

## External Jugular Venous Route for Central Venous Access: Our Experience in 563 Surgical Patients

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### Abstract

**Objectives:** Though external jugular vein is superficial, adequate sized, isolated from major neurovascular structures and its cannulation fairly simple and comfortable to patients, it is not commonly used. Internal jugular vein cannulation on the other hand is routinely used with reasonable success. This technique is not devoid of complications. In order to make the central venous cannulation safer, the author sought to explore the possibility of using external jugular venous route as the route of first choice to pass the vascular catheters.

**Design:** A prospective observational study,

**Setting:** Tertiary referral hospital

**Participants:** Five hundred sixty three patients requiring central venous cannulation.

**Interventions:** External jugular venous route as the choice of central venous cannulation

**Measurements and Main Results:** The type of the catheter required for the procedure- single, multi lumen, Swan Ganz, dialysis or pacing catheters were inserted via the external jugular vein. Inability to advance the catheter or the guide wire was considered a failed procedure. In the event of a failure to insert and or advance the catheter, from the same point of insertion, internal jugular vein was cannulated. Ultrasound image assistance was taken if needed by the operator. In 411 subjects, the desired catheter was inserted through the EJV. In 378 patients, the catheter was inserted in the first attempt. No life threatening complications occurred even among the cases, where external jugular vein cannulation was not successful. A few malpositions occurred when the external jugular route was chosen. In very obese patients, ultrasound was used to visualize the vein.

**Conclusions:** The clinicians should give a relook at alternate routes for insertion of central venous catheters. External jugular route is one of them.

### Introduction

The right IJV is widely used as a route for insertion of central venous catheter for administration of fluids and monitoring of central venous pressure, because of the following advantages: ease in identification, big size allowing insertion of catheters of size up to 9 to 10 French, unhindered straight passage to the right atrium and fairly well acceptable to even the awake patient. Although clinicians well conversant with this technique use it routinely, the use of IJV may result in complications and the frequency of those might increase in high risk patients requiring central venous cannulations [1]. Unintentional arterial punctures could prove catastrophic in such patients. Use of ultrasound to reduce such complications has been suggested. In order to avoid such complications, the authors performed this prospective study of evaluation of external jugular vein (EJV) and IJV as the route of first choice for passage of catheters including single, multi lumen central venous, Swan Ganz, Swan Ganz continuous cardiac output, pacing catheters. Use of EJV as the route for insertion of central catheter has been described many years ago, the technique does not seem popular among clinicians, despite this early study claiming successful central vein cannulation through EJV in 90% of their subjects [2]. Unlike use of IJV, the EJV route is safe and is not associated with serious complications. A few workers have suggested routine use of ultrasound for identifying and aiding safe insertion of jugular catheters [3,4]. EJV route may be a safer alternative in the absence of ultrasound machines and expertise to use them among anesthesiologists who have no prior exposure to IJV cannulations. Additionally, EJV cannulation has been shown to be complication free. The authors studied the feasibility of passing central venous, Swan Ganz, and pacing catheters through the

external jugular route.

### Methods

This observational study assessed the feasibility of EJV cannulation as the preferred route of central venous cannulation. It was conducted in a tertiary referral hospital. The institutional review board clearance and informed patient consent were obtained. The patients were informed that cannulation of EJV was untraditional but safe. If the planned technique was not successful, the ipsilateral IJV would be cannulated. Patients who underwent surgeries during April 2008 to January 2009 were studied. Patients over the age of 18 years, scheduled to undergo surgery requiring central venous cannulation considered prospective candidates to participate in the study. The indications for inserting EJV were same as that of IJV. Patients undergoing cardiac, intracranial, major general surgical procedures also received central venous cannulation. The inclusion criteria were elective surgery,

