FULL LENGTH ARTICLE

Ultrasound guided vascular access in pediatric cardiac critical care

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Introduction: **Safely obtaining vascular access in the pediatric population is challenging. This report highlights our real-world experience in developing a safer approach to obtaining vascular access using ultrasound guidance in children and infants with congenital heart disease.**

Methods: **As part of a quality initiative, we prospectively monitored outcomes of all vascular access attempts guided by ultrasound from January 2010 to September 2010. Variables monitored included age, weight, the time from first needle puncture to wire insertion, site of insertion, number of attempts, type of line, and complications.**

Results: **There were 77 attempts (15 arterial and 62 venous) to obtain vascular access in 43 patients. The mean age was 15 months (6 days–11 years; median 2.5 months). The mean weight was 7.2 kg (2–46 kg, median 3.8). Success rates were 93% and 95% for arterial and venous cannulation, respectively. Mean time from first needle puncture to wire insertion was 3.9 min (0.5–15 min, median 2 min). Fifty-five (75%) central line cannulations were successful from the first puncture; 17(23%) were successful from the second puncture; and one case (2%) required three punctures. Thirty patients (45%) weighed less than 3.5 kg. This lower body weight did not affect success rate, which was unexpectedly high (96.6%). There were no associated complications.**

Conclusion: **Ultrasound guided vascular cannulation in critically ill pediatric patients is safe, effective and efficient. This approach had a high success rate, and was associated with zero complications in our setting.**

Keywords: Ultrasound, Vascular access, Congenital heart disease, Pediatric

Introduction

Central vascular access is a lifesaving procedure in small compromised infants. Landmark-guided insertion is associated with a high failure rate and added complications [1–5]. The use of ultrasonography facilitates venous or arterial cannulation. In this study, we report real-world outcomes of vascular access under ultrasound guidance in children with congenital heart disease. The techniques of line insertion used in our center are described in detail.

Methods

As part of a quality initiative, we prospectively monitored outcomes of all vascular access attempts guided by ultrasound from January

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2010 to September 2010. One parent gave consent for central venous or arterial line insertion on admission to the unit. As our study is observational and descriptive of our routine practice with no new intervention, we did not require ethical committee approval. We documented age, weight, time from first needle puncture to wire insertion, number of attempts, site and type of the line, and short-term complications (including arterial puncture, hematoma pneumothorax and hemothorax). The main operators were pediatric cardiac intensivists who had acquired basic training in echocardiography while rotating in the pediatric cardiology department. In addition, they attended a critical care ultrasound course, which included hands-on training in ultrasound-guided vascular access and had one or more years of experience. Microsoft Excel 2007 software was used for statistical analysis.

Ultrasound probes

Straight linear probe (12L-RS) from General Electric Company (GE) were used for all access points, except for neck lines in smaller children where a Micro-convex probe (8C-RS from GE company) was often found to be helpful. Short size high frequency linear probe (which is the best for neonatal access) was not available in our unit.

Primary scanning and image configuration

After choosing a suitable probe, we aligned the marker of the probe in the same direction as the marker on the screen (Fig. 1).

To optimize the image we chose vascular mode, and increased the frequency to the maximum. Higher frequencies for near objects provided the best resolution. Focus was adjusted at the level of the vessel. Depth was reduced to optimize vessel visualization. We scanned the veins of patients to find the best site for cannulation. If venous thrombosis was suspected by the presence of decreased vessel compressibility, attenuated Doppler flow, or visible thrombus, then the site was considered not suitable, and no attempt would be made to cannulate the vessel.

Preparing the patient

Shoulder support was usually required to obtain optimal neck vessel visualization and cannulation. Similarly, hip support facilitated femoral line insertion. Patients were given adequate sedation during the procedure with continuous monitoring.

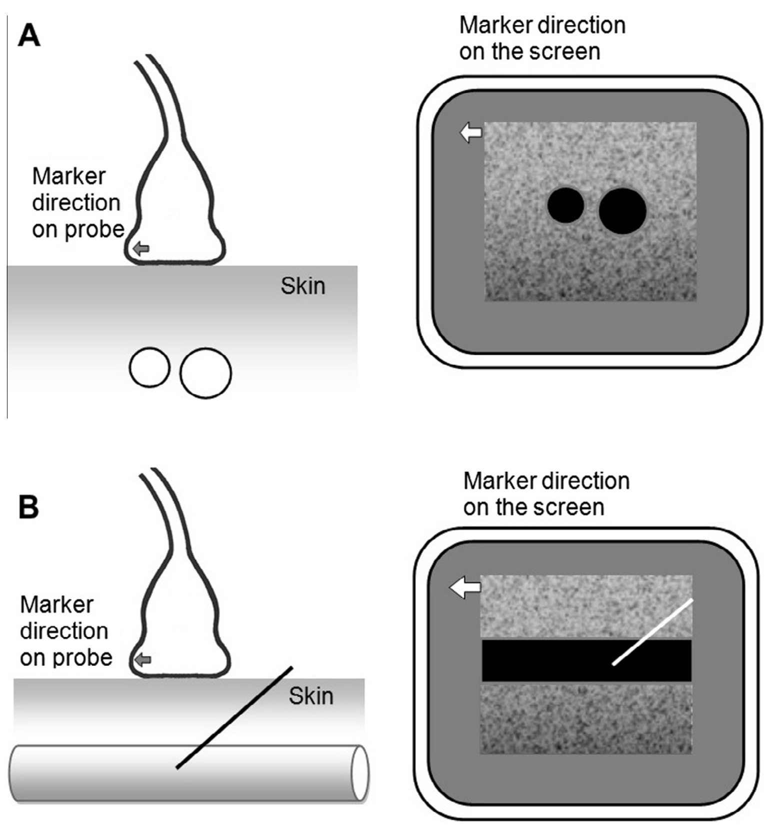

Figure 1. Probe marker should be in the same direction as the marker on the screen. (A) Example on transverse access. (B) Example on longitudinal access.