Temporary Lumbar Subcutaneous Cerebrospinal Fluid Shunt Placement in Pediatric Patient: a Technical Note

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Abstract

Background—We report the technical aspects of lumbar subcutaneous cerebrospinal fluid (CSF) shunt for temporary CSF drainage that may be an alternative strategy to lumbar catheter placement with external drainage system.

Case Description—A 7 years and nine-month old boy with developmental delay, intermittent episodes of agitation, and combination of myoclonic and generalized tonic clonic seizures, associated with communicating hydrocephalus was evaluated. A temporary CSF drainage trial was contemplated to determine whether a permanent CSF shunt would be beneficial. A temporary lumbar subcutaneous CSF shunt was performed to avoid catheter dislodgement or drainage system disruption due to child’s agitative behavior and seizures. The catheter was inserted into the subarachnoid space at L3–L4 vertebral level and advanced approximately 20 cm above site of insertion and approximately 4 cm was imbedded into the subcutaneous tissue. An ultrasound two days later demonstrated CSF collection in subcutaneous tissue measuring 3.48 cm × 0.84 cm surrounding the catheter tip. The patient’s parents reported improvement in clinical symptoms after four days of CSF drainage.

Conclusions—Lumbar subcutaneous CSF shunt may be used for temporary CSF drainage for diagnostic purposes without the need for in patient admission and monitoring required for standard lumbar catheter with external CSF drainage system.

Keywords
Cerebrospinal fluid drainage; cerebrospinal fluid shunt; hydrocephalus; lumbar catheter; lumbar subcutaneous shunt

Introduction

Lumbar catheter placement for temporary cerebrospinal fluid (CSF) drainage has been used for variety of indications, such as evaluation of normal pressure hydrocephalus, and treatment of communicating hydrocephalus secondary to subarachnoid or intraparenchymal hemorrhage, and headaches due to idiopathic intracranial hypertension [1–3]. The exterior portion of the catheter is connected through an intermediate catheter to a drainage bag. The position of the catheter is adjusted to ensure adequate CSF drainage per hour under gravity. However, such an arrangement requires patient compliance and in patient admission to ensure that the catheter is not dislodged or removed through manipulation of the exterior portion. Similarly, in-patient admission is necessary to ensure that the integrity of the connecting catheter and drainage bag are not disrupted to avoid uncontrolled CSF drainage or occurrence of infection [4,5]. Percutaneous introduction of a lumbar subcutaneous shunt has been recently described with 5 cm of the catheter flared in both directions with a blade and imbedded in the subcutaneous tissue for CSF drainage for 7–10 days [6]. We report a modified technique for placement of lumbar subcutaneous CSF shunt in pediatric patient for assessing effect of CSF drainage on communicating hydrocephalus.

Case Description

A 7 years and nine-month boy was evaluated for developmental delay, intermittent episodes of agitation, and combination of myoclonic and generalized tonic clonic seizures on a daily basis. Patient had a normal delivery
with normal development until the age of three years. The boy developed encephalitis associated with fever and seizures. Subsequently, he developed speech deficits involving both comprehension and expression. He did not have any focal motor deficits. A computed tomographic (CT) scan demonstrated persistent communicating hydrocephalus. A temporary CSF drainage trial was contemplated to determine whether a permanent CSF shunt would be beneficial. However, lumbar catheter placement and external CSF drainage for 3–4 days was not considered feasible due to child’s agitative behavior and seizures. A temporary lumbar subcutaneous CSF shunt was planned to avoid catheter dislodgement or drainage system disruption.

The procedure was performed under general anesthesia. The patient was placed in lateral decubitus position and preparation and draping of the patient was performed using standard sterile protocol. The midline technique was performed by placing the needle in the interspinous process between the spinous processes of L3 and L4 vertebrae. The syringe and needle (23 gauge) was used for local subcutaneous lidocaine injection along the projected needle track. A 19-gauge epidural SPROTTE® needle with rounded ramp was advanced toward midline in a cephalad direction. After initial insertion of the needle into the subcutaneous tissue, the lateral plane was imaged using fluoroscopy and the epidural needle was advanced into the interspace between the spinous processes of L3 and L4. The needle was advanced until CSF was withdrawn.

