Introduction

- Part-task simulation trainers offer a promising alternative to bedside teaching to learn subclavian central venous (SC-CV) access through deliberate practice for the acquisition of clinical skills and improved patient care. The objective of this study was to determine the effectiveness as a learning tool of a novel Central Venous Access Mixed Reality Simulator, which can be viewed at [http://simulation.health.ufl.edu/research/cv_introduction](http://simulation.health.ufl.edu/research/cv_introduction). A mixed reality simulator combines both physical and virtual components, with the virtual components registered in 3D space at the same location, orientation and size as the physical implementation would have occurred. In the simulator, the tip of an actual needle attached to a syringe is tracked by a magnetic sensor relative to the physical and virtual components of the simulator and allows the procedure and needle tip trajectory to be visualized for guidance and/or after action review (debriefing). Compared to existing central venous access trainers, this new simulator will detect iatrogenic pneumothorax.

Materials and Methods

- Anesthesiology residents and attending physicians were selected to perform three runs on the simulator. Levels of training included trainees ranging from residents in PGY1 to PGY4, fellows, and faculty. Participants contributed:
  1. A pre-intervention questionnaire about previous subclavian central venous line placement.
  2. Simulation run #1 (without the use of the visualization software) established the participant's baseline knowledge and skills.
  3. A teaching intervention by the same instructor followed by simulation run #2 – with the use of the simulator’s mixed reality (MR) visualization software.
  4. Simulation run #3 – a final test using the simulator without the visualization software.
  5. A post-intervention questionnaire about the realism of the simulator.

Results

From run #1 to run #3, average CVLScore was reduced by 23 points in all participants (N=28) and a reduction in average time (62.4 s) to obtain SC-CV access was observed. We performed repeated measure ANOVA on the outcomes from the three waves of data collection with follow-up pairwise dependent sample t-tests. There were reductions in average time (F=14.28, p<0.001), the number of attempts (F=10.77, p = 0.0001), skin punctures (F=5.59, p = 0.004) and SCVL score (F=14.59, p < .0001) (Table 1). For all outcomes, there were significant differences between Run 1 and Run 2 and between Run 1 and Run 3, but not between Run 2 and Run 3 (p < .05). The increased success rate from 82.1 (Run 1) to 92.9% (Run 3) was not significant (p = .08). Complication rates for pneumothoraces and subclavian arterial punctures were reduced from 11% to 7% and 13% to 7%, respectively. An increased success rate from 82.1 (Run 1) to 92.9% (Run 3) was not significant (p = .08). Complication rates for pneumothoraces and subclavian arterial punctures were reduced from 11% to 7% and 13% to 7%, respectively. (Table 2). On a five point scale (1=strongly disagree to 5=strongly agree), on average participants agreed that the SC-CV access simulator was realistic (M=4.1) and strongly agreed that the simulator should be used as a training/educational tool (M=4.8).

Conclusions

Our preliminary data indicate that the UF Mixed Reality Simulator offers a realistic representation of SC-CV access. Although there is a trend toward better performance with experience, the effect of PGY-level on performance variables was not statistically significant. This is however preliminary data and we planned a priori increasing the sample size at each level of training. This new device could be implemented into residency training programs in multiple disciplines to help training in subclavian venous access. This simulation training translates clinically to a likely reduction in pneumothoraces and arterial punctures.

References


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