

THE LABOUR ADMISSION CTG

**An assessment of the test's predictive values, reliability and effect
How the test is perceived by practicing midwives**

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ENGLISH SUMMARY

The thesis is based on the following papers:

- Paper I Blix E, Øian P. Labor admission test: An assessment of the test's value as screening for fetal distress in labor. *Acta Obstet Gynecol Scand* 2001;80:738-43.
- Paper II Blix E, Sviggum O, Koss KS, Øian P. Inter-observer agreement in assessment of 845 labour admission tests: comparison between midwives/obstetricians in the clinical setting and two experts. *BJOG* 2003;110:1-5.
- Paper III Blix E, Øian P. Interobserver agreements in assessing 549 labor admission tests after a standardized training program. *Acta Obstet Gynecol Scand* 2005;84:1087-92.
- Paper IV Blix E, Reinart LM, Klovning A, Øian P. Prognostic value of the labour admission test and its effectiveness compared with auscultation only: a systematic review. *BJOG* 2005;112:1595-1604.
- Paper V Blix E, Öhlund LS. Norwegian midwives' perception of the labour admission test. *Midwifery* 2006 (Epub ahead of print).

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Background

Public health is the science and art of preventing disease, prolonging life through and promoting health organised efforts of society¹. Surveillance of the fetus during labour is preventive care; the aim of fetal surveillance and other forms of labour management is to ensure the delivery of a healthy baby in good condition with the minimum of intervention².

Cardiotocography (CTG) is a complex technology applied for surveillance of the fetus during pregnancy, labour and delivery. The fetal heart rate and the frequency of the uterine contractions can be continuously monitored. There are two methods of monitoring the fetal heart rate: the external method, in which an ultrasound transducer is placed on the mother's abdomen by an elastic belt, and the internal method, in which electrocardiographic leads are attached directly to the fetus after rupture of the membranes. The uterine activity is monitored by an external tocotransducer or by an intra-uterine catheter; the transducers or electrodes are connected to a cardiotocograph where the fetal heart rate and the frequency and duration of the contractions are displayed. Both are recorded in a continuous tracing on paper³.

The labour admission test is a CTG of 20-30 minutes' duration, carried out when the woman is admitted to the labour ward. The test is a part of the labour admission assessment,

which, among other things, includes assessing the size, position and presentation of the fetus, the frequency and strength of the contractions and how the woman is coping with the contractions. The test was introduced as a risk screening in early labour, to detect the compromised fetus on admission and to select the women in need of continuous electronic fetal monitoring during labour^{4; 5}. The test is commonly used for screening in many countries^{6; 7}, and was introduced at a time when scientific knowledge about the test was scant, but trust in the benefits of electronic fetal monitoring was great. No systematic assessments or evaluations were performed before the test was taken into widespread use. Screening is the presumptive identification of unrecognised disease by the application of tests, examinations or other procedures. Screening tests sort out persons without symptoms who probably have a disease from those who probably do not⁸.

British guidelines published in 2001⁹ do not recommend the labour admission test in low risk women, while Swedish guidelines published the same year¹⁰ recommend the test in all women. The British recommendations were based upon three studies^{4; 11; 12}, and the Swedish upon seven studies^{4; 5; 13-17}.

Aim of the dissertation

The aim of the present dissertation was to assess to what degree the labour admission test can predict adverse outcomes, the effectiveness of the test in preventing adverse outcomes compared with auscultation only, the inter-observer variability (or the test's reliability) and to explore what information and knowledge the labour admission test is perceived to provide, and what meaning the test carries in the daily work of practicing midwives.

Material and methods

The patient records of all women (n=1639) who gave birth at Hammerfest Hospital in 1996, 1997 and 1998 were retrospectively reviewed. Variables like indication for admission, how the labour admission test was classified, time span from admission to delivery, interventions, medicaments, mode of delivery, indication for operative delivery, Apgar score, resuscitation of the infant, admission to neonatal unit and other maternal and neonatal outcomes were registered. Copies were taken of all labour admission tracings. Samples from these data were used in Studies I-III.

Paper I. Women who were admitted because of labour, were in the first stage of labour on admission, had a singleton pregnancy and a gestational age of more than 196 days and gave birth within 24 hours after the labour admission test were included. In all, 932

women, both high-risk and low-risk, met the inclusion criteria. Fetal distress was defined as operative delivery for the indication changed/ominous fetal heart rate, or Apgar score less than 7 five minutes after spontaneous delivery (or after operative delivery for other reasons than fetal distress)⁴. Sensitivity, specificity, positive and negative predictive value (PPV and NPV) and likelihood ratio for positive test result (LR+) and for negative test result (LR-) for fetal distress in labour were calculated at different cut-off levels in the whole population and in subgroups of high- and low-risk women, in women who delivered within six hours after the labour admission test and in women who delivered between six and 24 hours after the test.

