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Original Article

Admission Test and Pregnancy Outcome

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Abstract

Background: The admission test (AT) has been carried out for many years, but there are still debates about the prognostic value of the test. Therefore, we aimed to examine the value of the AT in predicting the adverse outcome in neonates.

Methods: In this cross-sectional study, 425 pregnant women with normal vaginal delivery were studied between2009 and 2014at Vali-e-Asr Hospital. Based on the results, the women were divided into 2groups of normal and abnormal ATs. All the patients were followed up until the birth of their baby, when the status of mother and neonate was determined. The main outcomes of the study were cesarean rate, neonatal intensive care unit (NICU) admission, fetus demise, neonatal acidosis, and Apgar score. The independent *t*-test, chi-square test, Fisher exact test, and logistic regression were used for statistical analysis. The data were analyzed using SPSS (version 17).

Results: Of 425 pregnant women studied, 142 (33.4%) had abnormal ATs with a mean age of 29 (±4.5) years. Multivariate analysis showed that an abnormal AT was able to predict the incidence of cesarean section, intrauterine growth restriction, turned cord, and Apgar<7, but it could not predict neonatal death and hypoxia.

Conclusion: The AT was shown to be a useful screening test with risk factors such as oligohydramnios, bloody amniotic fluid, meconium amniotic fluid, intrauterine growth restriction, and turned cord. Additionally, the test was also able to predict NICU admission and the need for cesarean section, but it could not predict the occurrence of neonatal death.

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Keywords ● Infant ● Outcome ● Admission test ● Electronic fetal monitoring ● Cardiotocography

What's Known

- Many studies have shown that admission test (cardiotocography) could determine pregnancy outcomes, but other studies have not confirmed such results. There are major disagreements regarding the benefits of this test.

What's New

- Admission test can be used for screening many outcomes such as bloody amniotic fluid, meconium amniotic fluid, NICU admission and turned cord, but it cannot predict the occurrence of neonatal death. It seems that, in countries with a weak economy and poor medical facilities, the use of this test can be helpful in labor management.

Introduction

Obstetricians and gynecologists are always interested in predicting the prognosis for neonates during delivery. The fetus may experience hypoxia and injuries caused by stress and contraction during the course of labor.[1] The occurrence of hypoxia during or before labor can lead to complications such as mental retardation, cerebral palsy, and paralysis of the infant; therefore, diagnoses and prompt responses are critical and vital for both fetus and mother.[1,2]

In developed countries, continuous monitoring of fetal heart rate (FHR) is drawn upon as a tool to identify the risk of asphyxia during labor and the method is broadly applied nowadays. Generally, FHR is measured through internal and external methods. The external method is used more often because it

does not need the connection of the electrodes to the fetus.[1,2]

The admission test (AT) is a method that has recently been introduced and employed in some countries.[2] The patterns of the AT are depicted in table 1. This method can monitor external FHR for 20 minutes upon the admission of a pregnant woman.[3] Although this type of assessment is considered noninvasive, it is not mandatory and can be used for the triage of high-risk fetuses.[4] Gurung et al.[5] studied the method and concluded that the test was useful for assessing the current status of the fetus. They also showed that this test could be a predictor of the neonate's well-being in the early hours of birth. However, some studies have reported that the test is inefficient in improving neonatal outcomes.[6] There are still debates over the effectiveness of this test in predicting the fetal outcome.[2,4,6,7]

In some developed countries, the AT may not have a significant effect in improving the prognosis of infants because neonates receive good antenatal care and have access to proper facilities such as intrapartum fetal monitoring and fetal blood sampling. However, in developing countries, this test may be a useful tool.[4] The occurrence of hypoxia during or before labor can give rise to complications such as mental retardation and cerebral palsy. Obstetricians and gynecologists are always interested in predicting the prognosis for neonates during delivery. In developed countries, fetal monitoring (AT) is utilized to identify the risk of asphyxia before labor. Although the test has been carried out for many years, there are still debates about the predictive value of the test. Accordingly, this study was aimed to examine the value of the test in predicting the adverse outcome in neonates.

Patients and Methods

This cross-sectional study, conducted between 2009 and 2014in Vali-e-Asr Hospital, Tehran, included 425 pregnant women who attended the labor ward in the hospital. The sample size was calculated according to alpha error and power of 5% and 90%, respectively, and prevalence of the unfavorable outcome in nonreactive and reactive ATsof55% and 38%, correspondingly. The primary sample size was 133 mothers in each group. We evaluated 142 nonreactive ATs and 283 reactive ATs.

