

Intrathoracic Vascular Catheterization Via the External Jugular Vein

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Successful placement of either a central venous (CV) or pulmonary artery (PA) catheter requires safe, simple, and reliable entry into the intrathoracic circulation. The vessels most often selected for entry during such catheterizations include the subclavian, internal jugular, and femoral veins. Difficulties and dangers associated with each of these routes¹ are tolerated by many physicians because using these vessels results in a very high rate of successful catheterization, whereas many physicians are under the impression that using superficial vessels (antecubital, external jugular) is less reliable.

Value of the external jugular (EJ) vein as an alternative or even primary route for CV cannulation was negated previously by the absence of a reliable catheterization technique. Use of the J guide wire overcame this objection.² A question remained, however: Was success due to the J configuration or would the use of any guide wire be as efficient? This study was undertaken in part, to evaluate the J wire relative to its straight counterpart.

We believe that the EJ vein has not become similarly popular as a portal of entry during PA catheterization. As our own clinical practice supported the impression that PA catheterization via the EJ vein was as safe, simple, and reliable a technique as CV catheter placement, we also studied the feasibility of PA catheterization using the EJ vein.

METHODS

Patients undergoing cardiac surgery were studied. The research protocol was approved by the University Committee on Studies Involving Human Beings. Informed

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consent was obtained. All patients who were candidates for CV pressure monitoring only, were evaluated by random assignment to one of the two following catheterization techniques: after the EJ vein was initially cannulated with a 20-gauge, 51-mm (2-inch) long intravenous catheter§; either a 40 cm-long, 0.64-mm (0.025-inch) diameter straight guide wire,¶ or a similar sized guide wire with a 3-mm radius of curvature J tip¶ was threaded with subsequent placement of a 16-gauge, 13.3-cm long CV catheter** over either wire. For an additional group of patients, in whom PA catheterization was deemed clinically indicated, the following technique was used: after the EJ vein was cannulated initially with a 20-gauge, 51-mm (2-inch) long intravenous catheter,§ a 40-cm long, 0.64-mm (0.025-inch) diameter straight guide wire¶ was threaded with subsequent 8.0-French dilator/sheath unit¶¶ guided over the wire, and 7.0-French curved tip PA catheter†† inserted into the sheath. The sheath was placed into the vein but did not precede the PA catheter into the thoracic cage in all cases.

Successful catheterization was indicated by the ability to thread the PA or CV catheter into the desired position, ease of blood withdrawal from these catheters, quality and respiratory variation of the pressure trace, and post-operative chest roentgenographic examination. Cross tabulations of the catheterization techniques were evaluated by chi-square.

RESULTS

EJ vein catheterization for placement of either a CV or PA catheter was attempted in 163 patients. Successful placement of a catheter into the thoracic cage using this insertion route occurred in 135 patients (83 per cent) (table 1). This required two or less cannulation attempts in 113 patients (84 per cent). The time required to perform these catheterizations was highly variable (range 5 to 25 minutes) bearing no relation to type of wire, sheath, or catheter being introduced.

CV catheterization from the EJ vein using the straight

§ Sherwood Medical Industries, St. Louis, Missouri 63103.

¶ Cook Inc., Bloomington, Indiana 47401.

** Deseret Pharmaceutical Co. Inc., Sandy, Utah 84070.

†† Edwards Laboratories Inc., Santa Ana, California 92711; Gould Inc., Oxnard, California 93030.

TABLE 1. External Jugular Central Venous and Pulmonary Artery Catheterization in 163 Patients

Catheterization Technique	Success/Patients	Per Cent
Straight wire-straight CV catheter	19/31*†	61
J wire-straight CV catheter	25/29*	86
Straight wire-curved PA catheter	91/103†	88
TOTAL EJ catheterizations	135/163	83

* *P* of difference <0.05 by chi-square test.

† *P* of difference <0.01 by chi-square test.

wire was successful in only 19 of 31 patients (61 per cent) requiring two or less cannulation attempts in 15 patients, while using the J wire was successful in 25 of 29 patients (86 per cent) (*P* of difference < 0.05) (table 1) requiring two or less cannulation attempts in 20 patients. PA catheterization from the EJ vein using the curved tip PA catheter was successful in 91 of 103 patients (88 per cent) (table 1) requiring two or less cannulation attempts in 78 patients. Reasons for failure included hematoma formation with inability to cannulate the EJ vein (17 patients), and in the CV cannulation attempts only, an inability to thread the wire and catheter into the thorax (11 patients).

Central position of all catheters was confirmed by a roentgenograph. No complications were noted in any patient during catheterization by any technique.

