A pilot study to measure the insertion force of a Tuohy needle in a porcine spine

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Introduction: There is a complex interplay of forces during an *in-vivo* epidural needle insertion and without accurate measurement of these forces it is difficult to create realistic epidural simulators. Previous models have relied upon expert user opinion rather than numerical force data, thus making validity difficult to assess. This pilot study presents the results of insertion pressures as a Tuohy needle is advanced through to the epidural space on a porcine cadaver. The primary aim was to test novel and innovative wireless pressure measuring and receiving equipment to facilitate a clinical trial in labouring parturients.

Methods: Approval for this study was granted by the Sponsor, PHFT and Bournemouth University. Ethics approval was not required. A saddle cut of a pig was obtained within 24 hours of slaughter without being frozen. Insertions were performed by two experienced anaesthetists using a Portex 16-gauge Tuohy needle (Smith Medical) at various intervertebral levels from T12 -L5 using a midline approach. Pressure measurement required the use of a three-way tap, manometer tubing, a pressure transducer (Kimal plc) and a uniquely designed wireless transmitter and receiver. Custom-designed computer software processed the relayed data which was continuously monitored and could display a real-time pressure graph. Funding was obtained through both Bournemouth University and Poole Hospital NHS Foundation Trust.

Results: We performed a total of 17 epidural insertions at various levels to minimise confounding effects of multiple insertions at one level. Figure 1 displays a typical graph obtained, with the arrow indicating when LOR occurs. The maximum pressure peak ranged from 470-500mmHg (62.7-66.7kPa). This equates to a force of 11.8N just prior to puncture of the ligamentum flavum.

Conclusions: The results demonstrate that our pressure - measuring system is both accurate and responsive in the porcine model and correlates well with previous studies. Following this pilot study, an *in-vivo* clinical study is now currently in progress, recruiting labouring parturients of varying body mass indices. Funding was secured through a grant from the NIAA. The data will ultimately be used to configure a haptic device for the purpose of creating a realistic force-feedback epidural simulator to assist training.

Reference

1. Tran D, Hor K, Kamani A, Lessoway V, Rohling R. Instrumentation of the loss -of-resistance technique for epidural needle insertion. IEEE Trans Biomed Eng 2009; 56: 820-7.