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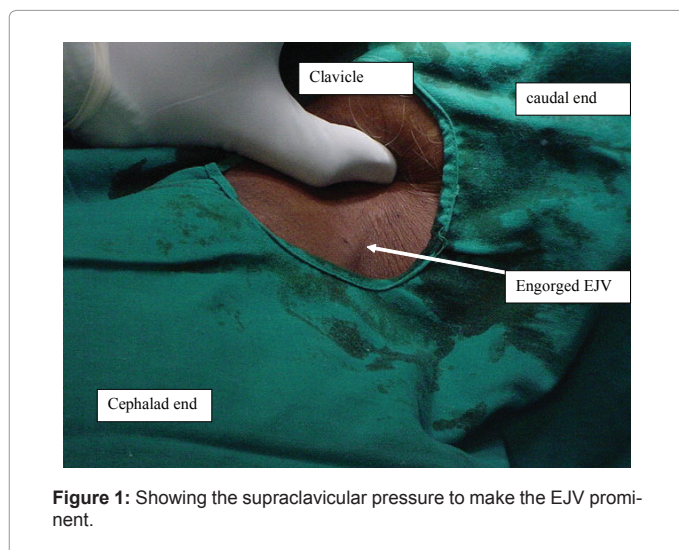
absence of anticoagulant medications and obstruction of the EJV. Exclusion criteria were surgeries on the head neck, patient refusal, The type of the catheter (Swan Ganz catheter or pacing catheter or dialysis catheter), presence of either obesity or short neck and the situation (whether emergency or elective) were not considered exclusion criteria. Only experienced anesthesiologist (having performed more than two hundred internal jugular and subclavian vein cannulations) were allowed to perform the cannulation. Right EJV was chosen over the left if either one of them could be cannulated. When there was contraindication to puncture any one side, the opposite EJV was used. Passing the intended length of cannula into the chest cavity with free return of blood on aspiration was considered successful cannulation. A triple (7F) or double (6F) lumen central venous catheter (BL Lifesciences Pvt Ltd, D-31, site IV, Kasna, Greater Noida, 201306, India) was used as central venous cannula. Patients undergoing cardiac surgery received Swan Ganz catheter (Swan Ganz CCO/VIP, Edward Lifesciences, LLC, Irvine, CA USA). EJV route was chosen for passage of pacing wire and dialysis catheter also. The chosen point of entry was 2 cm lateral to the apex of the triangle formed by the two heads of the sternocleidomastoid muscle in the neck. This point was chosen to change the route to IJV in the event of failure to insert the catheter via EJV, without additional skin punctures. Inability to puncture the vein or cannulate or pass the catheter intrathoracically was considered failure of cannulation. Imaging assistance using ultrasound was provided to the operators on request or, when cannulation by conventional technique was unsuccessful. At times when EJV was not visualized either due to obesity or short stout neck, ultrasound assist was thought of. Depending on patient consent, the procedure was performed under local anesthesia (in awake patients) or under general anesthesia. The catheterization was performed under local anesthesia and intravenous sedation with 1 mcg/kg of fentanyl and 1 mg of midazolam; or under general anesthesia in patients not consenting to remaining awake while the catheterization was done. Venous access was carried out using Seldinger technique. If the EJV was not prominent, the operator applied ipsilateral supra-clavicular pressure as shown in figure 1. If resistance was encountered during the passage of guide wire, abducting the ipsilateral arm and/or turning the neck to either the contra-lateral or ipsi-lateral side was tried. If multiple lumen central venous line was

being inserted through EJV, with the guide wire in situ in the supra-clavicular portion of the EJV, the multi-lumen catheter was threaded up to the point of resistance and the guide wire was withdrawn one or two millimeters, and the catheter advancement was attempted. Despite these attempts, if the catheter could not be advanced, the procedure was abandoned, termed a failure and conversion to IJV route was chosen. While inserting Swan Ganz catheter, if resistance was encountered, the introduction sheath was advanced over the guide wire up to the point of resistance, and the dilator and the guide wire was withdrawn, while the sheath remained intracavitary. After confirming the intravascular presence of the introduction sheath, the Swan Ganz catheter was inserted into the sheath. If the Swan Ganz catheter was negotiated beyond the clavicle, the portion of the introduction sheath (which was not yet inserted into the vessel) was advanced over the pulmonary artery catheter, which served the operator as the guide. The number of attempts to locate the vein, time taken for successful cannulation, incidence of successful cannulation, the frequency of success when either the right or left EJV, malpositions (noted on postoperative X ray) of the tip of the catheter were noted. The frequency of complications due to failed insertions was also made note of.

