EFFECTS OF ACOUSTIC STIMULATION ON BIOPHYSICAL PROFILE TESTING TIME

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Abstract- Biophysical profile (BPP) test is the most commonly used antenatal test of fetal well-being. Purpose of this study is determining the influence of acoustic stimulation (AS) on BPP testing time. About 55 pregnant women at 35 to 42 weeks who referred to department of Obstetric & Gynecology at university of medical sciences, Tabriz, Iran, were selected randomly. We used abdominal ultrasound guidance to place buzzer like device with power of 110 dB at the skin surface of the maternal abdomen, close to the fetal head. BPP test performed and BPP mean testing time calculated before and after AS. Data compared and analyzed by paired t-test. The results showed that fetal AS reduces the overall mean testing time from 24 minutes to 5 minutes. This clinical application can be helpful in busy clinics when rapid assessment of fetal health is required.

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Key words: Biophysical profile, acoustic stimulation, prenatal ultrasound

INTRODUCTION

The biophysical profile (BPP) was developed as a method of integrating real-time observation of the fetus in an intrauterine environment.

Manning et al introduced the BPP test in 1980, and since then it has been widely used as a comprehensive assessment tool for both acute and chronic fetal health and fetal congenital malformations in the antepartum period (1, 2). Previous studies indicated that mechanical, optical stimulation and glucose injection can not alter level of fetal behaviours (3). Antepartum assessment of pregnancies to predict fetal well-being included five biophysical variables (breathing movement, fetal movement, fetal tone, heart reactivity and amniotic fluid volume) which combined to form a biophysical profile score (4). A healthy fetus, if exposed to external sound stimulation, often responds with vigorous movements which can be felt by the mother. A hypoxic fetus usually does not show this response (5). The basic question of the present study is whether AS can change BPP testing time or not?

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MATERIALS AND METHODS

This study was conducted in 55 pregnant women at 35 to 42 weeks who attended to department of Obs & Gyn affiliated to Tabriz University of medical sciences. BPP examination before and after AS were performed simultaneously in all cases. We used abdominal ultrasound guidance to place buzzer like device with out put intensity of approximately 110 dB at the skin surface of the maternal abdomen near to the fetal head. Pulse rate was 15 with interval 1-2 seconds. All of cases received 3 seconds of acoustic stimulation. If fetal breathing, tone, or movement

were not present during the first minutes of the study, duration time of acoustic stimulation increased to 10 seconds. Four parameters of the BPP, including fetal breathing, gross fetal movement, fetal muscle tone and heart reactivity were assessed. Each of which was scored as 0, 1, or 2 before and after any acoustic stimulation were given. The total score (0-8) was calculated. We calculated and compared mean testing time to any parameter and total mean testing time in both of conditions. Tests of significance were done using paired t-test analysis to determine whether there was a difference between BPP testing time in before and after AS.

RESULTS

The results are shown in table 1. The mean testing time of observation of consecutive fetal breathing movement was 13 minutes before AS and 1.5 minutes after that (P=0.0003). The mean testing time to appear 1st, 2nd and 3rd fetal movement were 7.2, 12.5, 17.7 minutes before AS and 0.7, 2.2, 3.8 minutes after AS respectively (P=0.001). The mean testing time of evaluation of fetal tone without and with AS was 7.1 and 0.8 minutes respectively (P=0.001). The mean testing time of increase of fetal heart rate about 15 beat per minute was 13.5 and 2.6 minutes before and after AS respectively (P=0.001). The overall mean testing time was 24 minutes before AS versus 5 minutes following AS (P=0.001).

Table 1. Mean of test duration time before and after acoustic stimulation

	Before acoustic stimulation (minute)	After acoustic stimulation (minute)
time of fetal breathing movement	13	1.5
time of fetal movement	12.46	2.23
time of fetal tone	7.1	0.8
time of fetal heart rate	13.5	2.6

Significant different between before and after acoustic stimulation ($p<0.05$).

A P value < 0.05 was considered significant in all of criteria. The mean biophysical profile score was 7 before acoustic stimulation, and 7.6 after it. There was a significant difference between BPP scores in both conditions. (P=0.038)

DISCUSSION

One of the most commonly used antenatal tests of fetal well-being is the BPP test. This test includes an ultrasonic estimate of BPP parameters. The BPP can be used as an initial test of fetal health and as a secondary back-up assessment of fetuses at risk of adverse outcomes when preliminary evaluations are not reassuring (6).

McFarlin et al used the BPP test as a tool for prediction of preterm delivery (7). Fairly high false positive results may occur during long fetal sleeping in the routine examination. Attempts have been made to find a suitable stimulant to help decrease nonreactive results as well as to shorten the duration of testing: the recently introduced fetal AS test may have such attributes. The AS is a helpful adjunct in the management of high-risk pregnancies (8). To our knowledge, reports on effects of AS on standard BPP testing time are available (9). Pinette et al showed that fetal acoustic stimulation can be used to decrease the biophysical profile testing time and to reduce the number of non-reassuring tests (10). Also Qahtami indicated prenatal exposure to music and voice alters the fetal behaviour. No difference was detected in fetal response to music and voice (11). The human fetus in utero is able to hear and respond to external and internal (maternal) sounds (12). Intrauterine sound pressure levels in excess of 120 dB have been documented during vibro-acoustic stimulation (VAS) (13). Although there are some concerns about the safety of VAS, recent studies have shown that VAS, as applied in clinical practice, did not endanger either neurologic development or hearing in children exposed in utero (14, 15).

