Ultrasonic regional anaesthesia needles or ultrasound at tip of needle: fact or fiction?

Graeme McLeod, NHS Tayside, School of Medicine, University of Dundee, Dundee, UK

Background, Motivation and Objective

Ultrasound guided regional anaesthesia provides full anaesthesia for shoulder, elbow, hand, foot and amputation surgery with no need for general anaesthesia or even sedation. However, nerve injury may occur and limits clinical uptake. Nerve injury may be attributed to local anaesthetic toxicity, needle trauma, ischaemia , pressure and nerve haematoma. The key intervention that dictates the presence and extent of nerve injury is the position of the needle tip. Visualisation in clinical practice is impaired by the physical nature and interaction of needles, tissue and ultrasound. Needle tip visibility reduces with increased angle and depth. The clinical impact of inadequate needle tip visibility and inaccurate local anaesthetic injection is that the incidence of nerve damage has not decreased compared to peripheral nerve stimulation techniques despite at least a decade of routine ultrasound use.

Statement of Contribution/Methods

There is a clear need for technology that improves the safety of ultrasound guided regional anaesthesia and provides accurate and reliable high resolution, real time images of needle/tissue interaction for clinical practice and research. Microultrasound, defined as involving transducer frequencies > 30MHz, offers the potential to enhance visibility and improve patient safety. A 30MHz transducer is capable of resolutions of 100μm and a 40MHz transducer capable of resolution down to 75μm. Images derived from ultrasound at the end of a needle are presented. High resolution images of nerves are obtained by dissection of tissue and application of single element needles or as commercial multiple array transducers used for small animal and biological research (Visualsonics, Eglinton, Toronto). Our group has also developed a neurosurgical biopsy needle that operated using M-Mode ultrasound. In a pig back model, we inserted a single element 40MHz ultrasound needle in the midline. Reflections from tissue interfaces were observed with movement of the needle. We present images of a regional anaesthesia needle close to the epineurium of the axillary median nerve in an anaesthetised pig model. Good images of needle-nerve interface were consistently obtained across a number of operators and pigs. Upon needle withdrawal, neural tissue demonstrated elasticity with relaxation to pre-injection morphology occurring in 85% of cases.

Results/Discussion

High resolution ultrasound has an important role in the improved accuracy of needle placement for the purpose of administering regional anaesthesia. The magnitude and extent of nerve trauma may be attributed to the positioning of the needle tip. We observed cleaving of epineurium when the needle tip was positioned peripherally in the nerve, and global expansion of the nerve when the needle tip was placed centrally.