Training Prehospital Personnel in Saphenous Vein Cutdown and Adult Intraosseous Access Techniques

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Abstract

Objective. To compare the success rates, complication rates, and times required for paramedic students to perform saphenous vein cutdown and adult intraosseous infusion using the bone injection gun (BIG). **Methods.** This was a prospective, randomized crossover study of 13 senior-level students in a baccalaureate degree paramedic program. Study subjects were instructed in adult intraosseous and saphenous vein cutdown techniques through lecture and laboratory exercises and then randomized into two groups. Group 1 performed saphenous vein cutdown at the ankle, followed by intraosseous infusion using the BIG. Group 2 performed the same procedures but in reverse order. All procedures were performed on preserved cadavers and videotaped. Using a standardized scoring sheet, the authors evaluated the study subjects at the time of the procedures to determine success rates, errors, and complications. Videotapes were later reviewed to verify the time required to complete the procedures. **Results.** The normalized mean procedure scores were 96.15 (SD 4.28) and 83.83 (SD 15.52) for the intraosseous infusion and saphenous vein cutdown procedures, respectively (95% CI for difference in means, –12.34 to –1.3; p = 0.020). Success rates for establishing venous access were higher for the intraosseous route (92.3%) than the cutdown technique (69.2%), but did not achieve statistical significance (p = 0.250). The times required to initiate fluid flow were 3.91 minutes (SD 0.82) by the intraosseous route and 7.57 minutes (SD 1.80) by venous cutdown (95% CI for difference in means, 2.43 to 5.55; p = 0.000). One critical error and 11 noncritical errors were encountered during the intraosseous procedure, compared with ten critical errors and 29 noncritical errors during the cutdown procedure (p = 0.195). **Conclusion.** In a group of inexperienced paramedic students working on a preserved human cadaver model, intravenous access was gained more rapidly, with a higher success rate, and with fewer complications using the bone injection gun than by the saphenous vein cutdown procedure. Further study is needed to evaluate these procedures in the field setting and to compare their feasibility with other alternative venous access techniques such as femoral, external jugular, and central venous cannulation. **Key words:** intraosseous infusion; bone injection gun; intravascular access; venous cutdown; paramedic; emergency medical services.

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Intravascular access is a vital component of prehospital emergency care and resuscitation. In general, paramedics have enjoyed high success rates in gaining intravascular access using standard over-the-needle catheters placed in peripheral veins of the extremities.[1–5] However, occasions do arise when peripheral access is problematic and alternative means of access become necessary. In these instances, the options include femoral or external jugular cannulation, central venous lines, or saphenous vein cutdowns, although not all of these procedures are universally performed by paramedics.[6] More recently, the bone injection gun (BIG) has been introduced to permit intraosseous (IO) access in adults for whom venous access is problematic. The BIG is a spring-activated device capable of placing a 15-gauge trocar needle into the bone marrow of the tibia or radius, and is described in detail elsewhere.[7]

Although several options exist for establishing intravenous (IV) access when standard approaches fail, the feasibility of these alternative access routes for use by prehospital personnel is not well established. Assuming that the more traditional rescue techniques for IV access, such as external jugular and femoral vein cannulation, have been unsuccessful, use of other less commonly employed routes becomes necessary. Consequently, the purpose of this study was to evaluate the ability of paramedic students to successfully gain IV access using two of these alternative routes: 1) saphenous vein cutdown at the ankle, and 2) adult IO infusion in the proximal tibia using the BIG.

Materials and Methods

With approval of our institutional review board, the senior class of a baccalaureate degree paramedic program (n = 13) was selected to evaluate the feasibility of adult IO infusion and saphenous vein cutdown in a cadaver model. Paramedic students were chosen for this study because of their lack of experience in both techniques. Study subjects received didactic and laboratory training in both procedures. Table 1 describes the educational curriculum. Using a crossover design, students were randomized into two groups: group 1

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TABLE 1. Description of the Educational Curriculum

Topic	Hours of Instruction
Review of relevant anatomy and physiology	1.00
Review of lab manual describing adult intraosseous infusion*	1.00
Review video describing bone injection gun (BIG)†	0.17
Demonstration of the BIG	0.33
Return demonstration of the BIG using demo model‡	0.50
Review of lab manual describing saphenous vein cutdown*	1.00
Demonstration of suturing technique	1.00
Return demonstration of suturing technique on model§	1.00
Return demonstration of cutdown technique on model¶	1.00
Demonstration of cutdown technique on cadaver	1.00
TOTAL	8.00

*Lab manuals describing the procedures were developed by the authors.