**Statistical methods:** The values were mentioned as mean  $\pm$  standard deviation. Chi square test and Anova were used to compare the variables. MedCalc version 11.5.1 (Broekstraat 52, 9030 Mariakerke, Belgium) was used for statistical analysis. P value of  $<0.05$  was considered significant.

## Results

Five hundred sixty three patients participated in the study. The demographic profile of the patients is shown in table 1. Successful EJV cannulation was accomplished in 411 (73%) subjects. Right EJV was attempted in 521 patients; the success rate was 81%. Of the remaining forty two patients in whom the right EJV was attempted, thirty successful cannulation was possible. This was however statistically not significant ( $p = 0.6$ ). Most common cause of difficulty during EJV cannulation was inability to negotiate the guide wire and or the cannula into the intrathoracic portion of the vein. The other causes of difficulty in catheter or guide wire passage was inability to identify the vein (in obese and short necked patients), small size of EJV and premature anterior branching. The catheterization was performed under local anesthesia and intravenous sedation in 518 (92 %) and under general anesthesia in the rest. The time taken for catheterization ranged from 2 minutes to 18 minutes (mean  $5 \pm 7.9$  mins). The reason for non passage of the catheter in one hundred fifty two patients were: inability to identify the vein (in obese and short necked patients) in 44 patients, inability to pass the guidewire into the intrathoracic portion of the vein (62 patients), inability to pass the sheath or the catheter and small size of EJV. Twenty two patients in our series had been admitted for treatment of myocardial infarction which they had sustained recently and/ or had undergone thrombolysis 1 to 3 hours prior to central venous cannulation. Table 2 shows the frequency types of catheters inserted, success rates and the statistical significance when catheters were inserted into EJV. It was noted that stiffer and bigger catheters were difficult to pass. Passage of single, triple and quadruple lumen catheters were easier to insert, as seen by the higher success rates when their insertion was attempted. Swan Ganz catheter ( $p = 0.03$ ), 9.5 French sheath ( $p$  value = 0.01) and dialysis catheters ( $p$  value = 0.03) were significantly more difficult to insert and the rate of failure to insert these catheters were significantly higher. However, the inability to insert the catheter in to EJV was overall not significant. In 378 (92



**Figure 1:** Showing the supraclavicular pressure to make the EJV prominent.

1	Male: female	270:141
2	Height in cms	156 ± 19
3	Weight in kgs	62 ± 13.1
4	Body mass index	23 ± 5.6
5	Obesity	56
6	Cardiac surgery	112
7	Neurosurgery	21
8	General surgery	21
9	Intensive care	18
10	Trauma	24
11	Diabetes	311
12	Hypertension	287
13	Asthma	45
14	Emergency surgery	3

Table 1: Demographic details: n = 411.

Sl number		Attempted	Failed	Successful	P value
1	Single lumen central venous catheter	73	10	63	NS
2	Triple lumen central venous catheter	326	48	278	NS
3	Swan Ganz catheter	120	31	89	0.03 *
4	Quadruple lumen central venous catheter	15	6	9	0.4
5	9.5 French sheath	11	3	8	0.01*
6	Dialysis catheter	17	10	7	0.03*
7	Pacing wire	1	0	1	NS
	Total number	563	152	411	NS

\*= statistically significant (p value <0.05)

Table 2: Showing the types of catheters in the EJV and the success rate.

%) patients, venous access was obtained in a single attempt, second in 6% and more than 2 attempts in the rest. Ultrasound was used to pass the needle into the lumen EJV of two obese patients, in whom it could not be visualized and IJV cannulation could not be carried out because of recent prolonged cannulation of both IJVs. In one case, insertion of transvenous pacing catheter was performed through EJV in a postoperative patient who sustained cardiac asystole in the post anesthesia care unit (Figure 2). In eighteen patients, a transfixation stitch was required across the puncture site, to prevent hemorrhage. All unsuccessful EJV cannulations (n 152) were successfully cannulated through the IJV; ultrasound assistance was required in 28 of these.

