testing. The 3 patients who had placental abruptions also had pre-eclampsia and, in a primary care setting, would have been referred to hospital for management.

In view of the reasonable negative predictive value, the use of the can test in a low-risk population at a primary care level is worth investigating, given that there are few or no cardiotocograph machines and women need to be referred elsewhere for NSTs. It could potentially decrease the number of NSTs or patients referred by 74%.

Conclusion

We have shown that the can test is effective in eliciting a fetal response, and that auscultation for FHR accelerations is feasible as an adjunct to the clinical fetal arousal test. In view of the reasonable negative predictive value, the can test should be investigated as a screening test in low-risk women in a primary care setting.

We wish to thank Dr Nicola Jackson for her help with this project and Professor Claire Penn for the loan of the sound level meter used in our preliminary in vitro study. We acknowledge the MRC and Wits University Research Council for funding of this research project.

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Clinical disorders of the endometrium and menstrual cycle

Iain T Cameron, Ian S Fraser and Stephen K Smith

Hardcover, January 1998, R980

Disorders of menstruation are a major cause of morbidity in women. The treatment of such conditions presents an enormous clinical challenge, especially since some of the treatments used can themselves result in further menstrual and hormonal complications.

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