†Video provided by the manufacturer.

‡BIG demonstration model provided by the manufacturer.

§Suturing practice arm (Nasco, Inc., Fort Atkinson, WI).

¶Laerdal IV Foot (Laerdal Medical Corporation, Wappingers Falls, NY).

performed the saphenous vein cutdown procedure followed by adult IO infusion, whereas group 2 performed the same procedures but in reverse order. All procedures were performed on six preserved cadavers.

The scoring sheets for the procedures were developed by the investigators, using the National Registry of Emergency Medical Technicians Advanced Level Practical Examination as a model. Face validity of the scoring sheets was established by a panel of three emergency medical services (EMS) faculty members.

The scoring sheet for the saphenous vein cutdown procedure is shown in Figure 1. Students were allowed to enter the cadaver lab with body substance isolation gear in place. This was done to simulate the prehospital environment where paramedics typically don isolation gear prior to arrival at the emergency scene. A spiked 1,000-mL bag of sodium chloride solution and infusion set were provided. Again, this was done to simulate the field environment where typically one paramedic sets up the infusion set while the second team member performs IV cannulation. Furthermore, it was assumed that the times required to set up the infusions would be identical for the two procedures and therefore, not germane to the comparison of the techniques. Other materials provided are described in Table 2.

Six distinct times were recorded for the cutdown procedure: 1) at the start of the procedure when the student first touched the equipment, 2) when the skin was first incised with the scalpel, 3) upon initiation of fluid flow, and 4) when the catheter was secured with plastic adhesive closure strips. In order to evaluate the time required for closing the incision with sutures, time was stopped and the adhesive closures removed. Time was restarted and the student closed the incision with two interrupted sutures and the fifth time was recorded. The leg was then immobilized in a splint and the final time recorded.

The cutdown was performed using a modified version of the "mini-cutdown" technique described by Hansbrough and colleagues.[8] The modification consisted of puncturing the skin approximately 1 cm inferior to the cutdown incision and introducing the catheter into the vessel under direct visualization, as opposed to passing the catheter through the surgical incision and directly into the vessel as described by Hansbrough et al. (Fig. 2).[8] Although this modification may have lengthened the procedure time, it was believed that the technique would provide additional stability to the intravenous catheter and reduce the likelihood of dislodging of the catheter in the field setting.

The scoring sheet for the adult IO procedure is shown in Figure 3. Again, subjects were permitted to enter the lab with isolation gear donned, and a preflushed IV infusion set was provided. Three distinct times were recorded for this procedure: 1) at the start of the procedure when the student first touched the equipment, 2) upon initiation of fluid flow, and 3) when the leg was immobilized in a splint.

Successful placement of the IO needle and cannulation of the saphenous vein were verified by the authors. The scoring sheets were completed during the procedures, and failures, complications, and critical and noncritical errors were recorded at that time. A failure was defined as the inability to initiate fluid flow. For both procedures, each student was permit-

TABLE 2. List of Equipment and Supplies

Adult Intraosseous Infusion	Saphenous Vein Cutdown
1,000-mL sodium chloride and 10-gtts/mL administration set	1,000-mL sodium chloride and 10-gtts/mL administration set
IV start kit (Cypress Medical Products, McHenry, IL)	IV start kit (Cypress Medical Products, McHenry, IL)
Full leg splint (Moore Medical, New Britain, CT)	Full leg splint (Moore Medical, New Britain, CT)
3 × 5 roll gauze	Laceration tray (Graphic Controls, Buffalo, NY)
Bone injection gun (Kress USA Corp., St. Louis, MO)	Over-the-needle catheter
1-inch tape	3 × 5 roll gauze
10-mL syringe with 18-gauge needle	Plastic adhesive closure strips
Sharps container	Scalpel with number 11 blade
Pressure infuser bag	5-0 silk suture with PS-2 needle
	Sharps container

