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Ultrasound in Emergency Medicine

COMPARISON OF TWO TRANSDUCERS FOR ULTRASOUND-GUIDED VASCULAR ACCESS IN LONG AXIS

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□ **Abstract—The long-axis technique for ultrasound-guided vascular access may benefit users attempting deeper targets. The purpose of this study was to determine if a difference exists in the difficulty experienced by novice ultrasound users in obtaining vascular access in long axis with linear vs. curvilinear transducers. Subjects obtained access on simulated peripheral veins in a gel model. Time to successful cannulation, number of surface breaks, and number of needle redirects was recorded. Statistical methods used include analysis of variance, regression analysis, and negative binomial regression. The study population was a convenience sample of 24 4th-year medical students, Emergency Medicine residents, attendings, and nurses, and off-service residents rotating in the Emergency Department who had performed less than three ultrasound-guided vascular access procedures. The difference between the number of surface breaks and redirects and the perceived difficulty between the linear and curvilinear transducers was statistically significant ($p = 0.002$, $p = 0.049$, $p = 0.04$). The difference in time to cannulation with the linear and curvilinear transducers was not statistically significant. Novice ultrasound users found the curvilinear transducer easier to use for simulated vascular access in the long axis. Studies utilizing live patients and more experienced ultrasonographers could determine whether the preference for the curvilinear transducer amounts to clinically meaningful shorter times to needle entry and more successful first attempts. © 2007 Elsevier Inc.**

□ **Keywords—ultrasound; vascular access; long axis; transducers**

INTRODUCTION

Ultrasound-guided peripheral venous access is becoming a necessary skill in the current medical patient population. Ultrasound-guided peripheral venous access has been taught successfully to medical staff with varying degrees of experience in ultrasound and has become standard in select Emergency Departments (EDs), phlebotomy teams, anesthesiology departments, and in dedicated PICC (peripherally inserted central catheters) teams (1–5). In patients in whom it is difficult to obtain superficial peripheral venous access with traditional techniques, ultrasound has been shown to decrease the number of attempts to cannulation, decrease the time to obtain access, and result in few complications (2,4,6).

The most effective techniques to teach novice users ultrasound-guided procedures have not been well-established. Simulation has been used frequently to familiarize students with equipment in safe environments (7,8). Johnson et al. published a physical and cognitive task analysis for interventional radiologists performing vascular access that may assist in teaching novice users (9). Actual technique and transducer selection has been reported variably in published studies. Blaivas et al. demonstrated that novice users prefer short axis to long axis when using a linear high frequency transducer (8). Experienced sonologists recommend learning the long axis approach, particularly for deeper veins with vital structures posterior to the targets (3,10). The assumption that vascular access procedures are best performed with

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Figure 1. Hand position with curvilinear transducer aligned in long axis. Note the crystals on the transducer face extend in a curved array beyond the contact surface with the gel model. This curved array permits the needle to be seen proximal to the contact surface with the transducer.

a high-frequency linear transducer has not been proven. In fact, high frequency endocavitary probes and high frequency curved array probes have been used in both the emergency medicine and the anesthesiology literature (3,10,11). No studies have been carried out comparing curvilinear vs. linear high frequency transducers in long axis in novice users.

The study objective was to determine if there is a difference in difficulty experienced by novice ultrasound users in obtaining vascular access using high frequency linear and curvilinear transducers in long axis using a phantom model. Difficulty was assessed by comparing the time to successful needle entry, number of surface penetrations and needle redirections, and participants' perceived level of difficulty.

Figure 2. Hand position with linear transducer aligned in long axis. Note the crystals on the transducer face begin 3 mm distal to the edge of the contact surface, which permits visualization of only the section of the needle directly under the crystals.

Figure 3. Needle entry into simulated vein in long axis with curvilinear transducer. Note the sector shape, which distorts the true angle between the needle and the target vessel.

METHODS

The study population was a convenience sample of 4th-year medical students, Emergency Medicine residents, attendings, and nurses, and off-service residents rotating in the ED who had performed less than three ultrasound-guided vascular access procedures. Subjects watched a 20-min tutorial video on ultrasound-guided vascular access. A Blue Phantom® (Blue Phantom, Kirkland, WA) model of peripheral vessels was used to simulate peripheral venous access. Subjects were instructed to find the preferred vein in short axis, rotate to long axis, and obtain needle access in long axis under direct ultrasound guidance (Figures 1–4). Subjects used SonoSite® L38

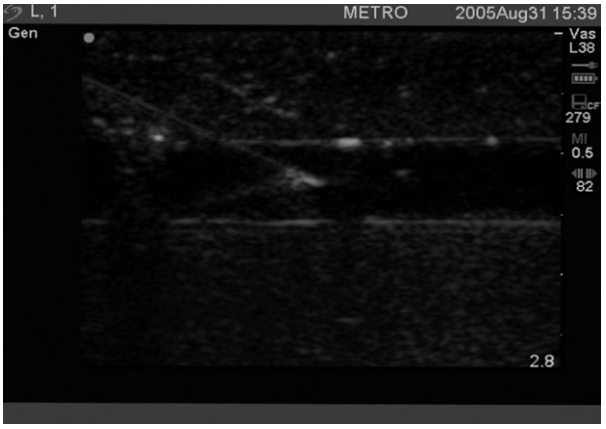

Figure 4. Needle entry into simulated vein in long axis with linear transducer. Note the horizontal surface of the transducer maintains true angles between the needle and the target vessel.