The inclusion criteria covered all full-term pregnant women who were admitted to the labor ward for vaginal delivery, whereas the exclusion criteria consisted of inaccurate gestational age, placenta previa, cord prolapse, previous cesarean section, preterm birth, suspected cephalopelvic disproportion, and any limitation on vaginal delivery.

Informed consent was obtained from the mothers enrolled in the study. The study was approved by the Perinatal Committee of Tehran University of Medical Sciences. The AT was performed through completed questionnaires for the participants, and the results were interpreted by 2obstetricians and gynecologists. The intra- and inter observer reliability was >87% and >85%, respectively, based on the results obtained from the AT.

Table 1: Three-tier fetal heart rate interpretation system

Category of FHR tracings	
Normal pattern or category I, comprising	• Baseline rate: 110–160 bpm • Baseline FHR variability: moderate • Late or variable decelerations: absent • Early decelerations: present or absent • Accelerations: present or absent
Indeterminable pattern or suspicious pattern or category II, comprising FHR tracing not categorized as category I or III	• Bradycardia not accompanied by absent baseline variability • Tachycardia • Minimal baseline variability • Absent baseline variability not accompanied by recurrent decelerations • Marked baseline variability • Absence of induced accelerations after fetal stimulation • Recurrent variable decelerations accompanied by minimal or moderate baseline variability • Prolonged deceleration>2 min but<10 min • Recurrent late decelerations with moderate baseline variability • Variable decelerations with other characteristics such as slow return to baseline, "overshoots", and "shoulders"
Ominous pattern or category III, including either	• Absent baseline FHR variability and any of the following: -Recurrent late decelerations -Recurrent variable decelerations -Bradycardia • Sinusoidal pattern

FHR: Fetal heart rate

First, the women visiting the labor ward with labor pain had a detailed history-taking, followed by a thorough physical examination. After the consideration of the inclusion and exclusion criteria, short electronic FHR tracing was performed simultaneously with uterine activity for 20 minutes[8,9] and was called "the AT". If the test was normal (table1), intermittent auscultation was performed to monitor FHR (every 30 min in stage I of labor and 15 min in stage II with a duration of 1 min).

As is shown in table 1, abnormal ATs were divided into indeterminable and ominous patterns.[10-13] If the AT was ominous, immediate delivery was performed via a favorable method. In the indeterminable AT group (table1), the women received oxygen and intravenous fluids in the left lateral decubitus position and were monitored for 20 minutes again and reclassified. The normal and indeterminable pattern groups were considered for normal vaginal delivery. If the ominous pattern persisted or if the indeterminable pattern and normal AT groups had significant variations as well as prolonged or late decelerations in the absence of beat-to-beat variability, then cesarean section was performed.

All the patients were followed up until the birth of their babies, when the status of both mother and neonate was determined.

The main outcomes of the study were cesarean rate, neonatal intensive care unit (NICU) admission, fetus demise, neonatal acidosis, and Apgar score. Amniotic fluid volume was estimated subjectively at the end of delivery (cesarean section or normal vaginal delivery) and if our estimation showed a volume <500 cc, the term "oligohydramnios" was used to describe this situation.[14]

Univariate analysis was conducted using the independent *t* test, chi-square test, and Fisher exact test to examine the relationship between abnormal ATs and the other studied variables. Variables with a significance level <0.25 were entered into multivariate analysis, performed by logistic regression. The AT was considered a dependent variable, and the other factors were included in the model as independent variables. A P<0.05 was considered statistically significant. The data were analyzed using SPSS (version 17).

Results

Totally, 425 pregnant women were studied. The results of the study are shown in tables 2 and 3. There were no statistically significant differences between the participants' age and their gestational age, mean cord blood pH, induction of labor, neonatal mortality, and intrauterine fetal demise between the 2 groups (table 2).

The Apgar scores at minutes 1 and 5in the abnormal AT group were lower than those in the normal AT group.

Multivariate analysis showed that an abnormal AT was able to predict the incidence of cesarean section, intrauterine growth restriction (IUGR), turned cord, and Apgar<7, but it could not predict neonatal death and hypoxia (table 3).

Discussion

In the present study, the AT was unable to predict the occurrence of neonatal death because there were relationships between some variables and our multivariate analysis was unable to predict these variables in the model. Nonetheless, the AT, as a rapid assessment, can be useful in identifying risk factors in pregnant women. Moreover, research has previously shown that the AT can demonstrate the status of oxygen transfer from the placenta to the fetus through heart rhythm.[6] There is controversy surrounding the efficacy of this test, and no consensus exists on its real prognostic value among different groups of pregnant women. Some researchers have considered it useful in all groups, while others have found it useful just for high-risk pregnant women. In a study by Gurung et al.,[5] the results of the AT were reported normal in 73% and abnormal in 27% of the pregnant women. In their study, the patients with an abnormal test were at a higher risk of intrapartum fetal distress, cesarean section, requiring resuscitation, and NICU admission. The Apgar score at minute 1did not differ between the 2groups of normal and abnormal ATs, but the Apgar score at minute 5 in the abnormal AT group was significantly less than that in the other group. Their study had a small sample size of 100 patients. Another study also showed similar results.[7]

