

Novel technique using 3D printing and sound waves to measure intrauterine pressure.

Objective

Diagnosing labour is a vital part for the safe delivery of a child. Normally diagnosis and monitoring of labour progress is performed by a trained midwife or doctor in a hospital at home by a trained midwife if the mother is having a homebirth. There is no universally accepted definition of labour, but a commonly used definition is having 3 strong contractions that last for a minute within 10 minutes. In this investigation, proof of concept for diagnosing labour by measuring intrauterine pressure through sound waves generated by a smartphone was developed. This can be used by mother on her own removing the need for any trained medical personnel to diagnose labour and also without touching the lady, completely non-invasive, reducing risk of infection, patient discomfort, cost to the hospital, as well as unnecessary admissions to the hospital. Other applications could be in diagnosing and monitoring intra-uterine pressure in cases of poly-hydramnios or oligo-hydramnios to be done at home, not needing expensive ultrasonic machines or any complicated training.

Method

Several experiments were carried out using a 3d printed 50% scale model of an average 40-week pregnant woman’s abdomen. The 3d printed skin was filled with water then 4 kHz and 20 kHz frequencies were applied at varying distances (0.17, 0.34, 0.51 m).

Conclusion

- In the future a phone app could be used to emit a sound and receive its reflection used to measure intrauterine pressure in a completely non-invasive way. This can open the door for self monitoring of intrauterine pressure, that can be used in various scenarios like for example diagnosing labour at home, reducing need for vaginal or abdominal examination, diagnosing preterm labour, diagnosing and monitoring polyhydramnios and oligohydramnios. The savings for health service for removing the need of the patient to attend hospital or be reviewed by midwives unnecessarily when service is over stretched could prove to be extremely valuable.

Results

The results revealed positive linear relationship between the reflection coefficients and the internal pressure indicating that the concept is feasible. However, plateaus in the reflection coefficient appeared when the distances decreased, caused by reaching the maximum reflection coefficient for the material at that frequency. 20 kHz was discovered to be an optimal frequency for determining pressure due to its lower error and non-audible qualities, compared to 4Hz, allowing it to be played over an extended period without discomfort.

Contacts and Authors

Mr Benjamin Alderson hashem.elhossamy@nhs.net
University of Birmingham, Birmingham, United Kingdom
Dr Hashem Elhossamy (Presenting)
hashem.elhossamy@nhs.net
The Dudle group NHS trust, Dudley, United Kingdom
RCOG College tutor, London, United Kingdom
Dr Adel Abdelwahab a.a.m.abdelwahab@bham.ac.uk
University of Birmingham, Birmingham, United Kingdom
Professor Khamis Essa k.e.a.essa@bham.ac.uk
University of Birmingham, Birmingham, United Kingdom