

A Simplified Atrial Catheterization Technique for Ventriculo-atrial Shunt: Puncture of the Subclavian Vein Through the Infraclavicular Approach

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Abstract

A simple technique to place an atrial catheter for ventriculo-atrial shunt has been developed. The subclavian vein is punctured percutaneously from the direction between the clavicle and the first rib by the same procedure used for central venous catheterization using the introducer designed for Fr. 7 catheter. The position of the tip of the catheter is determined by x-ray fluoroscopy. The technique was found to be simple, safe, and timesaving in two patients.

Key words: hydrocephalus, shunt, operative technique, ventriculoatrial shunt

Introduction

Ventriculoperitoneal (VP) shunt is frequently indicated for the management of hydrocephalus because the maneuvers are simple, revisions are easy to perform, and the incidence of serious complications including sepsis is low. However, in cases where the VP shunt is repeatedly obstructed at the abdominal portion, or where intraperitoneal catheterization seems difficult to perform because of previous surgery to the abdomen, ventriculo-atrial (VA) shunt is prescribed.

Surgery for VA shunt introduces the catheter into the atrium through the facial vein. However, to expose this vein at the lateral aspect of the neck the skin must widely be incised, and removal of the surrounding tissue requires much time. A shunt revision, if required, entails a tedious procedure to reopen the operative scar. With these considerations in mind, we have developed a simple method for atrial catheterization as described below.

Operative Technique

The atrial end of the VA shunt is placed at the level of the lower end of the 6th thoracic vertebral body. To identify this position, it is recommended to place a metal marker between the 6th and 7th thoracic vertebrae. The position of the catheter is determined by x-ray fluoroscopy. The technique was found to be simple, safe, and timesaving in two patients.

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vertebral bodies under fluoroscopic control. Fluoroscopy should be ready for intraoperative use.

The first step is to insert and place the atrial catheter (Pudenz Cardiac Catheter, Baxter Healthcare Corp., Ill., U.S.A.) into the subclavian vein by the same procedure as central venous catheter insertion (Fig. 1). For this purpose, a 5 mm long incision is made into the skin 1–2 cm caudal to the midpoint of the clavicle. Using the introducer designed for Fr. 7 catheters (effective length of the sheath 100 mm; Radifocus Introducer Kit A, Terumo Corp., Tokyo) (Fig. 2), the subclavian vein is punctured from the direction between the clavicle and the first rib. After the introducer is inserted into the subclavian vein, the dilator is removed, the sheath filled with heparinized physiological saline, and left in place.

A ventricular catheter is then placed and equipped with a flushing valve. The hub is cut off from the previously placed sheath, and the atrial catheter introduced through the sheath (Fig. 3). Under fluoroscopic control, the tip of this catheter, filled with contrast medium to ensure fluoroscopic identification, is advanced to a point a few centimeters distant from the previously placed marker between the 6th and 7th thoracic vertebral bodies, and then the sheath is removed (Figs. 4 and 5). The other end of the atrial catheter is brought up to the level of the flushing valve using a shunt passer. The length of the catheter is adjusted so that the atrial end lies at the level of the lower end of the 6th thoracic vertebral body while the other end reaches the flushing valve. The catheter is curved at a right angle over the clavicle so that no kink forms.

**Case 1:** A 64-year-old male suffered head injury after drinking alcohol. He was hospitalized with cerebrospinal fluid rhinorrhea, which did not improve during follow-up. Radical surgery was then performed. Hydrocephalus developed 2 months later because of traumatic subarachnoid hemorrhage. A...
Lumboperitoneal shunt was performed, but the shunt soon became obstructed. He had undergone extensive laparotomy because of appendicitis and associated peritonitis 9 years ago, with subsequent adhesion-induced ileus which was possibly responsible for the shunt obstruction. We therefore constructed a VA shunt on the left, contralateral to the region invaded by the radical surgery for cerebrospinal fluid rhinorrhea. This was the first VA shunt performed by our technique, and therefore we proceeded step by step to confirm the correctness of each procedure. Nevertheless, the operation took only 63 minutes to complete. The ventricles became smaller, and hydrocephalus-related dementia, gait disturbance, and urinary incontinence ameliorated.

**Case 2:** A 65-year-old male visited our hospital with acute epidural hematoma, severe brain contusion, and subarachnoid hemorrhage following head injury. The epidural hematoma was immediately removed. Tracheostomy was simultaneously performed because of serious consciousness disturbance and respiratory insufficiency resulting from aspiration. Approximately 1 month later, hydrocephalus developed. Methicillin-resistant *Staphylococcus aureus* had been detected by sputum culture, so we performed a lumboperitoneal shunt to distance the surgical wound and the tracheostomy site. Shunt obstruction occurred about 5 weeks later. We considered VP or VA shunt, choosing the latter to avoid methicillin-resistant *Staphylococcus aureus* infection by limiting the number of surgical wounds. The operative time was 52 minutes. The hydrocephalus was ameliorated, and he was able to walk.

**Discussion**

Two methods are available for introducing a catheter into the superior vena cava or the right atrium: puncturing the subclavian vein through the infraclavicular approach,\(^9\) and puncturing the subclavian or jugular vein through the supraclavicular approach.\(^2\)-\(^4\),\(^10\) Both are well-established techniques widely used by neurosurgeons for central venous pressure monitoring or hyperalimentation.

In 1989, Kock-Jensen *et al.*\(^5\) reported a new technique for placing an atrial catheter for VA shunt using a peel-away introducer to puncture the jugular vein through the supraclavicular approach.\(^3\) This is an excellent method producing a natural and direct arrangement of catheters, and therefore the length of the entire shunt system is favorably limited. In patients who have undergone tracheostomy, however, infections may occur because the tracheostomy wound and the puncture point for shunting are close. Our method provides an alternative approach, and is probably preferable in the following cases: 1) The surgeon is skilled in venipuncture through the infraclavicular approach. 2) The point of venipuncture is sufficiently distant from the tracheostomy wound to avoid infection.

In conventional procedures for VA shunt,\(^3\) the cervical region is incised to introduce an atrial catheter through the facial vein. Our method is superior to conventional procedures because: 1) Surgical invasion is smaller, maneuvers are simpler, and the operative time is shorter. 2) Shunt revision is easy to perform and can be repeated many times.

In fact, the operative time was 63 minutes in Case 1, and shorter at 52 minutes in Case 2. With further experience, the operative time will become even shorter than that required for conventional VA procedures or even for VP shunt.

We placed the tip of the atrial catheter at the level of the lower end of the 6th thoracic vertebral body under fluoroscopic control monitoring the tip and the vertebra. This position was chosen because Nulsen and Becker\(^6\) reported that tip placement at the level of the 7th thoracic vertebra or lower tends to induce sepsis while placement at the level of the 4th thoracic vertebra or higher results in catheter obstruction. Electrocardiography,\(^8\) sonography,\(^9\) rate of drip infusion, and various other parameters are available for confirming the position of the tip. Any of these parameters can be used with our venipuncture method. Thus, our method seems to be both safe and reliable.

**References**

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