

turbinate. Excessive force on the tube sheared the turbinate's lateral attachment on the nose and forced it into the nasopharynx. A strip of mucosa remained posteriorly, providing a vascular strip to the turbinate, which remained viable. Persistent epistaxis probably resulted from the relative mobility of the turbinate and pedicle.

This patient underwent the discomfort of nasal packing and an unnecessary anesthetic and surgical procedure as result of her original intubation. She did not suffer significant permanent nasal dysfunction. In this respect she was fortunate. The turbinates greatly increase the surface area of the nasal passage and facilitate heat and moisture exchange. Indiscriminate removal of a turbinate during elective intranasal surgery often results in an atrophic mucosa, loss of ciliary action, and a dry, crusty, functionless nasal airway.³

Hopefully, anesthesiologists are aware of the potential damage to the larynx produced by endotracheal intubation and actively avoid complications by respecting the anatomy and function of this structure. One also must consider the integrity of the nose. Nasal function will be preserved by such simple precautions as adequate decongestion, inspection of the airway, the choice of an appropriate sized tube, and avoidance of excessive force during nasal intubation.

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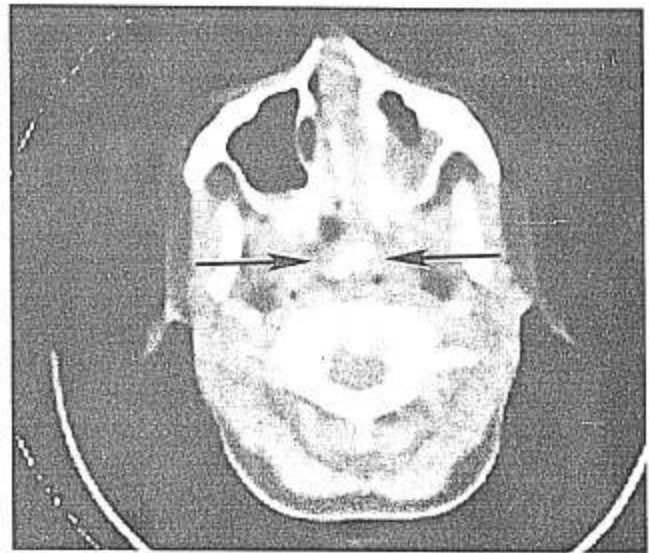


FIG. 1. Computer axial tomogram. Arrows outline a mass in the left posterior nasopharynx.

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Safer Jugular Vein Cannulation: Recognition of Arterial Puncture and Preferential Use of the External Jugular Route

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Cannulation of the central venous and pulmonary arterial circulation via the internal jugular vein is common practice. The most frequent complication asso-

ciated with this technique is arterial puncture, which is potentially lethal when a large needle or cannula is utilized.¹ Recognition of this complication led to the use of a 21GA "exploring" needle before insertion of a 14GA introducing needle for catheter insertion by many groups. Subsequent adoption of a modified Seldinger technique employed the same principle of a small initial needle to gain access to the vein.² However, failure to recognize arterial puncture by force and color of blood flow still may result in insertion of a large bore needle (14GA) or cannula (8Fr) in the artery. Serious bleeding can occur, requiring surgical intervention, postponement of elective surgery, or in some cases, death.^{1,3} Accidental insertion of an 8Fr cannula in five

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TABLE 1. Central Venous Cannulation

	RIJ*		Complications (Arterial Puncture)	EJ†	
	No. of Patients	Success		No. of Patients	Success
Retrospective Review January 1977–March 1979	1,021	973 (95.3%)	43 (4.2%)	—	—
Prospective Study April 1979–December 1982	1,284	1,207 (93.2%)	51 (3.9%)	1,086	876 (74%)

* Right internal jugular vein.

† External jugular vein.

patients prompted a review of our experience to determine the frequency and severity of arterial puncture. A modification in technique was introduced, and a prospective study of the effect of this change was made. During this period the external jugular (EJ) route primarily was elected where possible and the results recorded.

MATERIALS AND METHODS

Retrospective Study Period: Right internal jugular catheterization (RIJ) was accomplished in awake sedated cardiac surgical patients in 15°-head-down position with the head turned to the left. The point of insertion was the apex of the triangle formed by the two heads of the sternocleidomastoid muscle.⁴ A 20GA catheter† over a needle was inserted at 45° to the skin following the direction of the medial border of the lateral head of the sternocleidomastoid muscle. Negative pressure was created in the syringe, blood aspirated, and the catheter was pushed off the needle into the vessel. The blood was inspected for color and flow rate, and, if thought to be venous, a 0.025-in in diameter, 40-cm long, spring guidewire** was inserted and the short catheter removed. Either a 5¼ inch 16GA central venous catheter†† or an 8F dilator/sheath assembly‡‡ for pulmonary artery catheter insertion§§ was placed in the vessel over the guidewire.