Venous Cutdown Skill Sheet	Possible Points	Points Awarded
Checks selected IV fluid for proper fluid, clarity and expiration date.	3	
Sets up equipment and prepares infusion set.	3	
Places tourniquet proximal to site.	1	
Uses body substance isolation precautions.	2	
Identifies proper anatomical site for incision.	4	
Prepares site with antiseptic solution.	3	
Drapes the area with fenestrated drape.	1	
Verbalizes infiltration of 1% lidocaine in conscious patient.	3	
Makes an approximately 3 cm transverse incision over the vein.	4	
Using closed, curved hemostats pointed downward, places tip into the anterior aspect of the incision down to the tibia and scrapes along the tibia from anterior to posterior, picking up the vein, nerve, and subcutaneous tissues.	5	
Rotates hemostats 180 degrees and opens hemostats widely to spread tissues and isolate the saphenous vein.	3	
Inserts over-the-needle catheter through skin approximately 1 cm from inferior border of the incision.	2	
Under direct vision, inserts the catheter into the vein.	1	
Threads catheter and removes stylet.	1	
Properly disposes of stylet.	1	
Connects syringe to catheter and verifies intralumen position by aspirating blood.	2	
Releases tourniquet.	1	
Connects IV tubing and verifies patency of infusion.	1	
Sutures the incision using simple interrupted sutures.	5	
Places antibiotic ointment over incision and IV puncture site.	1	
Dresses incision and IV puncture site with sterile dressing.	1	
Securely tapes catheter and IV tubing in place.	1	
Immobilizes ankle to prevent line displacement.	1	
TOTAL SCORE	50	

Critical Criteria

- __________ Failure to establish a patent infusion within 8 minutes.
- __________ Failure to take body substance isolation precautions prior to making incision.
- __________ Contaminates equipment or site without appropriately correcting the situation.
- __________ Any improper technique resulting in the potential for air embolism or infection.
- __________ Failure to assure correct catheter placement before attaching administration set.
- __________ Failure to dispose of sharps in proper container.
- __________ Failure to properly suture and dress the incision.

FIGURE 1. Venous cutdown score sheet.

TABLE 3. Scores of the Groups

	Group 1 (n = 7)	Group 2 (n = 6)	Significance
GPA	2.65	2.89	Not significant
Intraosseous procedure score	95.0	97.5	Not significant
Intraosseous success rate	85.7% (6/7)	100% (6/6)	Not significant
Cutdown procedure score	92.23	83.5	p = 0.020
Cutdown success rate	85.7% (6/7)	50.0% (3/6)	Not significant

ted only one attempt to achieve intravascular access. If, for example, a student was unable to identify and cannulate the saphenous vein, the procedure was terminated and a failure was recorded. All procedures were videotaped and reviewed by the authors to verify the time required to complete the procedures. Consensus on scoring and procedure times was reached prior to data analysis.

Statistical analysis was performed using SPSS for Windows 6.0 (SPSS, Inc., Chicago, IL). Unpaired frequency data were analyzed using the chi-square statistic or Fisher's exact test. Paired categorical data were evaluated by McNemar's test. Normally distributed interval level data were analyzed using the t-test or paired t-test. A p-value of less than 0.05 was considered statistically significant.

RESULTS

There was no significant difference between group 1 and group 2 with regard to grade point average, procedure score, frequency of critical or noncritical errors, or success rates for the IO procedure (Table 3). A statistically significant difference in the procedure score was found between the groups on the cutdown procedure. Group 1 had a higher cutdown procedure score than did group 2 (Table 3). Although statistical significance was not attained, group 1 also had a higher success rate on the cutdown procedure than did group 2, while group 2 had a higher success rate and mean procedure score on the IO procedure.

The mean procedure score for IO infusion, normalized to 100%, was 96.15 (SD 4.28), compared with

