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Brief Report

SAFETY AND EFFICACY OF THE “EASY INTERNAL JUGULAR (IJ)”: AN APPROACH TO DIFFICULT INTRAVENOUS ACCESS

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Abstract—Background: The easy internal jugular (Easy IJ) technique involves placement of a single-lumen catheter in the internal jugular vein using ultrasound guidance. This technique is used in patients who do not have suitable peripheral or external jugular venous access. The efficacy and safety of this procedure are unknown. **Objective:** We aimed to estimate efficacy and safety parameters for the Easy IJ when used in emergency department (ED) settings. **Methods:** We conducted a prospective study of the Easy IJ in stable ED patients with severe intravenous access difficulty. The study was conducted simultaneously at two academic EDs and a community university-affiliated ED. Patients were selected for failure of alternative access, hemodynamic stability, and ability to increase the IJ diameter with the Valsalva maneuver. Emergency physicians prepped the skin and inserted an 18-gauge, 4.8-cm catheter using a limited sterile technique. We collected the following data: patient body mass index, age, procedure time, pain score, initial success, loss of patency, occurrence of pneumothorax, infection, or arterial puncture. **Results:** We recorded 83 attempts in 74 patients, with a median age of 44 years and a median body mass index of 27 kg/m². The initial success rate was 88%, with a mean procedure time of 4.4 min (95% confidence interval 3.8–4.9). The average pain score was 3.9 out of 10 (95% confidence interval 3.4–4.5). Ten of 73 successful lines

(14%) lost patency. There were no cases of pneumothorax, arterial puncture, or line infection. **Conclusion:** The Easy IJ was inserted successfully in 88% of cases, with a mean time of 4.4 min. Loss of patency, the only complication, occurred in 14% of cases. © 2016 Elsevier Inc. All rights reserved.

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INTRODUCTION

Intravenous (IV) catheter access is of vital importance in emergency medical care. The management of most medical emergencies involves an IV line for the administration of medications, fluids, blood products, or intravenous contrast. Over the years, solutions to difficult IV access have evolved from venous cut-down and landmark-based central venous access to intraosseous access, ultrasound-guided central and peripheral line placement, and vein transillumination (1–4). Difficulty in establishing IV access contributes to emergency department (ED) duration of stay by diverting personnel from other activities. In one study, the median delay to IV access in patients who required a physician to complete the procedure was 120 min (5).

The use of ultrasound guidance has assisted IV line placement in many patients with poor options for

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traditional landmark-guided insertion (6). When a patient has no suitable vein—as confirmed with ultrasound in the upper extremities or by inspection and palpation of the external jugular veins—the alternatives to vascular access are limited to intraosseous lines and central venous catheters. Intraosseous lines are preferred in the resuscitation of unstable patients but are seldom used in stable patients who are in need of IV access. Therefore, the only current alternative for stable patients is central venous access, which requires elaborate sterile draping of the patient and often the assistance of a second operator. In addition, central venous catheters are expensive and time-consuming to place and have the potential for many adverse effects not typically associated with peripheral access, such as systemic infection, deep vein thrombosis, and cardiac dysrhythmia.

Another option for IV access was described in 2009 (7). It involves placement of a single-lumen angiocatheter (typically used for peripheral IV access), under ultrasound guidance, into the internal jugular (IJ) vein (7–10). Termed the “Easy IJ,” this procedure is performed with limited sterile technique (i.e., a gown, sterile gloves, and drapes are not required). From a risk perspective, the Easy IJ is fundamentally similar to other methods of access that are routinely used. It shares features with peripheral ultrasound-guided access, external jugular venous catheterization, and central venous access. Since its original description, there have been three published series, totaling 37 patients, but the safety and efficacy of the procedure remain undetermined (8–10). The purpose of this study was to estimate the safety and efficacy parameters for this technique when used for difficult IV access in an ED setting.

METHODS

Design

In this multicenter, noncomparative trial, we enrolled ED patients who required IV access but in whom attempts to establish that access had failed through either peripheral or external jugular veins, including attempts using ultrasound guidance. Other inclusion criteria included the ability to dilate the IJ with the Valsalva maneuver—an important part of the procedure—and the ability to sign written consent. Exclusion criteria were hemodynamic instability (i.e., heart rate >150 beats/min or mean arterial pressure <60 mm Hg), untreated pneumothorax, or the clinical need for a triple-lumen venous catheter. The institutional review board at each hospital approved the protocol.

Setting

Participating hospitals included a residency-affiliated community hospital and two tertiary care urban academic medical centers in different states.