Birth asphyxia is a major cause of neonatal mortality and morbidity (16). The BPP test was more likely to predict perinatal death due to asphyxia than lethal anomaly (4). The early diagnosis intrauterine asphyxia avoids birth infants with asphyxia and

irreversible intrapartum damages. At present, BPP test is used to predict intrauterine asphyxia and accurate management of these pregnancies (16). Baskett et al reported a 71.8% false positive result of BPP test in asphyxia that allowed earlier termination of pregnancy (4). Nishioka et al showed that hypoxia itself influences the auditory system of the goat fetuses (17). Pinette et al in their studies showed that the fetal acoustic stimulation had fewer studies without breathing, potentially reducing the need for further testing or intervention. Fetal movements and amniotic fluid volume were most important in predicting the need for cesarean delivery. Fetal heart rate monitoring alone did not predict the need for cesarean delivery, whereas the BPP did (10). Sohmer et al indicated there is an improvement in human fetal auditory threshold during maternal oxygen respiration (18). The results achieved in this approach showed that applying of AS caused fetuses waked-up and responded to stimulation rapidly. It decreased the test duration time and improved BPP scores results in fetuses that were in long sleeping. On the other hand detection of mild asphyxia may have been missed, and then miscellaneous examination is required in this condition. Biophysical profile could prove to be a clinically useful adjunctive tool in the assessment of fetal well-being in labor.

In conclusion, the authors concluded that sound induced accelerations predicted fetal well-being and that sound stimulation significantly shortened mean BPP testing time. This rapid test should be used as a screening method for antepartum assessment of fetal well-being in a busy antenatal clinic.

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REFERENCES

1. Kim SY, Khandelwal M, Gaughan JP, Agar MH, Reece EA.Is the intrapartum biophysical profile useful?Obstet Gynecol. 2003 Sep;102(3):471-476.
2. Lin CC, Adamczyk CJ, Sheikh Z, Mittendorf R.Fetal congenital malformations.Biophysical profile evaluation.J Reprod Med. 1998 Jun; 43(6):521-527.
3. Romero R, Mazor M, Hobbins JC. A critical appraisal of fetal acoustic stimulation as an antenatal test for fetal well-being. Obstet Gynecol. 1988 May; 71(5):781-786.
4. Baskett TF, Allen AC, Gray JH, Young DC, Young LM.Fetal biophysical profile and perinatal death.Obstet Gynecol. 1987 Sep; 70(3 Pt 1):357-360.
5. Batcha TM, Goonewardene IM. The fetal acoustic stimulation test: a reliable and cost effective method of antepartum fetal monitoring. Ceylon Med J. 2005 Dec; 50(4):156-159.
6. Magann EF, Isler CM, Chauhan SP, Martin JN Jr.Amniotic fluid volume estimation and the biophysical profile: a confusion of criteria.Obstet Gynecol. 2000 Oct;96(4):640-642.
7. McFarlin BL, Baumann P, Sampson MB, Kruger M, Cotton DB.The biophysical profile as a tool for prediction of preterm delivery.Ultrasound Obstet Gynecol. 1994 Sep 1; 4(5):367-371.
8. Tongsong T, Piyamongkol W.Comparison of the acoustic stimulation test with nonstress test. A randomized, controlled clinical trial.J Reprod Med. 1994 Jan; 39(1):17-20.
9. Sarinoglu C, Dell J, Mercer BM, Sibai BM.Fetal startle response observed under ultrasonography: a good predictor of a reassuring biophysical profile.Obstet Gynecol. 1996 Oct;88(4 Pt 1):599-602.
10. Pinette MG, Blackstone J, Wax JR, Cartin A. Using fetal acoustic timulation to shorten the biophysical profile. J Clin Ultrasound. 2005 Jun; 33(5):223-225.
11. Al-Qahtani NH. Foetal response to music and voice. Aust N Z J Obstet Gynaecol. 2005 Oct; 45(5):414-417.
12. Sohmer H, Freeman S.The pathway for the transmission of external sounds into the fetal inner ear.J Basic Clin Physiol Pharmacol. 2001; 12(2Suppl):91-99.
13. Nyman M, Arulkumaran S, Hsu TS, Ratnam SS, Till O, Westgren M.Vibroacoustic stimulation and intrauterine sound pressure levels.Obstet Gynecol. 1991 Nov;78(5 Pt 1):803-806.
14. Nyman M, Barr M, Westgren M.A four-year follow-up of hearing and development in children exposed in utero to vibro-acoustic stimulation.Br J Obstet Gynaecol. 1992 Aug; 99(8):685-688.

15. Arulkumaran S, Skurr B, Tong H, Kek LP, Yeoh KH, Ratnam SS.No evidence of hearing loss due to fetal acoustic stimulation test.Obstet Gynecol. 1991 Aug; 78(2):283-285.
16. Muttitt SC, Taylor MJ, Kobayashi JS, MacMillan L, Whyte HE.Serial visual evoked potentials and outcome in term birth asphyxia.Pediatr Neurol. 1991 Mar-Apr; 7(2):86-90.
17. Nishioka N, Nishina H, Yoshida K, Kinoshita K, Ehara Y.Effect of hypoxia on the auditory system of goat fetuses during extrauterine incubation. J Obstet Gynaecol Res. 2003 Apr; 29(2):109-114.
18. Sohmer H, Geal-Dor M, Weinstein D.Human fetal auditory threshold improvement during maternal oxygen respiration. Hear Res. 1994 May;75(1-2):145-150.