## Discussion

In this prospective observational study, the possibility of passing single, triple, quadruple lumen central venous catheter, pacing catheters (Figure 2), Swan Ganz catheter (Figure 3) and dialysis catheters were via EJV was studied in five hundred sixty five patients. Successful cannulation was possible in 411(72 %) patients. A significant number of failed EJV cannulations were noted when bigger and stiffer catheterization was attempted. The authors are of the opinion that while bigger sized catheterizations are being contemplated, it is reasonable to expect difficulties and one should convert to the IJV route more readily than while inserting softer and smaller catheters. It is easily notable on the X ray how far the external jugular catheter is in comparison to the internal jugular (Figure 4). While handing over patients with EJV cannulas, the postoperative team should be informed of it; lest they may mistake it for an anatomical variation of IJV. No life threatening events occurred even if the catheterization was not successful. Although insertion of catheters via IJV route has become the first route of choice in most patients, it is not void of complications. The complications arise from the fact that a large number of IJVs have anatomical variations in their course [5]. Complications produced by misadventures during

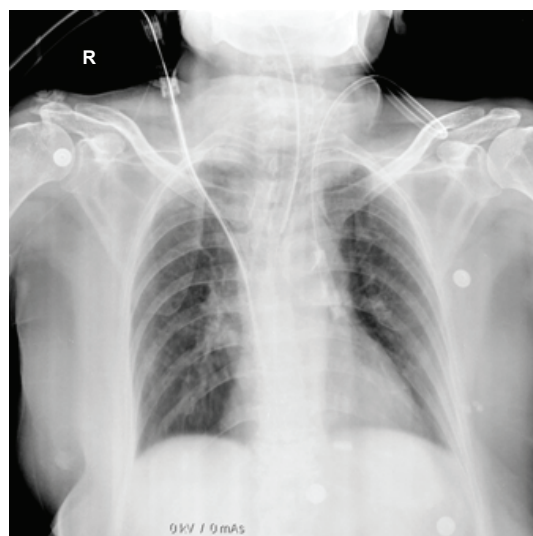


Figure 2: Showing temporary transvenous pacing catheter in right ventricle.

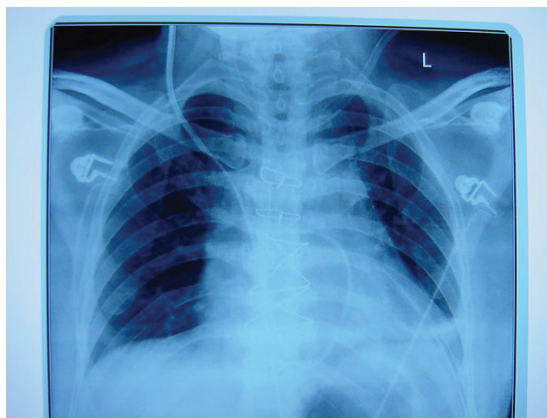


Figure 3: Showing the correct position of Swan Ganz catheter.

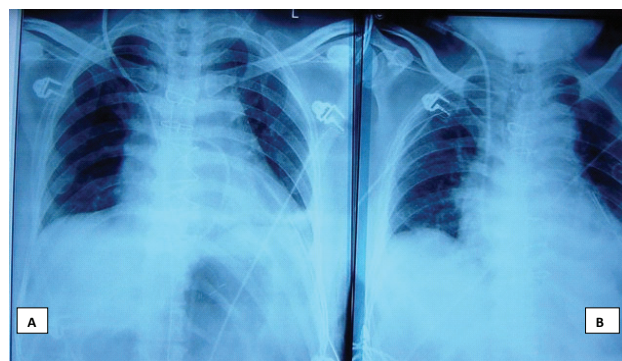


Figure 4: Showing the comparative positions of Swan Ganz catheters in external (A) in comparison to internal jugular vein (B).

