

Central venous access in pediatric patients

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ABSTRACT: Occlusion of traditional sites for central venous cannulation is a challenging problem in patients that require a permanent central venous line for chronic administration of nutrients or drugs.

In rare cases, extensive central venous thrombosis of the superior and inferior vena cava may preclude catheterization, and uncommon routes should be used.

We describe our approach for placement of chronic central venous lines in two pediatric patients with short bowel syndrome and extensive caval occlusion. (The Journal of Vascular Access 2001; 2: 125-127)

KEY WORDS: *Vena cava thrombosis, Vascular access, Total parenteral nutrition, Direct right atrial cannulation*

INTRODUCTION

Permanent right atrial central venous catheters have been used with increasing frequency in patients requiring long-term parenteral nutrition, chemotherapy or antibiotics (1).

Due to expanding indication for the use of chronic central venous lines (CVL), conventional routes of access are occasionally unavailable because of previous catheter-related complications (2).

Central venous thrombosis caused by multiple venous cannulation is a well-known complication, but thrombotic occlusion of the superior and inferior vena cava rarely occurs and precludes catheter insertion by traditional percutaneous and operative techniques. These rare cases represent a challenging problem for the surgeon, and alternative uncommon access routes of central venous catheter have been used.

The aim of this report is to describe several approaches for chronic central venous access in pediatric patients with total occlusion of the superior and inferior central venous system and to stress the necessity to preserve the vascular tree in patients requiring prolonged central venous access.

CASE REPORTS

Case 1

A 14-year-old boy had short bowel syndrome (SBS) secondary to neonatal mid-gut volvulus. During the first 7

years of his life he was not able to be weaned from TPN and many CVLs were replaced (n=7) because of displacement, breakage, infection or clotting.

An angiography, performed at 8 years of age, showed total occlusion of the superior vena cava (SVC) system (Fig.1), consequently the catheters (n=20) were placed in the traditional access of inferior vena cava (IVC). A second angiography, 7 years ago, showed exhaustion of these sites because of the thrombosis of the IVC up to the renal veins. Two percutaneous hepatic vein cannulations were performed, but the catheters were removed after 20 and 10 days because of dislodgement; a surgical placement in the azygous or right atrium was mandatory.

Following a right thoracotomy the chest was entered through the fourth intercostal space. A collateral vessel of the azygous vein was isolated and a 6.6 F silastic catheter was placed in a subcutaneous tunnel, and the tip inserted into the vessel.

In spite of various attempts, the catheter did not reach the right atrium because of the distal occlusion of the vein, probably originating from an injured vein wall. It was therefore placed directly in the right atrium by means of a small atriotomy.

The catheter was not fixed onto the thoracic wall and the exit site was made in intercostal space below the incision to avoid any possibility of damaging the catheter during the closure. The patient was discharged after seven days.

Twenty-five days after the placement, the boy was admitted to the hospital complaining of cough, thoracic pain and respiratory distress. Thorax examination



Fig. 1 - Case 1. Angiography showing superior vena cava obstruction and collateral circulation.

showed dullness to percussion and absent breath sounds over the right chest wall. The chest X-ray showed a large right pleural effusion and the catheter free in the right thorax, having probably been dislodged by cardiac motion or respiratory acts.

An urgent right thoracotomy was required to remove the free fluid in the pleural cavity and to place a new catheter. A single-lumen 6.6 F silastic catheter was placed in a different subcutaneous thoracic tunnel and then cut to size.

A second atriotomy was performed and two circumferential sutures were placed in the cardiac wall. The catheter tip was introduced into the atrial cavity and fixed at the myocardium with non-absorbable sutures.

The endothoracic tract of the catheter was not fixed onto the chest wall to prevent traction during the respiratory acts. The patient had an uneventful postoperative course and was discharged after 8 days.

The correct position of the tip in the right atrium was controlled by periodic clinical examinations, echocardiography and chest-wall X-ray.

After 25 months of follow up, the catheter is still well tolerated and working well. Complications (thrombosis, dislocation, infection) have not been observed and the patient has a fairly good quality of life.

Case 2

The patient was a 16-year-old boy with short bowel syndrome secondary to multiple jejuno-ileal atresia

without ileocecal valve; the residual small bowel segment was 20 cm and the residual large bowel was 15 cm.