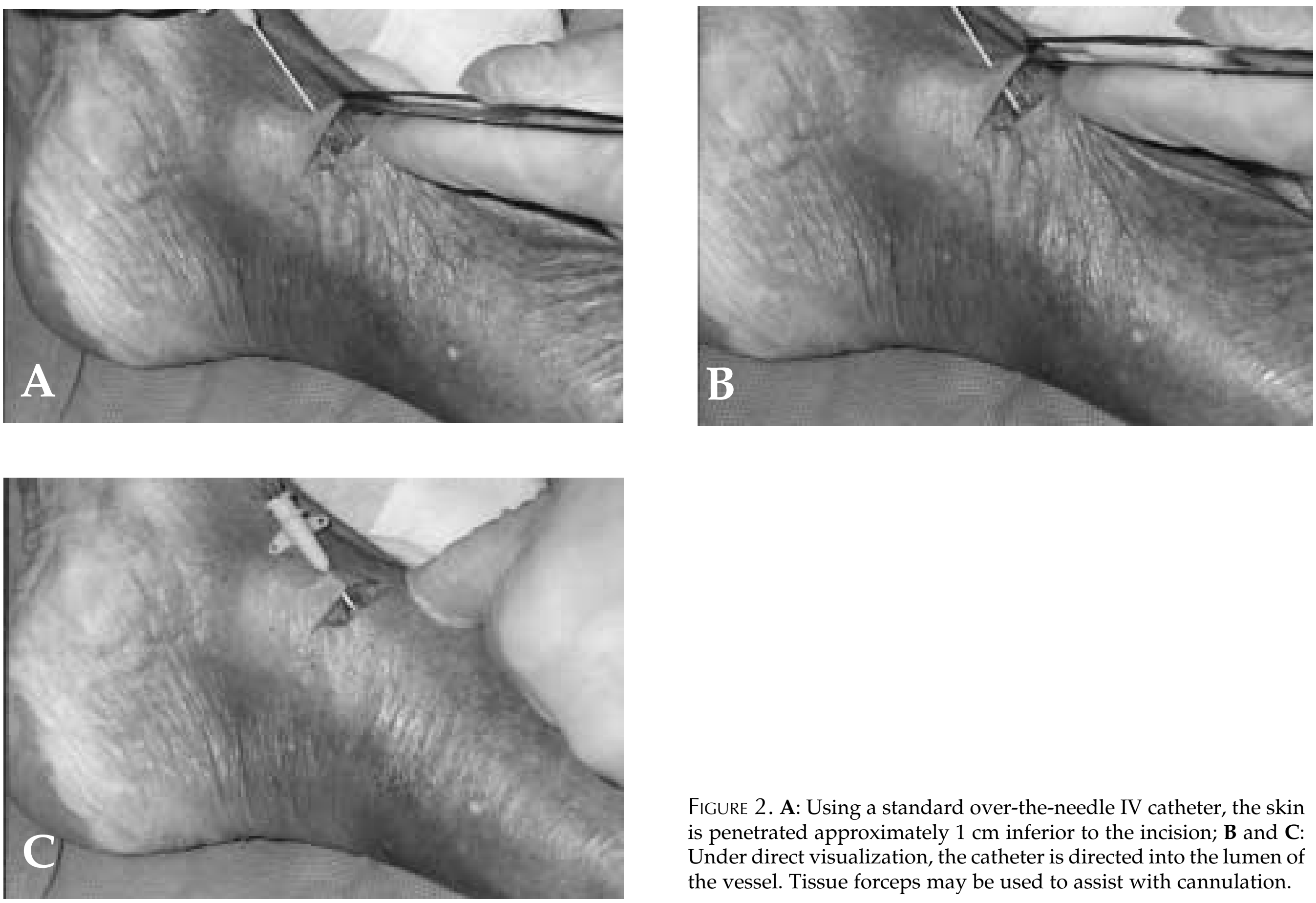

FIGURE 2. **A**: Using a standard over-the-needle IV catheter, the skin is penetrated approximately 1 cm inferior to the incision; **B** and **C**: Under direct visualization, the catheter is directed into the lumen of the vessel. Tissue forceps may be used to assist with cannulation.

83.85 (SD 15.52) for the cutdown procedure (95% CI for difference in means, –12.34 to –1.3; p = 0.020) (Table 4). The adult IO infusion was successful in 12 of 13 attempts (92.3%), and nine of 13 cutdown attempts (69.2%) (p = 0.250) (Table 4). The only unsuccessful IO attempt was the result of misidentifying landmarks. The study subject responsible for the sole failed IO attempt was also unable to attain vascular access by cutdown. Reasons for unsuccessful cutdown procedures are provided in Table 5. For the IO procedure, the average time required to initiate fluid flow was 3.91 minutes (SD 0.82) and the time to complete the