Study Procedure

The Easy IJ procedure was performed by physician operators with a minimum of 5 previous successful IJ vein catheterizations using the Seldinger technique and 5 previous successful peripheral ultrasound-guided vein catheterizations. Operators reviewed a one-page procedure description, which included instructions on gathering equipment (Figure 1), patient positioning, sterile procedures (e.g., prepare skin, bio-occlusive on probe, and sterile lube dripped onto probe), and having the patient perform the Valsalva maneuver. The procedure uses an 18-gauge 4.8-cm catheter-over-needle device that is typically used for ultrasound-guided peripheral IV catheterization. The sterile procedures were designed to enhance procedures typically used for peripheral catheters. Needle direction was at a 45° angle with the skin and directed toward the ultrasound image of the IJ vein. We posted informational materials in the ED featuring the photographs shown in Figure 2. Each operator also received brief oral instructions from one of the co-investigators.

Treating physicians could order a radiograph or computed tomography scan of the chest at their discretion to rule out pneumothorax after the procedure. The admitting service was informed that the line was intended for 24-h use only, mainly because of concern about the potential for line infection. We chose a 24-h recommended limit because this was a line placed in a central vein, using sterile techniques that were less elaborate than the accepted gowning and draping. Beyond 24 h, the Easy IJ could be left in, if the physician and patient preferred its retention over inserting another IV line.



Figure 1. Materials needed for insertion of an internal jugular (IJ) vein catheter (the Easy IJ technique) and step-by-step instructions. The technique requires an ultrasound machine with a high-frequency linear transducer, chlorhexidine, a 4.8-cm, 18-gauge single-lumen catheter, two bio-occlusive adherent dressings, sterile ultrasound gel media, a loop catheter extension, and a saline flush.

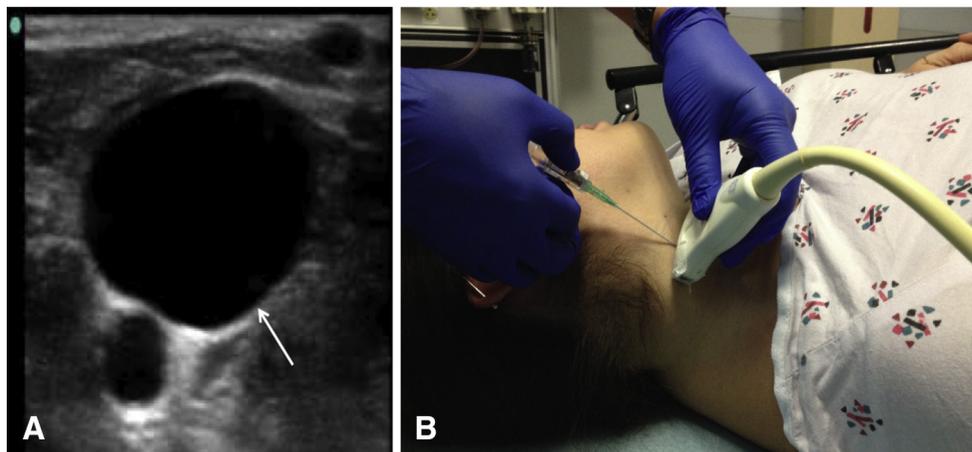


Figure 2. Components of the insertion of an internal jugular (IJ) vein catheter (the Easy IJ technique). (A) Ultrasound image of an internal jugular vein during the Valsalva maneuver (white arrow). (B) Recommended ultrasound probe position and needle direction for the procedure.

Data Collection

Patients were enrolled between August 2012 and December 2015. Research team members obtained patient consent forms and observed each attempt to record data. For each patient enrolled, we recorded age, height, weight, and a description of previous use of the IJ vein for IV access. For each operator, we recorded training level (i.e., attending or resident) and experience with IJ catheterization using the Seldinger technique (i.e., 5–10, 11–20, or >20 procedures) and with peripheral ultrasound-guided IV access (i.e., 5–10, 11–20, or >20 procedures). During each attempt, we recorded the time from skin preparation to confirmation of IV access by aspiration of blood and injection of 10 mL of sterile saline. After insertion, we assessed patency, meaning continued communication between the line and the intravenous space. We recorded the last confirmation of patency and whether there was any failure. We considered aspiration of blood or pain-free injection of fluids, contrast media, or medications as confirming patency and the inability to aspirate blood or infiltration of an injection fluid as indicating failure of patency. We noted the number of skin punctures required and the patient’s assessment of overall pain with each attempt on a 0 to 10 scale. We recorded whether pneumothorax was detected after IV line insertion. We assessed arterial puncture by observation of the initial attempt and by the presence of hematoma noted during patency assessments.