Paper II. Women who were admitted because of labour, were in the first stage of labour on admission, had a singleton pregnancy and a gestational age of more than 196 days, gave birth within 24 hours after the labour admission test and where the labour admission tracing was present in the woman's file were included. In all, 845 women, both high-risk and low-risk, met the inclusion criteria. Two experts were given copies of the CTG tracings for assessment. The expert assessment was carried out by two consultant obstetricians from other institutions. Inter-observer agreement (weighted kappa (κ_w) and proportion of agreement (Pa)) between the two experts and between the experts and the midwives/obstetricians who had assessed the tracings in the clinical setting were calculated. Sensitivity, specificity, PPV, NPV, LR+ and LR- for fetal distress in labour were calculated for the two experts.

Paper III. Women who gave birth within 24 hours after the labour admission test, had a singleton pregnancy and a gestational age of more than 196 days, where the labour admission tracing was present in the woman's file and had a labour admission test of minimum 15 minutes duration were included. In all, 1199 women met the inclusion criteria. A sample of 549 CTG tracings was included with the purpose to include as many abnormal tests as possible. The sample included both high-risk and low-risk women. The tests were assessed by three midwives and three obstetricians from other institutions who had completed a standard training program¹⁸. Inter-observer agreement (κ_w) and Pa) were calculated. Sensitivity, specificity, PPV, NPV, LR+ and LR- for fetal distress in labour was calculated for each of the six observers.

Paper IV: To assess the effectiveness of the labour admission test in preventing adverse outcomes compared with auscultation only and to assess the test's ability to predict adverse outcomes, a systematic review was performed. Three randomised controlled trials and 11 observational studies were included. The randomised studies comprised 11 259 women and the observational studies 5831 women. Main outcome measures were obstetric interventions (augmentation of labour, continuous electronic fetal monitoring, epidural

analgesia, fetal blood sampling and operative deliveries) and neonatal outcomes (perinatal mortality, Apgar score, seizures, resuscitation and admission to neonatal unit). Relative risks (RR) for the outcome measures and sensitivity, specificity, PPV, NPV, LR+ and LR- for different adverse outcomes (operative deliveries for fetal distress, Apgar score less than seven five minutes after delivery, fetal distress⁴, resuscitation of the infant and admission to neonatal unit) were calculated.

Paper V: This is a qualitative study where a theoretical sample of 12 practising midwives from four different institutions were interviewed in order to explore how the labour admission test is perceived. The in-depth interviews were transcribed verbatim and analysed using the grounded theory technique¹⁹.

Findings

When the tests were assessed by midwives and obstetricians in the clinical setting (*Paper I*), sensitivity in predicting fetal distress was 15, specificity, 95, PPV 16, NPV 95, LR+ 3.2 and LR- 0.9 in the entire study population. In the subgroups of low- and high-risk women, who delivered within six hours or between six and 24 hours after the labour admission test, sensitivity varied between 0 and 36, and PPV varied between 0 and 27. Specificity varied between 92 and 96, and NPV between 89 and 97. When the tests were assessed by experts in a non-clinical setting (*Papers II and III*), sensitivity varied between 22 and 48, specificity 72 and 70, PPV 11 and 15, NPV 94 and 95, LR+ 2,3 and 1.6 and LR- 0,8 and 0.9. For the 11 observational studies include in the systematic review (*Paper IV*), the values were generally low except for specificities and negative predictive values: sensitivity was above 50 in four of 28 single outcomes, LR+ was above 10 in two outcomes and between 5 and 10 in six outcomes. LR- was 0.2 in one single outcome, and between 0.5 and 0.2 in three of the 28 single outcomes.

When the labour admission tests were classified by midwives/obstetricians in the clinical setting and two experts in a non-clinical setting (*Paper II*), κ w varied between 0.25 and 0.38 between the three pairs of observers. Pa for a normal test varied between 0.85 and 0.89 and Pa for an equivocal/ominous test between 0.18 and 0.33. When the tests were assessed by six observers who had completed a standardised training program and in a non-clinical setting, κ w varied between 0.57 and 0.75 in the 15 pairs of observers. Pa for a normal test varied between 0.78 and 0.88, while Pa for intermediary/abnormal test varied between 0.56 and 0.69.

Meta-analysis of the controlled trials found that women randomised to the labour admission test were more likely to have minor obstetric interventions like epidural analgesia (RR 1.2; 95 % confidence interval (CI) 1.1-1.4), continuous electronic fetal monitoring (RR 1.3; 95 % CI 1.2-1.5) and fetal blood sampling (RR 1.3; 95 % CI 1.1-1.5) compared with women randomised to auscultation on admission. There were trends towards more operative deliveries for all reasons (caesarean section, vacuum and forceps) (RR 1.1; 95 % CI 1.0-1.3), operative deliveries for fetal distress (RR 1.1; 95 % CI 1.0-1.3) and caesarean sections for all reasons (RR 1.2; 95 % CI 1.0-1.4) among the women randomised to the labour admission test, although these differences did not reach statistical significance.