Adult Intraosseous Access Skill Sheet	Possible Points	Points Awarded
Checks selected IV fluid for proper fluid, clarity and expiration date.	3	
Sets up equipment and prepares infusion set.	3	
Uses body substance isolation precautions.	2	
Identifies proper anatomical site for injection.	4	
Prepares site with antiseptic solution.	3	
Verbalizes contraindications (alternative routes available, pediatric, skin infection, fracture, compromised extremity, burns).	4	
Properly Inserts IO needle -Properly holds the bone injection gun. (1 point) -Places in position. (2 points) -Directs away from joint space. (2 points) -Triggers the device. (1 point) -Removes housing. (1 point) -Removes stylet. (1 point)	8	
Properly disposes of stylet.	1	
Confirms Placement -Verifies rigid position of needle. (1 point) -Connects syringe to needle and verifies intramedullary position by aspirating blood (2 points) -Attaches syringe and infuses 10 cc of fluid, observing for extravasation (2 points)	5	
Connects IV tubing and verifies patency of infusion.	1	
Connects pressure infuser bag at 300 mm Hg.	2	
Places antibiotic ointment over IV puncture site.	1	
Stabilizes needle with bulky dressing.	1	
Securely tapes IV tubing in place.	1	
Immobilizes leg to prevent line displacement.	1	
TOTAL SCORE	40	

Critical Criteria

_________ Failure to establish a patent infusion within 6 minutes.
_________ Directs needle toward joint space.
_________ Failure to take body substance isolation precautions prior to making incision.
_________ Contaminates equipment or site without appropriately correcting the situation.
_________ Any improper technique resulting in the potential for air embolism or infection.
_________ Failure to assure correct needle placement before attaching administration set.
_________ Failure to dispose of sharps in proper container.
_________ Failure to properly dress the site.

FIGURE 3. Intraosseous infusion score sheet.

TABLE 4. Procedure Times for Successful Infusions

	Intraosseous	Cutdown	Significance
Attempts	13	13	
Success rate	92.30% (12/13)	69.20% (9/13)	Not significant
Time to fluid flow (minutes)	3.91 (SD 0.82)	7.57 (SD 1.80)	p = 0.000
Time to complete procedure (minutes)	6.36 (SD 1.14)	9.81 (SD 2.30) (adhesive strips)	p = 0.002
		12.16 (SD 2.28) (sutures)	p = 0.000
Incision to fluid flow		4.62 (SD 4.16)	
Vein isolation to fluid flow		1.85 (SD 0.54)	

TABLE 5. Explanation of Failures to Complete Procedures

Procedure and Reason for Failure	*n*	% of Total Attempts	% of All Errors
Intraosseous			
Misidentification of landmarks	1	7.69	100.00
Venous cutdown			
Failure to identify saphenous vein	2	15.38	50.00
Transected saphenous vein	1	7.69	25.00
Vein improperly cannulated	1	7.69	25.00

entire procedure was 6.36 minutes (SD 1.14) (Table 4). In comparison, the cutdown procedure resulted in a mean time to fluid flow of 7.57 minutes (SD 1.80) (95% CI for difference in means, 2.43 to 5.55; p = 0.000) and the time to complete the procedure was 9.81 minutes (SD 2.30) when the incision was secured with plastic adhesive closures, and 12.16 minutes (SD 2.28) when closed with sutures (Table 4). To aid in comparisons with the results of previous work, other times related to the procedure are provided in Table 4. One critical error and 11 noncritical errors were committed during the IO procedure, compared with ten critical and 29 noncritical errors for the cutdown procedure (p = 0.195). An analysis of critical and noncritical score sheet errors are given in Table 6. Even though a trend toward higher success rates and fewer complications using the BIG was evident, the small sample size did not permit these differences to achieve statistical significance.

DISCUSSION

Critically ill or injured patients require rapid IV access for the delivery of fluid, blood, and/or medications. In general, peripherally inserted, over-the-needle cannulas are the preferred method. When difficulty is encountered with peripheral access, several alternative routes are available, with preference varying according to the situation, perceived time required to complete the procedure, and experience of the clinician.

The Advanced Trauma Life Support (ATLS) guidelines recommend large-caliber peripheral IV catheters placed in the forearm or antecubital veins of injured adults.[9] If circumstances prevent placement of these catheters, the guidelines recommend large-caliber femoral, jugular, or subclavian access using the Seldinger technique, or saphenous vein cutdown. Saphenous vein cutdown is an optional skill in the ATLS course. According to the guidelines, which alternative route is chosen is based on the skill level and experience of the clinician.

