The use of cumulative sum (CUSUM) analysis as a competency assessment tool for ultrasound-guided arterial line procedures in young children performed by pediatric anesthesiology trainees

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Introduction

• Invasive arterial monitoring is an important tool in the management of critically ill children and the ACGME currently requires that pediatric anesthesia fellows perform a minimum of 30 arterial cannulations over the course of a 1 year fellowship.
• Neonates and small children can be challenging due the small caliber of their arteries and ultrasound-guided vascular access has become an invaluable skill for anesthesia providers (2).
• Fellowship programs may benefit from an objective assessment of procedural competency and the ability to monitor skill acquisition.
• Cumulative sum (CUSUM) analysis is a statistical methodology that looks at an individual’s progress over time and has been used to determine proficiency in various clinical procedures based on establishment of acceptable failure rates (1).
• Here, we describe CUSUM analysis as an assessment tool to evaluate competency in US-guided arterial line placement in a cohort of pediatric anesthesia fellows.

Methods

• 30 pediatric anesthesia fellows self-reported their successful and unsuccessful consecutive attempts at US-guided arterial line placement in pediatric patients older and younger than 2 years; each needle insertion through the skin was counted as an attempt. Individual CUSUM plots were created for each fellow.
• Acceptable and unacceptable failure rates of 25% and 50% respectively were established prior to data collection.
• “Competency achieved” was defined as the graphical CUSUM trend falling below two consecutive boundary lines.
• “Competency not achieved” was defined as the CUSUM curve failing to cross two boundary lines.
• If fewer than 17 attempts (based on power analysis) were recorded, then the fellow was determined to have insufficient number of attempts to determine competency.
• Frequency and percentage for competency outcomes were summarized by patient’s age (<=2 and >2 years old).

Results

• Ten and two fellows failed to achieve competency in younger and older pediatric patients, respectively.
• Among fellows who had a sufficient number of attempts in both age groups (n=18), more fellows failed to achieve competency in younger (n=9, 50%) than older (n = 2, 11%, p=0.0082 from McNemar test) pediatric patients.

Discussion

• Our data demonstrates the utility of CUSUM in determining competency for US-guided arterial line placement in pediatric patients.
• We found varying skill acquisition with some learners achieving competency faster than others.
• US-guided arterial line placement in children younger than two years appears to be a more challenging skill.
• Limitations of the CUSUM methodology include the need for self-reporting and large number of attempts required to prove statistical significance.

Conclusion

• CUSUM analysis has potential as an evaluation tool of competency in US-guided vascular access procedures among learners of pediatric anesthesia.
• It may be possible to use CUSUM analysis to identify those who lag behind to provide targeted intervention measures.

References