474708 - ELECTRICAL IMPEDANCE TO WARN OF INTRANEURAL INJECTION IN DUROC PIGS

Ban Tsui, MD, MSc, FRCPC, Jennifer Pillay, BSc

Anesthesiology and Pain Medicine, University of Alberta, Edmonton, AB, Canada

Introduction: Intraneural injection during peripheral nerve block can be a cause of neurological injury. The “basic rule [that remains is] not to inject local anesthetics into the nerve”.(1) Current approaches to prevent or detect intraneural injection have either shown to be at times unreliable and inconsistent, or have the limitation of proceeding intraneural injection.(2-4) Since even small volume injections of local anesthetic may be damaging (5), the search for a warning sign prior to such injection is clinically crucial. A tissue’s electrical impedance (EI) is highly sensitive to its composition (e.g. water and lipid)(6) and is readily measurable using a currently available nerve stimulator. The nonconductive connective and lipid tissues (including myelin) associated with nerves in the intraneural compartment should impede current more than the highly-hydrated (i.e. muscles) conducting tissues of the extraneural compartment. Dynamically measuring EI could alert clinicians to intraneural needle placement prior to any injection. Our hypothesis was that there is a detectable and significant difference in EI as measured at the needle tip between the extraneural and intraneural compartments.

Methods: After institutional Animal Care Committee approval, four Duroc pigs (30-35 kg) were kept spontaneously breathing and anesthetized. Sciatic nerves were exposed bilaterally (n = 8) in the subgluteal region and kept intact and moist with normal saline. An insulated needle (Sprotte 24 gauge), attached to a nerve stimulator displaying EI (B Braun Medical Inc., Stimuplex HNS 12), was first placed immediately outside and touching the nerve (extraneurally) and then advanced to barely penetrate the nerve sheath (intraneurally). Control EI values were initially measured in the surrounding muscle to confirm that the EI in the saline was similar and could represent the extraneural compartment. Five punctures within a one cm length were performed (n=40). Mean $\pm$ SD EI was calculated for each compartment. The difference between matched intra and extraneural measurements was tested for statistical significance using one-way ANOVA.

Results: The extraneural EI (12.12 ± 1.79 kohms) was significantly lower than that in the intraneural compartment (23.23 ± 4.45 kohms) for all punctures (n=40; $P < 0.001$). The difference in mean EI between the extraneural and intraneural compartments was not significantly affected by multiple punctures.

Discussion: With further study using intact models, EI could prove to be a quantifiable warning signal to alert clinicians to intraneural needle placement, preventing injection of local anesthetic solutions and thus avoiding potential chemical and mechanical nerve injection injury.

References: 1) Anesthesiology 2006;105:647-8, 2) Anesthesiology 2002;96:552-6, 3) Reg Anesth Pain Med 2006;31:445-50, 4) Anesth Analg 2007;104:1281-4, 5) Anesthesiology 2006;105:779-83, 6) Modern Bioelectricity, Marino A ed., New York, Marcel Dekker, 1988, pp 125-80