The analyses of the twelve interviews identified the core category “experiencing contradictions”, which explains what meanings the labour admission test can carry for practising midwives. The core category indicated that the midwives found conflicting interests within themselves or between themselves and others when using the labour admission test. They experienced contradictions between professional identity and the increasing use of obstetric technology, between feeling safe and feeling unsafe and between having power and being powerless.

Conclusions

There is no scientific evidence of benefit from the labour admission test in low risk women. The test performs poorly in preventing adverse outcomes and is a poor predictor of these adverse outcomes. There is not enough research available to draw any conclusions about its use in high risk women. Midwives and obstetricians who had completed a standardised training program achieved good levels of agreements in assessing labour admission tests. Medical staff taking care of labouring women should be aware that there is a certain disagreement in interpreting labour admission tests, especially in tests assessed not normal. Interviews with 12 midwives found that interpreting CTG tracings could be difficult, especially for newly qualified midwives. The hierarchy of power in the labour ward influenced the use and interpretation of the labour admission test, and some of the midwives felt their professional identity threatened and that midwives in general are losing their traditional skills because of the increasing use of obstetric technology.

Recommendations for practice

Low-risk women should not routinely be offered the labour admission test. Midwives and obstetricians should be aware that there are inter-observer variations in the assessment of the

labour admission test, especially in tests assessed as intermediary/abnormal. Pregnant women should be informed about why the test is not recommended anymore.

Recommendations for future research

Future research should emphasise the most appropriate method of fetal surveillance in high-risk labours and if training programs in assessing CTG are associated with improved outcomes of labour. Finally, the effect of obstetric technology on traditional midwifery skills, should be explored.

Key words

Cardiotocography; labour admission test; screening; inter-observer agreement; systematic review; midwifery practice.

Literature

- (1) Acheson D. Public health in England: the report of the committee of inquiry into the future development of the public health function. London: Great Britain Secretary of State for Social Services, 1988.
- (2) Whittle MJ, Martin WL. Fetal monitoring in labour. In: Chamberlain G, Steer P, editors. Turnbull's obstetrics. London: Churchill Livingstone, 2001.
- (3) Tucker SM. Fetal monitoring and assessment. St. Louis: Mosby, 2000.
- (4) Ingemarsson I, Arulkumaran S, Ingemarsson E, Tambyraja RL, Ratnam SS. Admission test: a screening test for fetal distress in labor. *Obstet Gynecol* 1986; 68:800-806.
- (5) Phelan JP. Labor admission test. *Clin Perinatol* 1994; 21:879-885.
- (6) Berglund S, Nordström L. National survey (Sweden) of routines for intrapartum fetal surveillance. *Acta Obstet Gynecol Scand* 2001; 80:552-553.
- (7) Devane D, Lalor JG, Daly S, McGuire W. Cardiotocography versus intermittent auscultation of fetal heart on admission for assessment of fetal wellbeing. *The Cochrane Database of Systematic Reviews* 2005; Issue 1, Art No.:CD005122.
- (8) Last JM. A dictionary of epidemiology. Oxford: Oxford University Press, 1995.

- (9) Royal College of Obstetricians and Gynaecologists. The use of electronic fetal monitoring. London: RCOG Press, 2001.
- (10) Nordström L, Waldenström U. Handläggning av normal födsel (Management of normal labour). Stockholm: Socialstyrelsen, 2001.
- (11) Umstad MP. The predictive value of abnormal fetal heart rate patterns in early labour. Aust N Z J Obstet Gynaecol 1993; 33:145-149.
- (12) Kulkarni AA, Shrotri AN. Admission test: a predictive test for fetal distress in high risk labour. J Obstet Gynaecol Res 1998; 24:255-259.
- (13) Phelan JP, Ahn MO. Perinatal observations in forty-eight neurologically impaired term infants. Am J Obstet Gynecol 1994; 171:424-431.
- (14) Phelan JP. The nonstress test: a review of 3,000 tests. Am J Obstet Gynecol 1981; 139:7-10.
- (15) Krebs HB, Petres RE, Dunn LJ, Smith PJ. Intrapartum fetal heart rate monitoring. VI. Prognostic significance of accelerations. Am J Obstet Gynecol 1982; 142:297-305.
- (16) Ducey J, Guzman E, Schulman H, Farmakedis G, Karmin I. Value of a screening fetal heart rate tracing in the latent phase of labor. J Reprod Med 1990; 35:899-900.
- (17) Sarno AP, Jr., Phelan JP, Ahn MO. Relationship of early intrapartum fetal heart rate patterns to subsequent patterns and fetal outcome. J Reprod Med 1990; 35:239-242.
- (18) Sundström A-K, Rosén D, Rosén KG. Fetal surveillance. Göteborg: Neoventa AB, 2000.
- (19) Strauss A, Corbin Juliet. Basics of qualitative research. Thousand Oaks: Sage Publications, 1998.