induced increased intraocular pressure by non-depolarizing muscle relaxants. *Anesthesiology* 29:123–126, 1968

**Clinically Silent Venous Thrombosis Following Internal and External Jugular Central Venous Cannulation in Pediatric Cardiac Patients**

**ROGER A. MOORE, M.D.,* KATHLEEN W. McNICHOLAS, M.D.,† HOWARD NAIDECH, M.D.,‡ STEPHANIE FICKLER, M.D.,§ JOHN D. GALLACHER, M.D.¶**

The internal and external jugular veins routinely are cannulated for central venous access in both adult and pediatric patients. One complication of flow-directed catheter insertion via the internal jugular route in adults is clinically silent venous thrombosis. This study evaluated prospectively the incidence of silent venous thrombosis in pediatric patients with central venous catheters inserted through the internal or external jugular veins.

**Methods and Materials**

Institutional review board approval and individual parental consent was obtained prior to entering children into the study. Twenty-five consecutive patients undergoing open-heart operations between the ages of 2 and 20 years were included. All patients underwent central venous cannulation through either the right internal jugular vein or the right subclavian vein. The catheter was advanced via a right atrial approach and the tip was positioned in the superior vena cava just below the azygos vein. The catheter was secured to the chest wall with a suture and the patient was monitored for signs of right heart failure.

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**Address for Correspondence:**

Deborah Heart and Lung Center, Trenton Road, Browns Mills, New Jersey 08015.

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* Co-Chairman, Department of Anesthesiology, Deborah Heart and Lung Center, Assistant Professor of Anesthesiology, University of Pennsylvania.
† Director, Pediatric Thoracic and Cardiovascular Surgery.
‡ Attending Radiologist, Deborah Heart and Lung Center.
§ Chairman, Department of Radiology, Deborah Heart and Lung Center.
¶ Attending Anesthesiologist, Deborah Heart and Lung Center, Assistant Professor of Anesthesiology, University of Pennsylvania.

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Address reprint requests to Dr. Moore: Department of Anesthesiology, Deborah Heart and Lung Center, Trenton Road, Browns Mills, New Jersey 08015.
13 years were studied. On the morning of the operation following induction of anesthesia and tracheal intubation, a catheter was inserted into either the internal (N = 10) or external (N = 15) jugular vein. The site of central venous cannulation was left to the discretion of the attending anesthesiologist, and previously described techniques were used for insertion of the internal jugular (“high” approach) and external jugular cannulae. Generally, for children weighing less than 12 kg, a 20-gauge, 8-cm-long Teflon® nonheparin-bonded catheter was inserted, while an 18-gauge, 12-cm-long Teflon® nonheparin-bonded catheter was used for children weighing more than 12 kg. A chest roentgenogram following surgery was used to establish the location of the catheter tip.

In all children, hypothermic cardiopulmonary bypass was established using a membrane oxygenator with blood flows greater than 2.4 l/M²/min after anticoagulation with a minimum of 400 U/kg of beef lung heparin. Cardiac repair was performed using either aortic cross-clamping with cardioplegic arrest or induced cardiac fibrillation. Circulatory arrest techniques were not used in any of the children.

For all 25 children, removal of the central venous catheter was performed under radiographic control upon discharge from the intensive care unit. Depending on the child’s weight, up to 35 ml of MD-60 contrast material was injected through the catheter over 10 s during withdrawal. Roentgenograms were obtained at 2-s intervals to assess dye washout. The presence of thrombus within the venous system was diagnosed by a persistence of irregular radiolucency within the vascular lumen.

Statistical comparisons between patients with internal and external jugular cannulation were carried out using the unpaired t test with significance assumed at the P < 0.05 level.

RESULTS

Ten of the 25 patients had central venous cannulation via the internal jugular vein. Nine of the internal jugular catheters were inserted on the right side and one on the left. Fifteen patients had central venous cannulation via the external jugular vein. The right external jugular vein was used in 10 of these children, and the left in the other 5. Comparisons of patients with internal and external jugular cannulation showed no significant difference in age, sex, height, weight, size of catheter, extracorporeal parameters, length of ICU stay, use of postoperative inotropes, or postoperative cardiac indices (table 1).

The incidence of silent venous thrombosis in patients with internal jugular venous cannulation was 10% (one out of ten). The only patient with thrombosis in this group had cannulation performed through the left internal jugular vein, and the thrombus was located in the proximal innominate.

The incidence of silent venous thrombosis in patients with external jugular venous cannulation was 27% (four out of 15), with the thrombus occurring in the external jugular vein (2), in the right atrium (1), and at the subclavian jugular junction (1). However, in two of the patients with thrombosis the catheter tip was located outside the thoracic cavity due to curving of the catheter back up into the ipsilateral neck via another vessel (fig. 1). All the other patients had placement of the catheter tip within the thoracic cavity. If the two patients with catheter tips outside the thoracic cavity were excluded from the group, the incidence of silent venous thrombosis in the patients with external jugular venous cannulation was 15% (two out of 13), which is not significantly different from the internal jugular cannulation group (P > 0.05). The two patients with silent venous thrombosis whose external jugular catheter tips were within the thoracic cavity did not differ from other patients within the group in regard to age, sex, height, weight, size of catheter, extracorporeal parameters, length of intensive care unit stay, or need for postoperative inotropes.