Current Advanced Cardiac Life Support (ACLS) guidelines recommend cannulating "the large and easily accessible peripheral veins such as the cephalic, femoral, or external jugular."[10] Recognizing the disadvantages and complications of central venous cannulation, only when peripheral sites are not readily available do the ACLS guidelines suggest central venous cannulation. The Pediatric Advanced Life Support (PALS) guidelines recommend IO infusion in children less than 6 years of age for whom peripheral venous access is unavailable. For injured children aged more than 6 years with failed peripheral venous access, the guidelines first recommend femoral vein cannulation, followed by saphenous vein cutdown if femoral access is unsuccessful. In nontrauma resuscitations without peripheral venous access, the guidelines recommend femoral, external jugular, internal jugular, and subclavian routes, with priority given to the technique with which the clinician is most experienced.[11]

Presumably, the foregoing recommendations reflect the standard of care for emergency IV access. However, a search of the literature yielded few evaluations of these techniques performed by paramedics. Furthermore, we were unable to identify a single prehospital investigation of the BIG, a device that offers a new approach to an old procedure and one that may hold promise for rapid venous access in the field setting. Consequently, our goal was to evaluate the feasibility of training paramedic students in two of these alternative access techniques: saphenous vein cutdown and adult IO infusion using the BIG.

The saphenous vein cutdown procedure was first described by Kirkham in 1945.[12] Since then, it has been a popular technique for gaining emergent intravascular access when other techniques have failed. While saphenous vein cutdown may be a common procedure among physicians, no published report exists describing its use by prehospital personnel.

Intraosseous infusion in children is now a commonly accepted prehospital procedure. Success rates have been reported to be as high as 85%.[13–15] However, there are few reports of IO infusion in adults, and even fewer evaluations of adult IO techniques performed by paramedics.[7,13,16,17] Iserson reported the successful use of IO infusion in adult, normovolemic cardiac arrest victims in the emergency department using a 13-gauge IO needle.[16] In a report of prehospital IO infusions that included adult patients, Glaeser et al. reported a 50% success rate among 14 patients between 16 and 102 years of age using an 18-gauge iliac Jamshidi sternal bone marrow needle.[13] Waisman and Waisman reported the successful use of the BIG in two groups of patients: group 1 included 31 patients with closed long-bone fractures undergoing orthopedic surgery; and group 2 included 12 trauma patients and seven patients with medical emergencies presenting to the emergency department.[7] Intraosseous infusion was universally successful in all patients in this series. More recently, Macnab and colleagues reported their investigation of the F.A.S.T.1 IO system.[18] In their series of 50 patients, the device was successfully placed in the sternum of 42 patients (84%); 29 attempts were made by paramedics in the field and 21 by physicians in the hospital. Flow rates of up to 80 mL/min were reported with this device

TABLE 6. Critical and Noncritical Scoresheet Errors (Successful and Unsuccessful Attempts)

Critical Errors

Procedure/Error	*n*	% of Total Attempts	% of All Critical Errors
Intraosseous infusion			
Failure to establish patent infusion within 6 minutes	1	7.69	100.00
TOTAL	1		100.00
Venous cutdown			
Failure to establish patent infusion	4	30.76	40.00
Failure to establish patent infusion within 8 minutes	3	23.07	30.00
Failure to assure correct catheter placement before attaching administration set	1	7.69	10.00
Contaminates equipment or site	1	7.69	10.00
Failure to properly dispose of sharps	1	7.69	10.00
TOTAL	10		100.00

Noncritical Errors

Procedure/Error	*n*	% of Total Attempts	% of All Non-critical Errors
Intraosseous infusion			
Identifies proper anatomical site for injection	3	23.07	27.27
Places antibiotic ointment over site	5	38.46	45.45
Properly disposes of stylet	1	7.69	9.09
Verifies rigid position of needle	2	15.38	18.18
TOTAL	11		99.99*
Venous cutdown			
Places tourniquet proximal to site	2	15.38	6.90
Prepares site with antiseptic solution	1	7.69	3.45
Drapes area with fenestrated drape	4	30.76	13.79
Verbalizes infiltration of 1% lidocaine in conscious patient	6	46.15	20.69
Identifies proper anatomical landmark	2	15.38	6.90
Isolates saphenous vein	4	30.76	13.79
Connects syringe to catheter and verifies intralumen position by aspirating blood	1	7.69	3.45
Releases tourniquet	4	30.76	13.79
Places antibiotic ointment over incision and IV site	3	23.07	10.34
Dresses incision and IV puncture site with sterile dressing	1	7.69	3.45
Securely tapes catheter and IV tubing in place	1	7.69	3.45
TOTAL	29		100.00