We determined the presence of line infection using a combination of patient report and record review. We attempted to contact patients between 3 and 14 days after the removal of their Easy IJ line to see if they had required treatment for a line infection. If we did not reach them by phone, we reviewed their hospital record to see if they had

been diagnosed with a line infection, either during their index hospitalization or during the following 2 months.

Data Analysis

Much of the analysis involved descriptive statistics. In categorizing previous patient IJ central venous access experience, we distinguished between patients who had any previous IJ attempt and the subset who had five or more IJ attempts in the past. Each patient’s body mass index (BMI) was calculated as kg/m^2 .

We calculated confidence intervals for proportions using normal binomial approximation or exact calculation, as appropriate. We compared mean BMI between subgroups using the *t*-distribution and compared proportions between subgroups using the chi-squared or Fisher’s exact tests, as appropriate. We chose our sample size to have a sufficiently narrow confidence interval for rare complications. For a complication rate of 2%, we wanted a 95% confidence interval range of $\pm 3\%$; this resulted in a sample size of 83 attempts.

A Kaplan–Meier curve was created, according to standard methods, using data from lines with successful initial placement. For this analysis, lines without confirmed patency were considered to have failed in the first hour.

RESULTS

Between 2012 and 2015, we recorded 83 attempts at Easy IJ access in 74 patients; four patients underwent more than one attempt on the same day. The BMI of study patients was statistically similar between those who failed insertion (28.8 kg/m^2), those with postinsertion loss of patency (30.3 kg/m^2), and those with preserved patency

(28.1 kg/m²). The patients' characteristics are shown in Table 1.

Table 2 shows the results of the 83 attempts. The initial success rate was 88%, and the mean procedure time was 4.4 min (range 1–10.5 min). The absence of pneumothorax was confirmed by a chest radiograph in 82 cases and by a computed tomography scan in one case. The absence of line infection was determined in the following manner: home contact after discharge, 10; hospital visit after 48 h, 18; and chart review, 55. No patient was noted to have arterial puncture.

Figure 3 shows the results of Easy IJ attempts. Ten attempts failed at initial insertion, and another 10 lines had postinsertion loss of patency. The remaining 63 lines were effective until they were discontinued, either because they were no longer needed (e.g., ED discharge, peripheral access after hydration, etc.) or because of compliance with the 24-h recommended use period. Figure 4 shows a Kaplan–Meier curve for catheter survival.

Table 3 shows the distribution of initial success rates and postinsertion patency failure at the three hospitals. The hospitals varied by IV insertion expertise. The great majority of attempts were performed at the community hospital by attending physicians. All attempts were made by physicians with >20 previous ultrasound-guided line placements, and previous IJ catheterization experience was distributed as follows: >20 lines, 76; 11–20 lines, 6; and 5–10 lines, 1. There was a trend toward higher initial success rates for the physicians at the community hospital, but our study was not powered to detect differences between subgroups.

DISCUSSION

This study estimated the success and complication rates of performing the Easy IJ on a subset of patients in whom vascular access was not possible via standard peripheral routes. To our knowledge, this is the largest study to date of this technique and the only multicenter study; it is unique because we documented the initial success rate

Table 1. Patient Characteristics*

Characteristic	
Median age, years (IQR)	44 (33–55)
Median body mass index, kg/m ² (IQR)	27 (23–32)
Female sex, n (%)	56 (67)
Previous IJ venous access, n (%)	
1–4	18 (22)
5 or more	23 (28)

IJ = internal jugular; IQR = interquartile range.

* Data based on 83 attempts in 74 patients (nine patients underwent multiple attempts).

Table 2. Results of 83 Easy IJ Attempts

Procedure Time, min (95% CI)	
Overall mean	4.4 (3.8–4.9)
Successful	4.1 (3.5–4.6)
Unsuccessful	6.4 (4.4–8.5)
Pain score, mean (95% CI)	3.9 (3.4–4.5)
Initial success rate, % (95% CI)	88 (79–94)
No. of skin punctures, n (%)	
1	62 (75)
2	16 (19)
3–5	5 (6)
Complications (95% CI)	
Pneumothorax (n = 83)	0 (0–5)
Line infection (n = 83)	0 (0–5)
Arterial puncture (n = 83)	0 (0–5)
Loss of patency (n = 73)	14 (7–24)

CI = confidence interval; IJ = internal jugular.

(88%), failure of patency (14%), failed attempts (12%), and pain scores (3.9).