Upon comparison of the combined patients in the internal jugular and external jugular groups with catheter tips placed within the thoracic cavity, no significant difference was found between patients who had silent

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**TABLE 1. Patient Data for External and Internal Jugular Catheter Groups with Means and ±SEM**

<table>
<thead>
<tr>
<th></th>
<th>Age (yr)</th>
<th>Sex</th>
<th>Time on Bypass (min)</th>
<th>X-Clamp Time (min)</th>
<th>Low Temp on Bypass (°C)</th>
<th>Inotropes in ICU (%)</th>
<th>Cardiac Indices (l/min)</th>
<th>Time in ICU (days)</th>
<th>Incidence of thrombosis (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>External jugular group (N = 15)</td>
<td>6.2 ± 0.90</td>
<td>27% F</td>
<td>49.2 ± 6.6</td>
<td>34.2 ± 5.7</td>
<td>26.0 ± 1.4</td>
<td>27%</td>
<td>3.53 ± 0.42</td>
<td>4.4 ± 0.83</td>
<td>27%</td>
</tr>
<tr>
<td>Internal jugular group (N = 10)</td>
<td>6.2 ± 1.04</td>
<td>30% F</td>
<td>68.5 ± 11.6</td>
<td>51.8 ± 9.1</td>
<td>22.2 ± 1.2</td>
<td>33%</td>
<td>4.00 ± 0.49</td>
<td>3.1 ± 0.28</td>
<td>10%</td>
</tr>
</tbody>
</table>
venous thrombosis develop and patients who did not except for a shorter ICU stay for thrombosis patients for reasons that are not clear.

In both patients whose catheter tip inadvertently curved back up into the neck, the left external jugular had been used for central venous access. Clinically silent venous thrombosis was found in each of these patients. In one case the central venous catheter had been in place for a prolonged period due to an extended ICU stay complicated by sepsis.

**DISCUSSION**

Withdrawal angiography is an accepted method for demonstrating the presence of thrombus formation around intravascular cannulae. One difficulty with this technique is the inability to adequately visualize a small thrombus or a thrombus extending upstream from the site of catheter insertion. In children, visualization of thrombi is further restricted by a limitation in amount of contrast material that can be used. Therefore, the actual incidence of silent intravascular thrombosis may be higher than shown with this method.

Intravascular catheters serve as sites for intravascular thrombus formation, whether the catheters are trans-
venous path, these catheters interrupted the smooth flow of blood, creating turbulence and possibly enhancement of thrombin deposition. In addition, the curve in the catheter brought more of its length into contact with the vessel wall. This could lead to areas of relative blood stasis as well as endothelial injury.

Though the number of patients in the study were small we tentatively can conclude that the incidence of clinically venous thrombosis from internal and external jugular cannulations in children following open heart surgery is low. In addition, when the tip of the central venous cannula is located outside the thoracic cavity, the risk for development of venous thrombosis may be increased and these catheters should not be left in place for extended periods.

REFERENCES

Anesthesiology

The One that Got Away: Misplaced Esophageal Stethoscope

JANE KUGLER, M.D.,* JOSEPH A. STIRT, M.D.,† DAVID FINHOLT, M.D.,‡ MICHAEL D. SUSSMAN, M.D.§

In addition to accidently inserting endotracheal tubes into the esophagus or stomach,1,2 nasogastric tubes have been inserted into the cranium,3,4 and esophageal stethoscopes into the trachea.5 We present here a case in which an esophageal stethoscope passed completely into the stomach.

REPORT OF A CASE

An 18-year-old man with scoliosis was scheduled for posterior spinal fusion. After inducing anesthesia with thiopental, endotracheal intubation was accomplished with a 7.0-mm (I.D.) endotracheal tube. A #24 (French) esophageal stethoscope was inserted orally without difficulty, with proper placement confirmed by auscultation of heart and breath sounds. A #18 (French) Salem Sump8 gastric suction tube was inserted into the stomach via the nose, after much difficulty in achieving tube passage. Proper placement was confirmed by aspiration of green fluid.

Following insertion of the nasogastric tube by the second anesthesiologist, the first anesthesiologist, seeing no esophageal stethoscope in place and assuming it had been removed to facilitate placement of the nasogastric tube, inserted a #24 (French) esophageal stethoscope into the esophagus, confirming proper placement by auscultation of heart and breath sounds. The patient was turned prone, and anesthesia and surgery were without apparent incident. After 6 h of operative time, the esophageal stethoscope was removed, the trachea extubated with the patient awake and responsive and the patient taken to the recovery room in satisfactory condition.

Interpretation by two radiologists of postoperative radiographs of the chest and thoracolumbar spine taken in the recovery room on the day of surgery stated, “An N-G tube is in the fundus of the stomach,” and “The tip of the N-G tube is again noted to be at the level of the G-E junction.”

* Resident in Anesthesiology.
† Assistant Professor of Anesthesiology.
‡ Assistant Professor of Anesthesiology and Pediatrics.
§ Associate Professor of Orthopedic Surgery and Pediatrics.

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Address reprint requests to Dr. Stirt: Department of Anesthesiology, Box 238, University of Virginia Medical Center, Charlottesville, Virginia 22908.

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† Argyle Division, Sherwood Medical, St. Louis, Missouri 63103.