*Does not total to 100% due to rounding.

when coupled with a pressure cuff. The mean time to infusion, measured as the interval from opening the package to commencement of fluid flow, was 77 seconds. However, it is not clear what site preparation and infusion setup, if any, were completed outside of this measured time interval. The BIG, F.A.S.T.1, and two other IO devices were investigated by Calkins and colleagues using a cadaver model.[19] The BIG was successfully placed in 94% of attempts, with a mean placement time of 70 seconds. Placement time began with preparation of the insertion site and ended when the study subjects believed the device had been successfully placed. The F.A.S.T.1 was also successful in 94% of attempts, but required a mean of 114 seconds to place. The other two devices had higher rates of successful placement (97%) with placement times similar to those of the BIG.

In our comparison study of adult IO and saphenous vein cutdown techniques, venous access via the IO route using the BIG was completed more quickly and with fewer procedural complications than the saphenous vein cutdown. The mean time to infusion was 3.91 minutes, which is comparable to standard peripheral IV techniques.[1,20,21] In contrast, the cutdown technique was successful in only 69% of attempts and required a mean of 7.57 minutes to initiate fluid flow from the time the procedure commenced. Despite the seemingly low success rate and lengthy time required to complete the cutdown procedure by paramedic students, our results are not vastly different from previous investigations of this technique when performed by emergency medicine residents. Rhee et al. found that first-year emergency medicine residents had a 70% success rate and required 6.5 minutes to initiate fluid flow from the time the skin was violated.[22] Westfall et al., in a comparison of saphenous vein cutdown and percutaneous femoral catheterization among critically injured trauma patients, reported that 90% of their patients undergoing venous cutdown by surgeons or attending-level emergency medicine physicians were successfully cannulated, requiring an average of 5.63 minutes from skin penetration to fluid flow, whereas femoral cannulation was successful in 89% of patients, requiring a mean of 3.18 minutes to initiate fluid flow.[23] In comparison, our study group had a 69% success rate and required on average 4.62 minutes to initiate flow with the saphenous cutdown procedure, and 3.91 minutes to complete the IO procedure with 92.3% success. While it is impossible to establish any direct correlations of these clinical investigations of physicians with our evaluations of paramedic students in a cadaver lab, we offer their results merely for the purpose of comparison.

Despite the similar procedure times and success rates of our study group when compared with other health care professionals, saphenous vein cutdown is never the preferred access method and would rarely be necessary. In general, paramedics are well-versed in establishing IV access using standard techniques.[1–5] However, when intravascular access is problematic in the in extremis patient, our data favor the IO route using the BIG over venous cutdown. Even when the surgical incision of the cutdown was closed with plastic adhesive closure strips, the cutdown procedure required substantially more time to complete than the IO route using the BIG.

While our data favor the BIG over venous cutdown, our findings should be tempered by the limitations of the study design. The sample size is small and consists solely of paramedic students working under laboratory conditions. Their performance results should not necessarily be extrapolated to more experienced practitioners performing in the field or in-house clinical setting.

The use of a cadaver model also carries several limitations. The preservation techniques used in the cadavers render the tissues less mobile and the tissue planes more adherent, making dissection more difficult and potentially prolonging the time required to complete the cutdown procedure.[24] The cadaver is also devoid of blood, making it more difficult to identify the saphenous vein during the cutdown procedure and precluding investigation of other alternative venous access techniques such as femoral or central venous cannulation, which may prove more advantageous than saphenous vein cutdown. Finally, the cadaver model does not permit discovery of longer-term complications such as osteomyelitis, cellulitis, thrombophlebitis, or saphenous nerve injury.

Conclusion

Despite the design limitations of this investigation, our data suggest that paramedics can gain venous access using the saphenous vein cutdown procedure in a cadaver model. However, the IO technique using the BIG enjoyed a higher success rate, was completed more quickly, and encountered fewer procedural complications compared with venous cutdown in our study population. Further study is needed to evaluate these procedures in the clinical setting and to compare their feasibility with those of other venous access techniques such as the F.A.S.T. 1 system, and femoral, external jugular, and central venous cannulation.

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