Cardiac Catheterization through the Internal Jugular Vein in Pediatric Patients*  
An Alternative to the Usual Femoral Vein Access

Paolo Guccione, M.D.;  M. Giulia Gagliardi, M.D.; Maurizio Bevilacqua, M.D.; Francesco Parisi, M.D.; and Bruno Marino, M.D.

The percutaneous femoral vein approach is used routinely for cardiac catheterization in the pediatric age but in some children, it may be impossible as in the case of iliac vein or inferior vena cava thrombosis due to previous cardiac catheterization, or inconvenient as for right ventricular endomyocardial biopsies. In the period between 1982 and 1990, 160 cardiac catheterizations or right ventricular endomyocardial biopsies were performed in 102 children. Patients ranged in age between 2 months and 17 years (mean, 3.8 years) and in weight from 3.2 to 57.3 kg (mean, 14.4 kg). Indications for the internal jugular vein approach were as follows: (1) thrombosis of the inferior vena cava due to previous cardiac catheterization in 42 patients (41 percent); (2) right ventricular endomyocardial biopsy after cardiac transplant in 19 patients (19 percent); (3) control catheterization of the pulmonary arteries following classic or bidirectional cavopulmonary anastomosis in 16 patients (16 percent); (4) superior vena cava obstruction following Mustard’s procedure in 14 patients (14 percent); (5) failed percutaneous femoral venous approach in six patients (6 percent); and (6) absence of the hepatic segment of the inferior vena cava in four patients (4 percent). The right or left internal jugular vein could be entered in all but three procedures (98 percent). Seventeen patients had more than one procedure through the same internal jugular vein and the vein was found patent in all. A complete right heart catheterization was performed using this route. Right ventricular endomyocardial biopsy and interventional procedure were performed through this route. Two major complications occurred. A patient developed a central transient ischemic attack and another patient developed a persistent Horner syndrome. Accidental carotid puncture occurred in five patients without consequences. Our data indicate that cardiac catheterization in infants and children can be performed safely through the internal jugular vein, with a high success rate and a low incidence of major complications. (Chest 1992; 101:1512-14)

CC = cardiac catheterization; IJV = internal jugular vein; IVC = inferior vena cava

Methods

Study Population

In the eight-year period between 1982 and 1990, 3,303 CCs were performed in 2,130 pediatric patients; the IJV approach was used in 160 CCs (4.5 percent) and 102 patients (4.7 percent). Patients ranged in age between 2 months and 17 years (mean, 3.8 years) and in weight from 3.2 to 57.3 kg (mean, 14.4 kg). Indications for the IJV approach included the following: (1) thrombosis of the inferior vena cava due to previous CC in 42 patients (41 percent); (2) right ventricular endomyocardial biopsy after cardiac transplant in 19 patients (19 percent); (3) control catheterization of the pulmonary arteries following classic or bidirectional cavopulmonary anastomosis in 16 patients (16 percent); (4) superior vena cava obstruction following Mustard’s procedure in 14 patients (14 percent); (5) failed femoral venous approach in six patients (6 percent); and (6) absence of the hepatic segment of the inferior vena cava in four patients (4 percent).

Technique

Patients were not allowed to eat or drink for 8 to 12 h before the procedure. All were premedicated with mefedine (1.5 mg/kg) and promethazine hydrochloride (1.5 mg/kg) and received mask inhalation anesthesia with halothane (Flotothane). Continuous electrocardiographic monitoring was maintained. In each patient, we tried to use the right IJV rather than the left because this is a more direct route to the heart. The patient’s head was turned contralateral to the side of the catheterization, the shoulders were slightly elevated, and the arms were placed parallel to the body. The neck was sterilized using the standard technique. The site of puncture was
located 3 cm above the superior border of the clavicle, between the medial and lateral bellies of the sternocleidomastoid muscle. A 19-gauge, 3.75-cm needle was then advanced at an angle 30° to 40° caudal from the vertical and 20° to 30° toward the patient’s right. Continuous suction was applied to the needle with a 5-ml syringe. If a vein could not be cannulated with this technique, the needle was angled first more laterally and then medially to reduce the chance of carotid artery puncture. If the vein was not entered after several attempts, the left IJV approach was undertaken. After the IJV was successfully probed, a guide wire was advanced to the right atrium under fluoroscopic visualization, the needle was removed, and an appropriate size sheath (5F to 7F) was advanced along the guide wire through the IJV. Cardiac catheterization and angiography were performed with balloon-tipped catheters (Berman) and an endomyocardial biopsy specimen was obtained with GU biopette.

