The Journal of Emergency Medicine, Vol. 53, No. 2, pp. 172–177, 2017

0736-4679/$ - see front matter

http://dx.doi.org/10.1016/j.jemermed.2017.04.002

Original Contributions

PREDICTORS AND DELAYS ASSOCIATED WITH THE NEED FOR ADVANCED TECHNIQUES FOR INTRAVENOUS ACCESS

Michael D. Witting, MD, MS,* Siamak Moayedi, MD,* Latoya A. Brown, PCT,† and Ammar Ismail, MBBS, RDMS†

*Department of Emergency Medicine, University of Maryland School of Medicine, Baltimore, Maryland and †University of Maryland Medical Center, Baltimore, Maryland

Reprint Address: Michael D. Witting, MD, MS, Department of Emergency Medicine, University of Maryland School of Medicine, Baltimore, MD 21201

□ **Abstract—Background: The need for advanced techniques for intravenous access (ATIVA) can lead to delays in care and contribute to emergency department (ED) crowding. Objective: In this article, we estimate the delay and predictors associated with the need for ATIVA. Methods: In this case-control study, we collected data from ED cases requiring ATIVA and control patients in whom i.v. access was gained by traditional inspection and palpation. We included two control groups—a random retrospective sample and a prospective limited convenience sample. We collected time and acuity data from all groups and data on predictor variables from cases and prospective controls. We analyzed time data using quartile regression and predictor variable data using contingency table analysis and logistic regression. Results: We collected data from 116 cases (91 of which had time interval data), 98 retrospective controls, and 144 prospective controls. The median time from triage to i.v. line establishment was 199 min for cases vs. 64 min for prospective controls and 81 min for retrospective controls. The need for ATIVA was associated with a 1.1-greater quartile time interval (95% confidence interval [CI] 0.8–1.3). Two variables—i.v. drug use (IVDU; odds ratio 3.7; 95% CI 1.8–7.3) and prior need for ATIVA (odds ratio 5.2; 95% CI 2.7–9.8)—were associated with a need for ATIVA; obesity, renal failure, and diabetes were not. Conclusions: The need for ATIVA increases median time to i.v. line placement by 118 to 135 min compared with traditional inspection and palpation. IVDU and prior need for an advanced technique are associated with a need for ATIVA.** © **2017 Elsevier Inc. All rights reserved.**

□ **Keywords—catheterization; peripheral; emergency service; hospital; time factors; case control studies; administration; intravenous**

This work was presented at the Society for Academic Emergency Medicine Annual Meeting, San Diego, California, May 2015.

INTRODUCTION

Intravenous (i.v.) access is a basic and vital part of emergency medical care. Occasionally, it cannot be established by the traditional methods of inspection and palpation of peripheral veins. These situations often require advanced techniques for i.v. access (ATIVA), including external jugular vein cannulation, ultrasound-guided placement of a peripheral i.v. line, insertion of a central venous catheter, and intraosseous access. Some of these advanced techniques can be performed by only a limited number of emergency department (ED) staff, sometimes only physicians. One study, based on a small sample, estimated that requiring a physician to insert a line using an advanced technique delayed i.v. access by 2 h (1). The delay in settings in which personnel other than physicians can perform advanced techniques is unknown.

Efficient management of an ED requires anticipating and mitigating delays in care. If a need for ATIVA results in substantial delays, and the administrative and clinical

Received: 9 November 2016; Final submission received: 1 April 2017;
Accepted: 5 April 2017

staff can predict which patients will require ATIVA, they can take action to minimize delays in treatment and disposition. Some patients in whom difficulty is anticipated might be treated without an i.v. line; studies have shown that many such i.v. lines placed in the ED are unnecessary (2,3). When difficulty is anticipated in patients who clearly require rapid i.v. access, an ED manager may work to free a skilled care provider from other duties to perform an advanced technique. In this study, we identify variables associated with the need for ATIVA and estimate the delay associated with the need for ATIVA in a setting where nonphysician care providers can use advanced techniques.

METHODS

Design and Setting

In this case-control study, all data were collected according to protocols accepted by our institutional review board. Data were collected at an urban, university, tertiary care ED with an annual patient census of 60,000 patients. In this setting, some nurses are able to perform external jugular vein catheterization and to use ultrasound to guide peripheral i.v. access.

Data Collection

The "cases" were patients enrolled in a registry used to record data regarding the use of ATIVA, which has been described previously (4). In brief, these were patients who were being treated in an urban ED, who required ATIVA, and who were able to provide written informed consent to have their data collected. In this ED, less than half of nurses are able to start i.v. lines using peripheral ultrasound guidance or via the external jugular vein. Patients were enrolled by one of several research team members, usually when a team member was working. Patients receiving ATIVA when research team members were absent, or too busy to enroll them, would have been missed by this registry. Therefore, the registry was, in effect, a convenience sample. ATIVA were defined as any i.v. access procedure beyond inspection and palpation of peripheral veins: external jugular vein catheterization, ultrasound guidance for peripheral i.v. access, central venous catheterization, and intraosseous access (4). We recorded standard times (time of triage and time of first successful i.v. access) and noted the presence of predictor variables (obesity [body mass index > 30 kg/m^2]; end-stage renal disease requiring hemodialysis; diabetes mellitus; prior need for advanced i.v. techniques; intravenous drug use [IVDU], defined as any in the prior 2 weeks or any lifetime use of two or more per week over a 6-week period; and hypotension [systolic blood pressure < 90 mm Hg]). Triage acuity level, based on the Emergency Severity Index, was also recorded. These data were collected between June 2011 and May 2012.

We created two control sets (one prospective and the other retrospective), each intended to exceed the number of cases. The prospective control set was a limited convenience sample, intended to sample a variety of time periods, with randomization used to limit convenience effects. To create this set, a single assistant (LAB) reviewed the electronic records of all patients during a given shift and approached every third registered patient who seemed to meet eligibility criteria (being stable and able to provide informed consent). She worked shifts at a variety of times to prevent over-representation of business-hour periods. After a patient gave consent to participate, she recorded data for predictor variables (as defined for cases), acuity level, triage time, and time of first successful i.v. line insertion. These data were collected between January and May of 2014. Because simple random sampling provides the most precise and unbiased estimation, and because cases were collected between 2011 and 2012, we also collected a random retrospective control set (5). To create this set, we obtained a log of consecutive ED visits between May 2011 and March 2012 and numbered them in chronological order; we then selected a simple random sample of these. Triage acuity level (as above) and time interval from triage to i.v. access were abstracted for retrospective controls.

Data Analysis

For each predictor variable, we constructed a 2×2 contingency table relating the presence of the variable to the need for advanced i.v. access techniques (case vs. prospective control). We calculated p values for these crude associations using a chi-squared test and calculated odds ratios and confidence intervals using standard formulae. We placed any predictors with $p \leq 0.1$ into a multivariable logistic model and eliminated variables from the model that were not significant after adjustment at a $p < 0.05$ threshold.

We examined the times and found that they were not normally distributed; therefore, we present the data as medians with interquartile ranges (IQRs). We used quartile regression to compare quartiles for cases and controls and to adjust for triage acuity levels and type of control (prospective vs. retrospective). For this analysis, we included only cases who were enrolled prior to their first advanced i.v. attempt; our intent was to avoid biasing the time analysis by excluding patients who were enrolled after the first advanced attempt had failed. We constructed a histogram of time intervals for cases and prospective controls.