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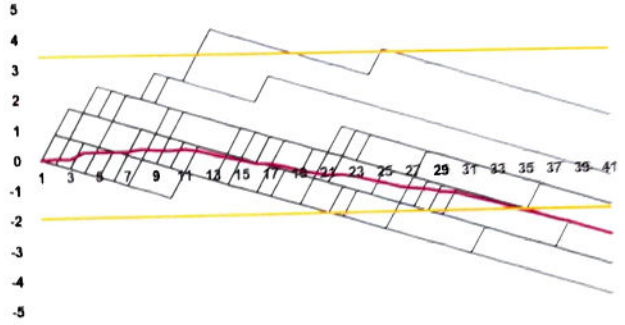
THE LEARNINGCURVE FOR ULTRASOUND-GUIDED PERIPHERAL INTRAVENOUS CANNULATION IN ADULTS

Introduction

Peripheral intravenous cannulation has an estimated prevalence up to 85% in hospitalized patients, making it the most commonly performed medical invasive procedure. A previous study reported a success rate of 81% on the first attempt of peripheral intravenous cannulation with the traditional landmark technique of visualizing and palpating the extremity to identify the target vein, as performed by trained and experienced practitioners. Despite its routine nature, intravenous access cannot be established successfully on the first attempt in every patient. In these situations, advanced techniques to obtain vascular access are required, including ultrasound-guided peripheral intravenous cannulation. To lower the threshold for applying ultrasound guidance during peripheral intravenous cannulation, different healthcare providers need to be trained and gain experience in using this technique, including nurses.

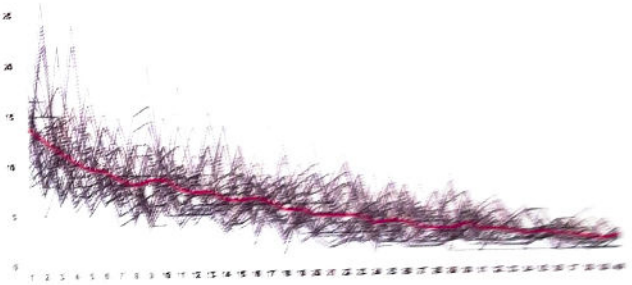
The primary outcome of the current study was to quantify the number of procedures novices need to perform in a life-case supervised environment before competency in ultrasound-guided peripheral intravenous cannulation was achieved.



Methods

This was a multicenter prospective observational study. The population (participants) in this study consisted of nurse anesthetists, PACU nurses, oncology nurses and radiographers with an equal educational background and experience in skills. Participants who are not competent and qualified in peripheral intravenous cannulation with the traditional landmark approach, those with prior experience in ultrasound-guided peripheral intravenous cannulation, those in training, as well as participants with an employment less than three days a week were excluded from participation in this study. Before performing ultrasound-guided peripheral intravenous cannulation on patients, participants received a brief training in a fixed curriculum:

- Theoretical training with a reader including background and theoretical information, followed by a one-hour face-to-face training including lectures to support the transfer of knowledge;
- Hands-on training to practice tracing veins on a life model (classmate) without cannulating them, and cannulating veins on one of the phantoms;
- Life-case training to gain experience and routine in cannulating veins on the upper extremity with an ultrasound-guided technique in human subjects (patients). Data regarding cannulations during the life-case session were registered in the participants logbook and used for analyses.



The outcome of interest was the number of ultrasound-guided peripheral intravenous cannulations a participant needed to perform successfully in the life-case setting to achieve competency, based on a cusum analysis. Competency was defined as optimal performance of US-guided cannulation with cannulation in the least amount of time with the highest success rate on the first attempt.

Results

In total, 49 practitioners participated in the study. Of those 40 (82%) completed the session with 40 procedures. A total of 2066 punctures were performed. The first attempt success rate during this session was 93%. The success rate on the first procedure was 73%, which was 98% on the fortieth procedure ($P<0.001$, $\chi^2=40.761$, 38 / 78%) participants gained competency within 40 procedures, resulting in a lower failure rate per procedure than the acceptable failure rate. A mean number of 34 procedure was needed to achieve competency. Time needed to perform a procedure successfully decreased when more experience was achieved by the practitioner. only 121 minutes were needed during the fortieth procedure.

Competency in ultrasound-guided peripheral intravenous cannulation can be gained after following a fixed educational curriculum. The combination of theory-based didactic training, followed by and hands-on training session and a supervised training session in a life-case session resulted in a steep learning curve. In general, nurses were competent in the procedure after performing 34 procedures. To add on this, first attempt cannulation success increased as the number of performed procedures increased, while time required to obtain successful vascular access decreased. Thus, training of nurses in ultrasound-guided peripheral intravenous cannulation will result in beneficial outcomes for daily clinical practice.

Final publication: The learning curve for ultrasound-guided peripheral intravenous cannulation: a multicenter study" in Medical Ultrasonography (2021). Fontys University of Applied Sciences, Research Group PeriOperative Care & Technology, De Run Eindhoven, The Netherlands. Catharina Hospital, department of Anesthesiology, Intensive Care and Pain Medicine, Maastricht University Medical Center, Eindhoven, The Netherlands. Contact by email rick.vanloon@fontys.nl

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