RESULTS

The IJV could be entered in all but three procedures (98 percent). The right IJV was utilized in 145 procedures (91 percent) and the left IJV was utilized in 15 (9 percent). Six patients had two CCS through the same IJV, five had three CCS, and six had four or more procedures through the same IJV. The IJV was found patent in all patients who had more than one procedure through the same IJV. A complete right heart catheterization could be performed using this route. However, catheter manipulation was somewhat more difficult from the IJV than that from the femoral vein approach; in particular, left atrium catheterization even in a patient with an atrial septal defect was more awkward.

Interventional procedures performed from the IJV entry were balloon dilatation relief of superior vena cava obstruction in five patients after Mustard surgery and of pulmonary artery stenosis after superior vena cava-pulmonary artery anastomosis in two patients.

Right ventricular endomyocardial biopsy was performed in 19 children, without complications, following the technique described by Mason in adults.

Two major complications occurred (1.3 percent of the procedures). One patient with a congenital heart defect and right-to-left shunt developed a transient central ischemic attack but the computed tomogram showed an area of decreased density in the frontal region, probably due to paradoxical embolism. The symptomatology manifested after several attempts to cannulate the IJV, immediately following the introduction of the sheath, and before the insertion of the catheter. The patient was not heparinized. A 19-month-old patient, weighing 12 kg, developed a permanent right Horner’s syndrome. In this patient, the right IJV could not be cannulated after several attempts with the formation of a large hematoma on the right side of the neck. Accidental carotid artery puncture occurred in five patients (3.1 percent of the procedures) with formation of a small hematoma without consequences.

DISCUSSION

The Seldinger technique for percutaneous vessel catheterization has been widely applied using the femoral vein in infants and children and it remains the first approach for CC in patients with congenital heart defects. However, in some cases, the femoral venous approach is impossible. The occlusion rate of the inferior vena cava in patients who underwent CC through the femoral vein during the first six months of life can be as high as 16 percent. Furthermore, through the femoral vein, there is no access to the pulmonary arteries in case of previous bidirectional cavopulmonary anastomosis and the catheterization of the superior vena cava (SVC) can be very difficult as in patients after Mustard surgery with severe SVC obstruction. In these conditions, a complete catheterization of the heart from the groin is precluded. In other conditions, as in case of right ventricular endomyocardial biopsy, the IJV approach is usually preferred. Alternative venous approach such
as antecubital or axillary may be used, but they require a cutdown. Multiple cutdowns will progressively limit the sources of access to the heart in a group of patients who may require other catheterizations and operations.

The IJV route for central venous line is widely used in the critical care of infants and children, but information on its use in pediatric CC is limited to the series of 14 patients from Latson et al. Our experience based on a larger series of patients confirms the feasibility and safety of this procedure.

Percutaneous transluminal angioplasty performed through the IJV is reported without major complications and our experience confirms these data. Many complications of IJV catheterization are reported, such as pneumothorax and hydrothorax, thoracic duct puncture, injury to the vagus, phrenic, and other nerves, and hematoma from accidental carotid puncture. In the present series, the incidence of complications was 5 percent.

Although other authors suggest a percutaneous subclavian vein approach as a first alternative to the femoral vein, our data indicate that CC in infants and children can be performed safely through the IJV, with a high success rate and low incidence of major complications. CC through the IJV may become a good alternative approach in children with congenital heart defects who are candidates for repetitive CCs.

ACKNOWLEDGMENTS: We acknowledge and appreciate the assistance of Luigi Ballerini, M.D., Giuseppe De Simone, M.D., Roberto Di Donato, M.D., Salvatore Giannico, M.D., and Luciano Pasquini, M.D. We thank Giuseppe Bolla for technical assistance and the nurses and technicians of the catheterization laboratory at the Bambino Gesu Hospital for their excellent work.

REFERENCES
1 Seldinger SI. Catheter replacement of the needle in percutaneous arteriography: a new technique. Acta Radiol 1953; 39:368-76
5 Belani KG, Buckley JJ, Gordon JR, Castaneda W. Percutaneous cervical central venous line placement: a comparison of the internal and external jugular vein routes. Anesth Analg 1980; 59:40-44
7 Latson LA, Kugler JD, Cheatham JP, Guminer CH, Hofschire PJ. Percutaneous cardiac catheterization via the internal jugular vein in infants and children. Cathet Cardiovasc Diagn 1984; 10:593-95
8 Mason JW. Techniques for right and left ventricular endomyocardial biopsy. Am J Cardiol 1978; 41:887-92
10 Chaara A, Zniber L, El Haitem N, Benomar M. Percutaneous balloon valvuloplasty via the right internal jugular vein for valvular pulmonic stenosis with severe right ventricular failure. Am Heart J 1988; 117:684-85
11 English DCW, Frew RM, Pigott JJ. Percutaneous catheterization of the internal jugular vein. Anaesthesia 1969; 24:521-31
12 Briscoe CA, Bushman JA, McDonald WI. Extensive neurological damage after cannulation of the internal jugular vein. BMJ 1974; 1:314