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Technical notes & surgical techniques

Ultrasound-guided percutaneous ventriculo-atrial shunt placement: Technical nuances with video demonstration

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ABSTRACT

Hydrocephalic patients with abdominal pathologies often need a ventriculo-atrial (VA) shunt placement. Cut-down on the internal jugular vein has historically been used to insert a VA shunt. This technique is more time consuming and has greater complications. Less invasive methods, such as ultrasound-guided percutaneous VA shunt placement provides greater comfort for surgeon, is more rapid, and has fewer complications. However, this technique has not been demonstrated on video. Here we demonstrate ultrasound-guided and ECG-aided VA shunt catheter placement in a 70-year-old patient with normal pressure hydrocephalus. The internal jugular vein is punctured under ultrasound guidance with an 18-gauge needle. A guidewire is introduced through the needle, the needle is removed, and a small skin incision is placed at the entry point of the guidewire. A skin dilator with a sheath introducer is advanced to the vein using the guidewire and the guidewire is thereafter removed. An atrial shunt catheter (e.g. Codman® Medos® Atrial catheter) filled with sterile water is inserted through the sheath. The sheath is removed and a syringe filled with sterile aqua is connected to the catheter with a metal tip. The ECG connection of the right upper limb is connected to the tip of syringe to adjust for the optimal depth of the catheter under ECG guidance (point of highest p-wave amplitude). The catheter is clamped and tunneled to reach the site for the valve on the scalp. The ventricle catheter is placed at the Kocher point and connected to the valve (Video 1).

Conclusion: Ultrasound-guided VA shunt placement is safe, comfortable, rapid, and has a reduced rate of complications.

1. Introduction

Hydrocephalic patients with abdominal pathologies often need a ventriculo-atrial (VA) shunt placement. Cut-down on the internal jugular vein has historically been used to insert VA-shunt. This technique takes more time and has higher complications. Less invasive methods such as ultrasound guided percutaneous VA-shunt placement is a comfortable and fast method having fewer complications but never been demonstrated as a video. We demonstrate a simple and fast method of VA shunt placement with a high definition video and elaborate technical nuances of this technique.

2. Details of surgical procedure

We demonstrate an ultrasound guided and ECG aided VA-shunt catheter placement in 70-year old patient with normal pressure hydrocephalus. The internal jugular vein is punctured under ultrasound guidance with an 18 gauge needle. A guidewire is introduced through the needle, the needle is removed and a small skin incision is placed at the entry point of the guidewire. A skin dilator with a sheath introducer is advanced to the vein using the guidewire and guidewire is thereafter removed. An atrial shunt catheter (e.g. Codman® Medos® Atrial catheter) filled with sterile aqua is inserted through the sheath after removal of the dilator and then clamped (Video 1). The sheath is removed and a syringe filled with sterile aqua is connected to the catheter with a metal tip. The ECG connection of the right upper limb is connected to the tip of the metal syringe adjust for the optimal depth of the atrial catheter under ECG guidance (point of highest p-wave amplitude). Once the proper depth has been chosen, the catheter is clamped and tunneled to reach the site for the valve on the scalp. Ventricle catheter is placed at Kocher point and connected to the valve (Video 1).

Abbreviations: VA, ventriculo-atrial; ECG, electrocardiography

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3. Technical nuances and notes

- **Selection of the vein for catheter placement**: The right internal jugular vein is preferred as the right internal jugular vein is larger than on the left side and the route to the right atrium of the heart is shorter and straighter thus decreasing the risk for misplacement of the catheter (e.g. turning to the subclavian vein).
- **Avoiding air embolism**: The atrial shunt catheter (e.g. Codman® Medos® Atrial catheter) should be filled with sterile water to avoid any air embolism.
- **Adjustment of optimal depth of atrial catheter**: To adjust for the optimal depth of the atrial catheter, the catheter is moved slightly back and forth while monitoring ECG. The point at which the p-wave reaches its highest amplitude or a bifid p wave appears is chosen. If ventricular arrhythmias are detected the catheter is too low and reaching the ventricle and should be drawn slightly back.
- **Optimal connection of atrial catheter with the valve**: To connect atrial catheter optimally with the valve, the catheter can be pulled upwards a measured length (e.g. 4 cm). This allows a convenient placement of the valve on the scalp with a minimal curved incision. The atrial catheter is returned (the same length) back after it has been properly trimmed and connected to the valve.

4. Usefulness of ultrasound-guided percutaneous ventriculo-atrial shunt placement technique

Open techniques of VA shunt implantation is more laborious and time consuming as it needs surgical exploration in the neck region. Open extensive surgical exploration increases the risk of neurovascular injuries. Moreover, open VA shunt implantation causes more scar formation and hence difficulty of tissue dissection in case of shunt revision. Furthermore, placement of atrial catheter under ECG guidance does not require X-rays and hence avoiding radiation during the operation.

5. Limitations

The patients with conditions including bacteremia, CSF infection, endocarditis, prothrombotic state, pulmonary hypertension, congestive heart failure and pulmonary embolism are not suitable for a VA shunt procedure.

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Disclosures

The authors have no conflict of interest and have nothing to disclose.

Conflict of interest

None.

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