DISCUSSION

The ability to utilize the EJ vein, a superficial venous access site, for reliable placement of a CV or PA catheter, is most desirable, as it avoids complications (carotid puncture, pneumothorax, concealed hemorrhage) associated with catheterization of the deeper venous routes.^{1,3,4} Our own experience over a 27-month period, with more than 1,700 internal jugular cannulations has resulted in a 4.3 per cent arterial puncture rate.³ This included one fatality attributable to carotid artery puncture. Primary selection of the EJ for intrathoracic cannulation, however, has often been avoided, because many feel that 1) the presence of venous valves at the junction of the EJ and subclavian, 2) the lateral direction the EJ vessel may take (potentially leading to the arm rather than chest), or 3) the existence, in some individuals, of a diffuse, plexus-like network as the EJ courses under the clavicle,⁵ may preclude successful intrathoracic catheterization. This study indicates that these anatomic variations do not frequently prevent successful placement of a CV or

PA catheter via the EJ vein. Our reported 86 per cent success with CV cannulation via the EJ vein compares favorably with other series.^{1,2}

Not only does the J configuration of the wire improve success in CV placement over success with the straight wire, but the curve of the 7.0-French balloon tip PA catheter also improves success of intrathoracic placement during EJ insertion over success with the straight wire or straight CV catheter. Curved catheters have long been used by radiographers to negotiate vessels with tortuous courses. Neither the wire or sheath could be advanced into the thorax in eight patients, but by leaving the sheath in the EJ vein alone, the PA catheter was advanced into its correct intrathoracic position without difficulty. Had attempts not been made in each of these patients to float the PA catheter, irrespective of the inability to pass the sheath into the thorax, these cases would have been reported as failures of EJ PA cannulation when in fact they were successes. In contrast to another report,⁶ this study demonstrates that the J wire is *not* necessary for PA cannulation using the EJ route, and suggests that the curved tip of the PA catheter alone, is sufficient.

We modified our clinical practice using the EJ vein when present as the initial site for PA catheterization because the results of this study indicated reliability of the EJ route. In the thirty-month experience since this change, 479 PA catheters were placed successfully via the EJ vein in a total of 621 patients (77 per cent). The 77 per cent clinical success rate is less than the 88 per cent success reported during the controlled study, and we believe the clinical success rate to be more realistic. The difference is primarily accounted for by the occasional prolongation of time taken by the authors to manipulate a catheter during EJ PA catheterization during the controlled study. The level to which subsequent operators persisted with the required manipulations varied greatly in actual clinical practice. This observation suggests that persistence yields a higher success rate. In addition, the clinical success rate is lower accounting for failures by trainees learning the EJ cannulation technique.

We conclude that during CV catheterization via the EJ route, the use of the J guide wire is superior to a straight wire. Additionally we conclude that PA catheterization using a curved-tip 7.0-French balloon flotation catheter is performed easily, relatively free of complication and reliably accomplished via the EJ route. This technique is recommended as the initial approach in all patients with an appropriate EJ vein.

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Electrode Polarity and Peripheral Nerve Stimulation

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Quantitating neuromuscular blockade by assessing strength of muscle contraction is a well-established clinical practice. Important among the factors that influence muscle response are the location of the electrodes and the intensity of the electrical current. Since the peripheral nerve stimulator uses direct current, the polarity of the electrodes should also be important. The purpose of this study is to determine whether the electrode polarity of the peripheral nerve stimulator affects the twitch tension of the thumb in response to stimulation of the ulnar nerve.

METHODS

Nine surgical patients without known neuromuscular disease were studied. The protocol was approved by the University Committee for the Protection of Human Subjects. After induction of anesthesia, to insure nerve contact, two 25-gauge steel-hubbed needle electrodes were inserted subcutaneously (fig. 1): one at a right angle across the ulnar nerve at the wrist (A) and another 5 cm proximally (B). Additional electrodes were placed in the olecranon groove (C) and in the hypothenar eminence 3 cm distal from the electrode at the wrist (D).

The adduction response of the thumb to electrical stim-

ulation was recorded with a Grass FT 03 force displacement transducer.¹ Single stimuli of 0.2-ms duration delivered every 5 s (0.2 Hz) were applied by using a Professional Instruments peripheral nerve stimulator. The voltage was adjusted to 10 per cent greater than that required to evoke a maximal twitch response.

During the initial recording, the polarity of the electrode at the wrist was always negative. After each stimulation, the polarity was reversed by means of a manual switch. Responses to single-twitch stimuli were recorded so that a common electrode, A, was always at the wrist and was paired alternately with the other three electrodes, thus forming the combinations of AB, AC, and AD (fig. 1).

A total of six responses were recorded for each. After twitch height was determined for AB, AC, and AD in this manner, incremental doses of pancuronium (1–2 mg) were injected intravenously until the twitch height decreased to about 50 per cent of the control values. When twitch height was no longer diminished, the procedure was repeated. In three patients, additional electrodes were also placed, one 5 cm proximal to that in the olecranon groove and one in the deltoid muscle on that side. Twitch responses for the supraolecranon electrode paired with the one in the olecranon groove and for the deltoid muscle electrode paired with the one at the wrist were then recorded. Twitch-height responses were analyzed for each pairing of the electrodes by using an analysis of variance. When a significant *F* value was obtained, a paired *t* test was performed. Statistical significance was accepted when *P* was less than 0.05.

RESULTS

The mean twitch-height recordings for each pairing of the electrodes before pancuronium administration are

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