The epidural catheter (Epidural Kit [AS-E/S] Biotek International, Jiangxi China) was advanced cephalad through the needle into the subarachnoid space approximately 20 cm above site of insertion. The epidural needle was withdrawn and exterior portion of the epidural catheter was cut to leave approximately 5 cm protruding through the skin. A second incision was made 3 cm superior to initial incision and the epidural needle was passed under the skin until the tip was visualized through the first incision. The catheter was introduced through the tip and withdrawn through the hub of the needle through the second incision. The needle was withdrawn and the exterior catheter tip was placed in the subcutaneous tissue under the second incision. Both incision sites were sutured leaving the exterior portion of catheter imbedded under the skin.

Two days after insertion of catheter, there was induration under the insertion site without any fluid transmission on palpitation (Fig. 1). No pain was elicited on palpation. An ultrasound (Logiq e, GE Healthcare, Little Chalfont, United Kingdom) was performed which demonstrated hypoechoic mass representing CSF collection in subcutaneous tissue measuring 3.48 cm × 0.84 cm surrounding the catheter tip (Fig. 2). The catheter was visualized in longitudinal axis as a tubular structure with hyperechoic walls. The catheter was maintained in position for four days. The patient remained afebrile throughout this period. The patient’s parents reported improvement in behavior. No episodes of generalized seizures occurred during the period of CSF drainage with infrequent occurrence of myoclonic seizures. The catheter was removed without any complications. No fluid exudation was observed at the time of catheter removal.
Discussion

There are two issues that need to be addressed. The first issue is whether the lumbar subcutaneous CSF shunt is a reliable method for CSF drainage in amounts large enough to result in clinical improvement. Ushewokunze et al. [6] reported the results of lumbar subcutaneous CSF shunt in a total of 46 patients with normal pressure hydrocephalus and 24 patients with idiopathic intracranial hypertension. Temporary improvement in clinical symptoms was seen in 29 (63%) of the patients with normal pressure hydrocephalus and 13 (54%) patients with benign intracranial hypertension. In our patient, we observed clinical improvement after placement of lumbar subcutaneous CSF shunt. We also observed collection of fluid in the subcutaneous tissue in proximity to exterior end of the catheter. Ushewokunze et al. [6] considered the procedure to a more reliable analogue to high-volume (>30 mL) spinal tap (lumbar tap test) [7,8].

The mechanism by which high-volume spinal tap elicits a clinical response is presumed to be through a CSF leak into the subcutaneous tissue. The 30 mL of CSF removed during the procedure only represents a fraction of approximately 500 mL of CSF produced daily [8].

The second issue is whether CSF accumulating within the subcutaneous tissue is going to be resorbed. Lipschitz et al. [9] demonstrated using radioactive tracers that 500 mL of 0.9% sodium chloride administered within the subcutaneous tissue is completely resorbed within 1 hour of infusion. Slesak et al. [10] observed that 750 mL/day of 0.45% sodium chloride was adequately resorbed from the subcutaneous tissue with inadequate resorption in only two of 48 patients treated. Localized collection of CSF in subcutaneous tissue, an appearance called pseudomeningocele, is very rare in patients with constant leakage of CSF through the dura into the overlying tissue after spinal surgery [11,12]. Collection of CSF that requires aspiration to remove the fluid is very rarely observed in patients with CSF leak in the lumbar region [13,14]. Such observations suggest that CSF accumulating in the subcutaneous tissue is resorbed at an adequate rate to prevent large accumulations.

We did not observe any adverse event associated with lumbar subcutaneous CSF shunt. Ushewokunze et al. [6] found that the low-pressure headaches and sciatica were infrequently seen after lumbar subcutaneous CSF shunt. We think that lumbar subcutaneous CSF shunt may be used for temporary CSF drainage for diagnostic purposes. The method avoids the need for in patient admission and monitoring required for standard lumbar catheter with external CSF drainage system.

References

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