In his second year of life he underwent the "Bianchi" surgical bowel lengthening procedure, but it proved unsuccessful for nutrients absorption. Prolonged central venous access was therefore required for the chronic administration of the nutrients.

During the first 15 years of life, 14 CVLs was placed in the vascular access of the superior vena cava, at this time colordoppler ultrasound and angiography showed a complete occlusion of the superior vena cava vascular tree.

As a result, cannulation of vascular access (3 CVLs in saphenous veins) of the inferior vena cava was performed. However, the catheters were not well tolerated during the ambulation and after a short period (13 months) these accesses were also occluded.

The patient was taken to the operating theater, and after making an arcuated incision in the lower abdominal right quadrant, we isolated the right superficial hepigastric vein. A circumferential suture was placed in the site of the venotomy near the outlet in the iliac vein. A new single-lumen 9.6 F silastic catheter was placed in a subcutaneous abdominal tunnel and was then cut to size. The venotomy was performed and the catheter was inserted in the vein. Intraoperative fluoroscopy confirmed correct position of the catheter tip in the inferior vena cava and the

right atrium. The circumferential suture in the venotomy site was closed gently around the catheter and the abdominal wall was sutured. No clinically detectable complications were observed in the postoperative period. Two years later, the catheter is still well tolerated and continues to function well.

DISCUSSION

The Broviac catheter was first introduced in 1973 for the administration of long-term parenteral nutrition. Since its development, the permanent right atrial catheter has been modified by Hickman, and the indications for its use have been greatly expanded.

The first description of insertion was given by Heimbac and Ivey in 1976. The procedure involves a cutdown over the cephalic vein and requires intraoperative fluoroscopy to confirm proper positioning of the catheter tip in the right atrium.

Subsequently, alternative routes (internal or external jugular veins, subclavian vein) were obtained by percutaneous or surgical methods.

In pediatric patients the most frequent indications for long-term central venous access are cancer chemotherapy and home parenteral nutrition. Children who require a chronic central venous catheter because of medical or surgical pathologies since the first days of life, frequently experience thrombotic occlusion of the conventional accesses, caused by multiple cannulations or administration of hyperosmolar fluids (e.g. parenteral nutrition) (2-4).

In rare cases, an extensive superior and/or inferior central venous thrombosis may preclude catheterization of the common routes in pediatric patients with extremely short bowel syndrome (5, 6).

Moreover, extensive thrombosis of the inferior vena cava may involve the renal veins and hepatic veins; the venous return from the kidney and the liver flow into the azygos and hemiazygos veins by collateral vessels.

The development of a collateral circulation prevents obstructive symptoms of thrombosis with consequent non-symptomatic extension of the thrombus into the central venous system.

In our experience of cases extensive thrombosis, thrombolytic therapy has not been successful, and cannulation of an alternative route is mandatory to guarantee adequate administration of nutrients.

Several methods have been described in the literature. Oram-Smith et al in 1978 performed the direct operative catheterization of the right atrium, Malt and Kempster reported surgical cannulation of the azygos vein in a patient with bilateral thrombosis of the subclavian and internal jugular veins, and Maher reported catheter insertion by a retroperitoneal approach. Other authors have described percutaneous methods that employ translumbar or transhepatic approaches (7-10).

In our experience with percutaneous methods in patients with exhaustion of the common venous sites, there is no guarantee of long life for the catheter. This is probably due to the impossibility of adequately fixing catheters that get dislodged during the respiratory or cardiac motion (11).

In these critical patients we prefer a surgical approach because it assures good control of the residual venous site for cannulation, and the possibility to fix the catheter on the venotomy or atriotomy site. Prolonged duration is therefore assured.

In these selected groups of patients requiring long-term CVL, it is mandatory to preserve the vascular tree and to trace out periodically a detailed map of the vascular access with color doppler ultrasound and/or angiography.

Finally, it is well documented in the literature that dedicated personnel can help reduce complications, and correct training of the parents is essential to guarantee long-life of the catheter. In conclusion, in pediatric patients requiring administration of long-term parenteral nutrition or therapy, a permanent central venous line is mandatory. Thrombosis is a frequent complication in these patients and may preclude cannulation of the conventional venous sites. Central venous access with caval occlusion remains a challenging problem for the pediatric surgeon. We report our experience of two cases with superior and inferior vena cava (SVC, IVC) obstruction.

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