

Heating by neonatal transcranial ultrasound: a survey of clinical equipment

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The current clinical practice is seeing an increasingly widespread use of ultrasound in neonatal units, together with the increasing sophistication of ultrasound scanners and the associated potential for increased ultrasound exposure to neonates. In this context, it is important to produce validated, anatomically relevant phantoms to survey the temperature increase caused by neonatal clinical ultrasound equipment.

This study presents the development of special tissue mimicking phantoms, which simulate the key acoustic and thermal properties of the neonatal head. These were used in a small survey of the ultrasound systems that are in current clinical use for neonatal head imaging. The survey took the form of an experimental evaluation of the temperature rise caused by exposure to ultrasound at settings typically used for neonatal examination. The temperature was measured at key positions along the main perpendicular axis of the ultrasound field, at positions corresponding to the skin surface at the centre of the anterior fontanel, the surface of the brain immediately below the centre of the fontanel, the centre of the brain, and the bone at the base of the skull. The phantom was maintained at a constant core temperature with a heat exchange mechanism with a thermal response similar to the one of real perfusion. The output settings tested for each scanner were those typically used clinically, and 3 modes were studied: B-mode, colour-flow and pulsed Doppler.

This study is part of a larger survey to investigate the safe use of ultrasound for neonatal head scanning, funded by the Department of Health (DH). Other activities include a paper-based survey of neonatal ultrasound use and two training workshops, as well as the development and validation of the models used in this equipment survey. The impact on the design of future scanners will be also discussed.