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Fetal Response to Sound and Light: Possible Fetal Education?

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Abstract

Purpose: To assess fetal well-being and education ability by fetal response to sound and light.

Material: Intrauterine fetuses in late pregnancy.

Methods: The sound source was a loud speaker connected to an audioamplifier, of which source was sine waves, generated in a stimulator. The sound power was measured by an audiometer. The loud speaker was placed at the pregnant abdomen. A photographic speed light, of which guide number was 25, was flushed at pregnant abdomen around at fetal face, in the photic stimulation.

Results: Acoustic and visual stimulation effects were fetal movements and heart rate (FHR) acceleration in fetal actocardiogram. The stimulation with 1,000 Hz 80 decibel (dB) sound for 2 S produced positive effects at 28 weeks, while 60 dB sounds achieved positive effects in 40 weeks, namely, sound sensitivity increased 10 folds in late pregnancy. Although foetuses responded to 250 and 500 Hz sound in 28 and 40 weeks, sound intensity reduction was insignificant. Positive results to photic stimulation were noted in 23 or later weeks and 77% cases achieved positive results in 40 weeks.

Discussion: Positive effect of sound and light stimulation was fetal movements and FHR acceleration, which were the sign of healthy fetal brain, while, significant sound power reduction was noted only in 1,000 Hz, higher frequency than maternal voice, thus, fetal education will not be expected, and mother voice should be changed to 1,000 Hz using a voice changer in fetal education, however, healthy fetal hearing is expected by the response to 250-1,000 Hz sound and the response to flush light is the sign of healthy fetal retina and light sensing.

Keywords: Fetus; Sound and light stimulation; Actocardogram; Fetal heart rate acceleraion; Fetal movement; Fetal education; Maternal voice

Introduction

There were various problems to discuss the possibility to educate the fetus during pregnancy. The first problem was the conduction of sounds into the uterus from outside, while it was confirmed recording sounds in the pregnant uterus by Murooka [1] and Saling [2] using intrauterine microphone. Next problem was to confirm fetal hearing by fetal response to outside sound with objective technique. Final problem was fetal listening to maternal conversation and the feasibility of fetal education with human voice. Fetal response to outside stimuli was objectively studied using actocardiogram, which recorded fetal heart rate (FHR) and movement in this study [3].

Materials

The subjects to discuss antenatal education were the fetuses after 20 weeks of pregnancy, because we tested fetal response to sound and light after 20 gestational weeks.

Methods

The sound source was electric sine wave signals of Toshiba DCS-002A stimulator (Tokyo, Japan) [3]. Sound frequencies were 250, 500 and 1,000 Hz and the signals were introduced to audio amplifier of which highest ouput was 5 W at 16 ohm load and connected to a 10 inch audio loud speaker of which high frequency range was higher than 1,000 Hz. Acoustic power of the speaker was expressed by decibel (dB), which was determined by an audiometer at 1 meter distance. The speaker was placed covering maternal abdomen, and the sound stimulation were done in the order of 250, 500 and 1,000 Hz, with 2S duration [4,5]. The fetus was stimulated with a photographic flush light, of which guide number was 25 [3]. The light was flushed at maternal abdomen around at fetal face once or twice. The fetal heart rate (FHR) and movements were monitored by an actocardiogram [4], where the stimulation was done in resting fetal state, in order to avoid false positive record.

Results

The 1,000Hz 80 dB sound stimulation developed fetal movement followed by FHR acceleration in 28 gestational weeks, while it developed the same reaction with 60 dB intensity sound in 40 weeks (Figure 1A) with significant difference, namely, the fetus increased sensitivity to sound for about 10 folds during 12 weeks in late stage of pregnancy. The sound sensitivity increase was noted also in 250 and 500 Hz sound, but the changes were insignificant, namely, the difference of fetal sound sensitivity was not confirmed exactly in 250 and 500 Hz. The light stimulation produced fetal movements associated with FHR accelerations (Figure 1B), in 30% of the fetuses in 23 weeks and increased to 77% in 40-41 weeks [3].

Discussion

As we studied, fetal education will be unable with around 300-400 Hz adult human voice, because acoustic intensity changes were insignificant in 250 and 500 Hz. To 1,000 Hz changed adult voice using a voice changer will be used in fetal education, because 1,000 Hz sound intensity difference was significantly detected in fetal responses (Figure

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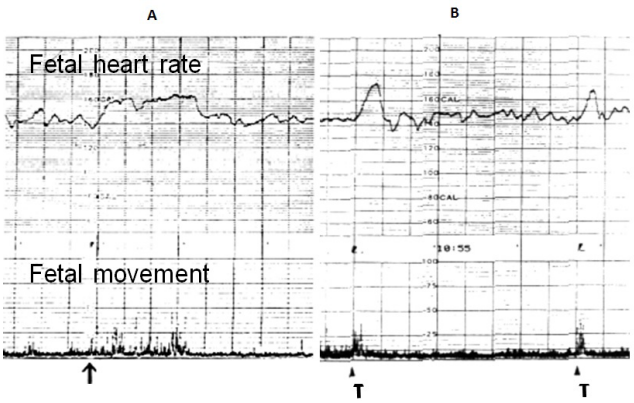

Figure 1: Fetal heart rate and movement response in actocardiogram to stimulations with sound and light. A. Sine wave sound (1 kHz, 80dB) stimulation for 2 s (arrow) B. Photographic flush light (guide number 25) stimulation twice (arrow).

1A). Although vocal education of the fetus is not feasible without voice frequency change to 1,000 Hz, fetal positive response with fetal movement followed by FHR acceleration to 250-1,000 Hz sound stimulation confirmed healthy fetal hearing function, and positive fetal response to the flush light will show healthy eye-ground and light sensing.

Conclusion

Fetal sound and light stimulaion and response showed healthy fetal hearing and light sensing. However, fetal education with maternal conversation will be unable, because 1,000 Hz sound will be mandatory to communicate to the fetus, where mother's voice is definitely lower than required frequency. Fetal education with mother's voice will be feasible by the change of mother's voice to 1,000 Hz using voice-changer, which is very unusual artificial technique compared to mother's voice after the birth, thus, antepartum fetal education will not be feasible, because the voice is only way to communicate with intrauterine fetus.

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