Variations on this technique first appeared in the literature in 2009 in the form of letters and reports. In 2011, in a letter to the editor, Zwank described a single-center prospective cohort of 9 ED patients in whom the Easy IJ was successful, rapid (mean procedure time 5.54 min), and effective with no reported complications (10). Another single-center prospective observational study of 9 successful Easy IJ placements in the ED also suggested that this procedure could be safe, rapid

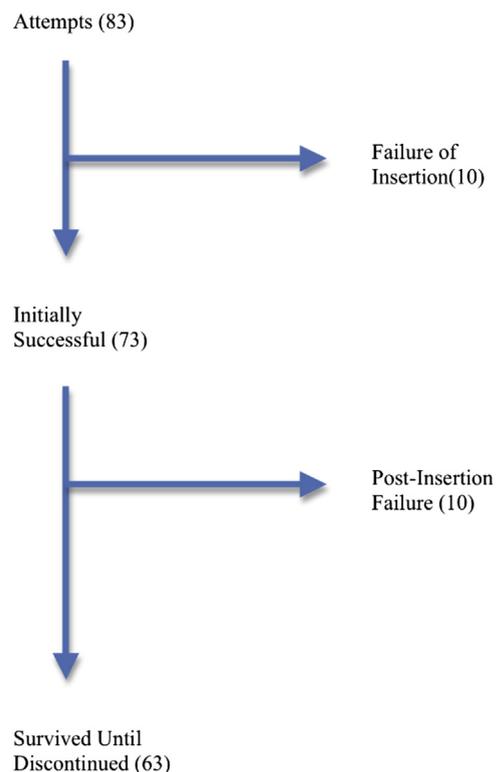


Figure 3. Study flowchart.

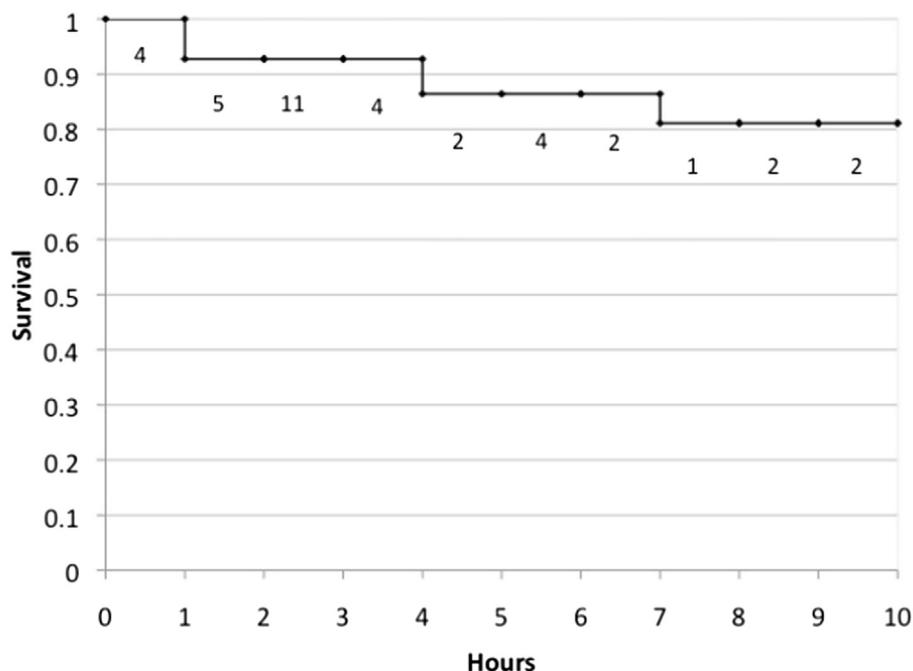


Figure 4. Kaplan–Meier curve for catheter survival for the 73 initially successful internal jugular (IJ) vein catheter placements (Easy IJs). Numbers in the graph indicate lines that were removed because they were no longer needed. All lines (26) lasting beyond 10 h survived until they were no longer needed or were replaced because the 24-h recommended stop period was reached.

(procedure time 2.5–7 min), and effective in a select group of patients in whom more traditional means of establishing venous access were unsuccessful (8). The only reported complication in these case series was failure of patency caused by catheter kinking. In 2015, a study based in an intensive care unit described a single-center experience with 19 patients who underwent 20 Easy IJ attempts. The technique proved rapid (mean procedure time 5.3 min) and safe; no pneumothoraces or other major adverse events were reported (7). This cohort was slightly older than our population (mean age 57 vs. 44 years) but had similar BMI measurements (27 kg/m² in both cases).