Records were kept for all patients beginning in January 1977, listing operator names, type of catheter placed, location(s) used, number of attempts, success/failure, and complications. The retrospective review was based on these records from January 1977 to March 1979.

Prospective Study Period: A modification in technique and a choice of access site were instituted as a result of the review. The short 20GA catheter always was at-

tached to a pressure transducer before insertion of the guidewire, and pressure and waveform were observed when using the RIJ. When the vessel was identified as a vein by this method, the wire, introducer/dilator, pulmonary artery catheter, or central venous catheter sequence was followed. When the vessel was an artery, the 20GA catheter was removed and gentle compression was applied. During this period, the EJ access site primarily was elected because arterial complications are not associated with this approach and because of reports of increased success using a "J" configured guidewire. Patients were positioned as described for the RIJ route, and the EJ veins inspected for size and course. The Seldinger technique, using a "J" guidewire, then was used as in the RIJ approach if the vein was acceptable. The right side was preferred because it is a shorter route, although use of the left side occasionally was necessary. Records then were kept from April 1979 to December 1982, and the data were tabulated.

Most initial attempts at catheterization were performed by second-year anesthesia residents with senior fellow or staff cardiac anesthesiologists in attendance. Approximately 290 residents and fellows and 16 staff anesthesiologists were involved during the evaluation periods. Approval was obtained from the Committee on Studies Involving Human Subjects at the University of Pennsylvania for publication of the collected data.

RESULTS

Retrospective Review: The results in table 1 represent the 27-month period (January 1977 to March 1979). The RIJ was attempted in 1,021 patients, with successful placement in 95.3%. Failures followed inability to locate the vein, which, in most cases, was because of hematoma from immediate precedent arterial puncture. Arterial puncture in 43 patients (4.2%) was the only serious complication encountered. When the smaller catheter-needle was placed unintentionally in the artery and recognized, only clinically insignificant hematoma formation resulted. However, in five of 43 incidents, the incorrect placement was unrecognized by blood flow and color criteria, and the 8F dilator/sheath was placed

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in the artery. All these patients developed large hematomas requiring postponement of the proposed surgery, with immediate surgical repair performed in one patient. A second patient hemorrhaged from the cannulation site 12 hours later during resuscitative efforts. The resultant hemothorax may have contributed to his death.

Prospective Study: Table 1 shows the results of the second review. When RIJ catheterization was attempted in 1,284 patients, successful cannulation was achieved in 93.2%. Failures occurred for the same reason as noted previously. The only complication of insertion that was observed was arterial puncture, which occurred in 3.9% of the RIJ group. Arterial catheterization was not suspected in 10 patients and was only detected by observing the pressure and waveform tracings. There were no 8F sheath arterial insertions and no serious sequelae from any of the unintentional carotid punctures with the 20GA catheter/needle.

EJ catheterization was attempted in 1,125 patients, with a 74% success rate. Failures were nearly always caused by inability to pass under the clavicle into the central circulation. Occasionally the vein could not be entered successfully by the initial 20GA catheter. The only complication seen was the occasional formation of a small subcutaneous hematoma at the failed insertion site.

DISCUSSION

Complications of RIJ cannulation requiring intervention or delay of proposed surgery were found to be related to unintentional placement of a large cannula or needle intraarterially, while the smaller catheter/needle produced, at most, a small hematoma, which did not result in arterial or venous occlusion or deviation of normal cervical anatomic relationships. The use of blood flow and color criteria were not always reliable in detecting arterial puncture, but when verification by transducer was used, identification was always correct. A slightly larger (18GA vs. 20 GA) catheter might enhance proper vessel identification, using blood flow and color criteria without increasing morbidity or requiring a transducer. There are no available data to support this speculation. Accidental arteriotomy with a 16GA catheter/needle can produce life-threatening hemorrhage.⁵

The frequency of arterial puncture did not change significantly. The reported incidence of this complica-

tion ranges from 0–11%, with experience and technique being variable.⁶ The lowest incidence apparently is associated with fewer operators and increased experience; the higher incidence is associated with learning residents.^{1,6} The influence of different approaches to the IJ upon frequency of arterial puncture is not clear.⁶ Although we have not reduced the frequency significantly, we virtually have eliminated the most serious sequelae of arterial puncture.

Additionally, electing to use the external jugular vein in the same patient population has had an impact.^{7,8} Eight hundred seventy-six patients were at no risk of related arterial complications. One must balance the external jugular route's lower success rate, possible increased time of insertion, and lack of arterial complications against the internal jugular route's higher success rate, probable shorter insertion time, and potential arterial complications in choosing the primary elective route of cannulation. The overall effect of observing the tracing from the short initial access catheter during the IJ approach and electing the EJ where possible reduced the incidence of arterial puncture and eliminated serious sequelae. These are important clinical considerations in any practice of jugular vein cannulation, particularly in a teaching/learning setting.

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