IJV cannulation may prove costly in high risk patients [1]. Despite vital structures surround the intended point of puncture of IJV (such as vital arteries, nerves, pleura and lymphatic duct); it continues to enjoy the route of choice because of the short straight route to the heart and high success rate. At times, when difficulties are encountered, assistance by ultrasound imaging to facilitate its cannulation might be required [6,7]. In contrast to the difficulties encountered during IJV cannulation, EJV seems to be a viable alternative. It is a very superficial vein, not in relation to important anatomical structures unlike the IJV. Such a choice has been explored several years ago [2]. Though the authors of this publication described a success of 90% without technical complications during attempted EJV cannulation, surprisingly most other clinicians seem to have neglected their findings. In order to use EJV as the route of cannulation, one has to be patient and perseverant. At times after failed EJV cannulation, ultrasound imaging might be required to assist the operator to safely complete the cannulation of EJV. It is important to make the most during the first attempt at cannulation of EJV. If the first puncture of the EJV does not result in cannulation for whatever reason, further attempts may not be successful, because the fragile wall of the EJV may produce a hematoma and obscure the further course of the vein. If EJV is not visible as in some obese short necked individuals, ultrasound visualization may aid identification and cannulation of EJV. A word of caution during identification of EJV by ultrasound – with slight pressure one may obliterate the venous cavity. Procuring ultrasound, training to use it, making it available for every central venous cannulation may be far from reality in all the healthcare facilities. Additionally, several authors have pointed out the inadequacies while jugular ultrasound is used to assist the cannulation [8-11]. Inadvertent arterial cannulation and posterior vein wall puncture have occurred despite the ultrasound use [8,9]. In contrast to these observations, failed EJV cannulation is not tantamount to complications as in the case of failed IJV cannulation. Induction of a false sense of security has been cited to emerge when ultrasound is used to image the jugulars [11]. It is the author's opinion that ultrasound aid may be required when conventional approach fails. Using ultrasound for even simple straight forward cases might blunt the native instincts of identifying a vein in relation to the anatomic structures. One might reach a stage where attempts at jugular cannulation may not be possible without the assistance of either ultrasound or other means of imaging

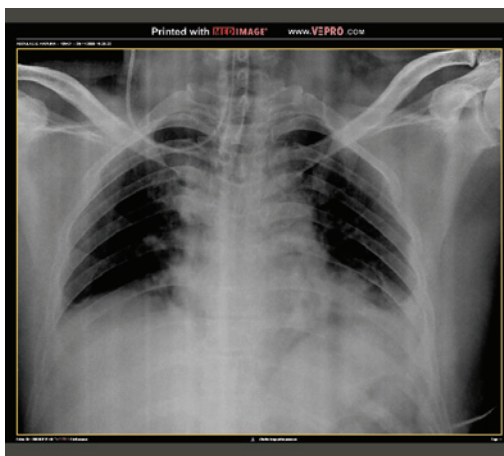


Figure 5: Malposition of catheter inserted in the external jugular traversing to ipsilateral internal jugular vein.

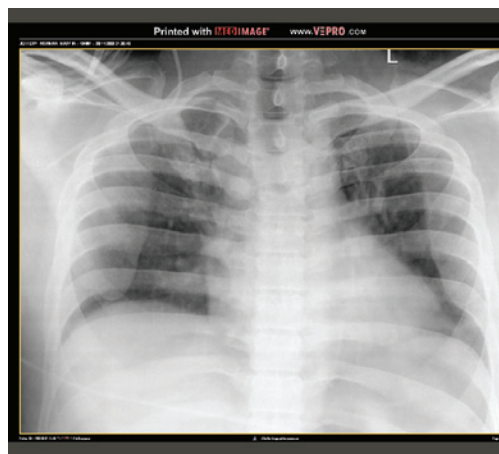


Figure 6: Catheter inserted in the external jugular traversing into axillary vein.

the jugulars, which is not good either for the physician or the patient.

Using EJV route is not without pitfalls; malposition seems to be the most common misadventure associated with EJV cannulation. Seventeen instances of malposition of the EJV catheter was observed in our series. The catheter traversed to ipsilateral IJV in 9 (Figure 5) and peripherally into axillary vein in the remaining 8 patients (Figure 6). This incidence may be an underestimate because, many patients were not subjected to post procedure chest X ray. The malpositioned catheters are not repositioned if they are indwelling for a short time. If a long indwelling is planned, under guidance with image intensifier, the catheter is repositioned.

## Conclusion

The EJV route for passing central venous catheters seems to be underutilized by clinicians. As per our observation, it may be possible to successfully cannulate the right heart and beyond via the EJV route in a majority of patients; a few subtle changes in the technique might improve the rate of successful cannulation. The complications that occur when this route is used are very benign compared to the internal jugular and it deserves yet another look by the clinicians.

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