The Easy IJ is similar to ultrasound-guided peripheral IV lines (with regard to technique, speed, and size of catheter), external jugular catheters (i.e., use of the neck), and central venous catheters (i.e., use of a central vein). Concerns about the technique that might be raised by clinicians skilled in vascular access but unfamiliar with the Easy IJ are discussed below.

First, what are the risks associated with this procedure, and is it safe for patients? Our study found no major patient-centered adverse events. The only complication in our study was loss of patency (14%). Despite concern about pneumothorax, neck hematoma, inadvertent arterial placement, line infection, or site infection, neither the published literature nor our study reported any major adverse outcomes. We noted no adverse events in patients for whom Easy IJ placement was unsuccessful.

Second, can this procedure be performed rapidly compared with insertion of a central venous catheter? This study and others have found that an Easy IJ can usually be placed in approximately 5 min. While the time needed to place a central venous catheter is operator-dependent, most clinicians would not be able to place a fully sterile central venous catheter in that timeframe. One ED study of central line placement found a mean placement time of 20 min (standard deviation 11.7 min)—including the time required to gather equipment (11).

Table 3. Results by Hospital Site

Site	No. of Attempts	Resident Operator, n (%)	Initial Success, n (%)	Loss of Patency, n (%)
Community hospital	60	5 (8)	55 (92)	6 (11)
University hospital 1	18	11 (61)	15 (83)	4 (27)
University hospital 2	5	0 (0)	3 (60)	0 (0)

Third, is this procedure prohibitively painful? Pain might constitute an obstacle to peripheral IV line placement. One ED-based study of IV line placement in healthy volunteers found an average pain score during insertion of 7 on a 10-point visual analogue scale (12). Other studies in patients with difficult access have found average pain scores between 3.9 and 4.5 (13,14). Our study's average pain score of 3.9 is comparable to these small studies, which suggests that, in terms of patient discomfort, placement of an Easy IJ could be similar to placement of a peripheral or external jugular IV line.

Limitations

This study has several important limitations. First, the vast majority of attempts (76/83) were made by experienced operators who had placed >20 ultrasound-guided peripheral IV lines and had completed >20 IJ vein catheterizations; in fact, although we did not record the specific operator, we believe that the majority were placed by co-investigators. It is likely that inexperienced operators would have less success and greater complications. Second, the study was designed to define sufficiently narrow confidence intervals around estimates for infrequent complications, but our confidence intervals are still wide relative to complication rates for procedures that are better characterized in the literature. Third, we limited the dwell time for the Easy IJ catheters, so we cannot comment on the infection risk for catheters left in beyond 24 h. Fourth, because of a requirement for written informed consent, we excluded patients with hemodynamic instability. We therefore cannot comment on the use of this procedure in unstable patients.

CONCLUSION

In summary, our study adds to the growing body of literature suggesting that the Easy IJ technique can be used as a safe and rapid method of achieving short-term venous access in appropriately selected patients. We had an initial success rate of 88%; over the first 10 h, 14% of lines failed, yielding an overall success rate of 76%. The mean procedure time was 4.4 min. We documented no cases of pneumothorax or line infection.

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conduct of the trial and data collection. S.M., M.W., and M.P. undertook recruitment of patients and managed data. S.M. authored the first draft of the introduction. M.W. analyzed the data and authored the first draft of the methods and results sections. M.P. authored the first draft of the discussion and limitations sections. All authors contributed substantially to the revision and editing of the final manuscript, and S.M. takes responsibility for the paper as a whole. We thank the research team members who helped enroll patients: Ryan Spangler, Haney Mallemat, Ashley Strobel, Colleen Holley, Debra Lee, Ashley Crimmins, George Willis, and Dana Beach. We also thank Linda Kesselring, MS, ELS, for copyediting previous versions of this manuscript.

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ARTICLE SUMMARY**1. Why is this topic important?**

Severe intravenous access difficulty causes delays in care. Popular approaches to difficult access include external jugular vein access or ultrasound-guided peripheral vein catheterization. When these methods fail, a traditional choice has been central venous catheterization, a lengthy procedure.

2. What does this study attempt to show?

A method of catheterization of the internal jugular vein, using ultrasound guidance and a standard peripheral catheter, has been described in a few case series, but prospective studies are lacking. This study estimates initial success rates, procedure times, and complication rates for this procedure, termed the Easy IJ.

3. What are the key findings?

The initial success rate was 88%, with a mean procedure time of 4.4 min. There were no cases of arterial puncture, pneumothorax, or line infection. Postinsertion loss of patency was seen in 14% of cases.

4. How is patient care impacted?

The Easy IJ may be considered a rapid and safe alternative to a traditional central venous catheter in patients in the emergency department who require short-term intravenous access.