Blix et al.[15] revealed that the AT was not significantly efficient for low-risk pregnant women and it did not fully predict poor outcomes. In some cases, a highly abnormal AT led to surgical interventions such as cesarean section; however, it did not change neonatal outcomes. Another study, showing that perinatal morbidity was higher in women with an abnormal AT, concluded that the application of the AT for high-risk groups could be useful for predicting fetal well-being.[16] Other studies have confirmed the efficacy of the test in predicting intrauterine fetal asphyxia,[17] fetal distress, and the need for NICU admission.[6] Perveen et al.[18] reportedthat 75% of their pregnant women, who were admitted for delivery, had a normal AT and that fetal distress

Table 2: Univariate analysis of the relationship between an abnormal admission test and the studied variables

Variables	Normal (N=283)	Abnormal (N=142)	OR (95% CI)	P value
Age	29 (±5.5)	28.9 (±5)	-	0.803
Gestational age	38.5 (±1.9)	38.3 (±2.2)	-	0.377
Fetal weight	3163.3 (±614.5)	3009.2 (±720.8)	-	0.022
Oligohydramnios†	20 (7.1%)£	28 (19.7%)£	3.23 (1.74–5.97)	<0.001†
Bloody *amniotic fluid*†	8 (2.8%)	12 (8.5%)	3.17 (1.26–7.95)	0.01†
Meconium amniotic fluid†	31 (11%)	29 (20.4%)	2.08 (1.2–3.62)	0.008†
Prolonged deceleration†	4 (1.4%)	18 (12.7%)	10.12 (3.35–30.53)	<0.001†
Variable deceleration†	11 (3.9%)	31 (21.8%)	6.9 (3.35–14.22)	<0.001†
Late deceleration†	1 (0.4%)	19 (13.4%)	43.56 (5.76–329)	<0.001†
Cesarean†	50 (17.7%)	81 (57%)	6.18 (3.94–9.71)	<0.001†
Slow return to base†	5 (1.8%)	19 (13.4%)	8.59 (3.13–23.52)	<0.001†
IUGR†	8 (2.8%)	24 (16.9%)	6.7 (3.05–16.01)	<0.001†
NICU admission†	30 (10.6%)	33 (23.2%)	2.55 (1.48–4.39)	0.001†
Induction†	137 (48.4%)	58 (40.8%)	0.73 (0.49–1.1)	0.14
Turned cord†	29 (10.3%)	46 (32.4%)	4.18 (2.48–7.03)	<0.001†
Neonatal death or IUFD†	4 (1.4%)	3 (2.1%)	1.5 (0.33–6.81)	0.691
Apgar minute 1	8.6 (±0.9)	8 (±1.3)	-	<0.001†
Apgar minute 5	8.9 (±0.6)	8.7 (±1.1)	-	0.02†
PH	7.37(±0.06)	7.31 (±0.11)	-	<0.001†

† Categorical variables according to Yes or No; †Statistically significant differences; £Were determined subjectively; IUGR: Intrauterine growth restriction; NICU: Neonatal intensive-care unit; IUFD: Intrauterine fetal death

Table 3: Multivariate analysis for the relationship between an abnormal admission test and the studied variables

Variables	B	S.E.	Wald	P value	Adjusted OR	OR (95% CI)	
						Lower	Upper
Oligohydramnios£	0.506	0.399	1.609	0.205	1.659	0.759	3.628
Bloody amniotic fluid	0.500	0.547	0.836	0.361	1.649	0.564	4.820
Cesarean	1.349	0.275	24.065	<0.001†	3.852	2.247	6.603
IUGR	1.148	0.562	4.166	0.041†	3.151	1.047	9.486
Turned cord	0.941	0.306	9.427	0.002†	2.562	1.405	4.670
NICU admission	-0.546	0.451	1.463	0.226	0.579	0.239	1.403
Fetus death	-0.494	0.988	0.250	0.617	0.610	0.088	4.228
Apgar<7	0.805	0.285	7.959	0.005†	2.236	1.278	3.911
PH<7.25	0.081	0.504	0.026	0.872	1.084	0.404	2.911

Categorical variables according to Yes or No; £Determined subjectively; IUGR: Intrauterine growth restriction; NICU: Neonatal intensive-care unit

and the need for resuscitation were more prevalent in the group with an abnormal AT.

In a study by Rahman et al.,[19] about 77% of the patients had a normal AT. In their study, fetal distress, NICU admission, and moderate/thick meconium were more prevalent in the group with an abnormal AT, but this group had lower rates of vaginal birth. The authors concluded that the test was noninvasive and inexpensive and it could be useful for high-risk groups. Nonetheless, the test can be used for initial screening, diagnosis of the fetus at risk, and application of intrapartum fetal monitoring and has a satisfactory predictive power for both fetal distress and the need for NICU admission.[20]

In a study by Sandhu et al.,[6] 67% of the pregnant women before delivery had a normal AT. In addition, the authors showed that whereas the test had high specificity for predicting fetal distress, its sensitivity was low. Mires et al.[21] showed that the women with an abnormal AT required more continuous FHR monitoring in labor (OR=1.49), augmentation of labor (OR=1.26), epidural analgesia (OR=1.33), and operative delivery (OR=1.36). Impey et al.[22] revealedthat the AT did not improve outcomes related to infant mortality and morbidity such as cesarean section and Apgar score and that its application might increase some of the other procedures. The investigators compared the test with routine care and conducted a randomized clinical trial with a large sample size among low-risk individuals. In a study by Patel et al.,[23] fetal and maternal outcomes such as fetal distress

(55.6% vs. 6.4%), meconium stained (44.4% vs. 7.7%), cesarean section (66.7% vs. 14.8%), and NICU admission (44.4% vs. 2.4%) were higher in the nonreactive group than in the reactive group.

In another study by Rajalekshmi et al.[8] on over 400 pregnant women, 267 (66.75%) of the patients had reactive tracings, 114 (28.5%) indeterminable tracings, and 19 (4.75%) ominous tracings. Since admission cardiotocography can assess early fetal risks, early intervention can lessen fetal mortality and morbidity. The study showed a good correlation between reactive tracings and good fetal outcomes even with less frequent monitoring. Consequently, the AT can be used as a useful tool to analyze cardiotocography tracings of women in early labor with a view to providing high-quality care and predicting the delivery mode and the fetal outcome. In this study, the sensitivity and specificity of the test were computed to be 92.85% and 94.16%, respectively.

Santosh et al.[9] evaluated over 200 women with the AT and reported that the incidence of fetal distress, meconium fluid, need for resuscitation, and need for NICU admission were significantly more frequent among the patients with ominous test results than among those with indeterminable or reactive test results on admission. The authors also demonstrated that the incidence increased as the test changed from reactive to indeterminable and ominous. It seems that the test value was dependent on the type of patients and the availability of other facilities. In countries where suitable facilities are available, this test does not change neonatal outcomes since fetuses with problems can be quickly identified. Conversely, in countries without proper tools or with lower levels of practice, this test may show its relative superiority.

The use of the AT as a method for the routine evaluation of pregnant women is still somewhat controversial. It seems that this test may be able to predict certain outcomes, but it cannot predict important outcomes such as fetal death and is, thus, unable to rule out the risk of fetal death. The lack of difference between the 2 groups in terms of fetal death may have resulted from the early termination of pregnancy in the abnormal AT group. An abnormal AT could be as a result of primary fetal distress, which causes abnormal newborn's blood gas and PH compared with the normal AT group. A noteworthy drawback to the test is that the physician or midwife may report the test abnormal so as to avoid legal issues and longer follow-up of the patient, leading to unnecessary cases of cesarean section.[24] The main limitation of this study is its cross-sectional design. We suggest that cohort or clinical trial methods be applied for the evaluation of AT relevancy and applicability. It is, however, deserving of note that while we conducted multivariate analysis in our study, the previous studies did not employ this analytical modality. Multivariate analysis can decrease confounding in the results.

Conclusion

The AT is useful in some situations such as oligohydramnios, IUGR, bloody amniotic fluid, and meconium amniotic fluid. Additionally, an abnormal AT can forecast high incidence of cesarean section, NICU admission, and turned cord, but it cannot predict the occurrence of neonatal death. It seems that early termination of pregnancy in a nonreassuring AT can prevent fetal demise and fetal acidosis; hence, there is no significant deference in fetal death and umbilical cord PH between normal and abnormal ATs. Accordingly, in a nonreassuring AT, after taking initial steps for augmenting fetal oxygenation, we can improve fetal situation. In this study, if the patient failed to respond to the initial measures, we performed caesarean section immediately. As a result, the abnormal AT group was associated with IUGR, lower Apgar score, and more cases of cesarean section. However, with accurate and timely intervention, adverse outcomes such as fetal acidosis and fetal demise were not more than those in the normal AT group.

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Conflict of Interest: None declared.

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