Familiarization with Lumboperitoneal Shunt Using Some Technical Resources

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Key words
- Endovascular neurosurgery
- Halfway incision
- Hydrocephalus
- Lumboperitoneal shunt
- Ventriculoperitoneal shunt

Abbreviations and Acronyms:
LP: Lumboperitoneal
VP: Ventriculoperitoneal

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BACKGROUND: **Although lumboperitoneal (LP) shunts are thought to be less invasive, they are used less frequently compared with ventriculoperitoneal shunts in the treatment of communicating hydrocephalus. This may be due to limitations such as troublesome patient positioning, difficulty in valve pressure confirmation and adjustment, and concerns regarding overdrainage. The aim of this study was to increase operator familiarization with the technical aspects of LP shunt procedures.**

METHODS: **To reduce the abovementioned shortcomings, we developed a new device called SiphonGuard. Our method has the following technical advantages: avoidance of a halfway incision, valve placement between the dermis and subcutaneous fat in the patient's lumbar region near the puncture point, and minimal space requirement for valve placement.**

RESULTS: **Two reversible complications were experienced, and there were no infectious complications. A relatively low rate of complications was achieved. Valve pressure detection on an anteroposterior view of a plain abdominal X-ray was possible in all patients with our method.**

CONCLUSIONS: **Our method provides solutions to certain troublesome issues concerning LP shunt procedures; in practical terms, resolution of these issues may contribute to more widespread usage of LP shunt procedures by neurosurgeons. In this study, we demonstrate our familiarization procedure for LP shunt procedures.**

INTRODUCTION

The choice of either a ventriculoperitoneal (VP) or a lumboperitoneal (LP) shunt in the treatment of communicating hydrocephalus will depend on the cerebrospinal fluid flow dynamics and the preference of the surgeon (6). In general, the majority of neurosurgeons may be more familiar with VP shunt procedures than LP shunt procedures; this is likely because most neurosurgeons do not consider LP shunt procedures to be suitable substitutes for VP shunt procedures (6, 7). A complicated patient position change is not required in VP shunt procedures (11). Valve instability may be directly related to the difficulty in visualizing valve pressure on plain abdominal radiographs. The position of the reservoir is obscured by the skin surface, making it difficult to pump, which is used to confirm shunt system patency and to change the valve pressure without image guidance. In addition, the fear of overdrainage persists. The distal catheter passing through the halfway incision is another obstacle to patient position change, especially affecting maintenance of cleanliness of the operative site.

A conventional LP shunt method was suggested by Kuwana et al. in 1977 (8, 9). In this method, however, valve pressure confirmation is not always easy. Valve pressure visualization under image guidance is frequently necessary because an obscured reservoir position may cause difficulty in placing the reprogramming unit and taking satisfactory radiographs (2). In addition, patient position change and redraping are bothersome (11). Quantitative flow tends to fluctuate among the sitting, standing, and supine positions in the LP shunt method (4, 5). Therefore, a low-pressure setting may cause hemorrhagic complications due to overdrainage. These problems, along with the increased case volume for endovascular treatment in our institution in recent years, prompted us to amend the conventional method. In addition, LP shunt procedures have an advantage over the VP shunt procedures in avoiding the need for accessing the cerebral ventricles (1, 3, 10, 13).

METHODS

A total of 51 shunt procedures for normal-pressure hydrocephalus were carried out in our institution from April 2006 to October 2010. Forty cases were treated by the LP shunt procedure, whereas 11 cases were treated by VP shunt procedures. The VP shunt method was chosen when the LP method was thought to be difficult because of prolonged spinal drainage, which could result in infectious complications or severe lumbar spondylosis. The first 12 LP cases were performed by the conventional meth-

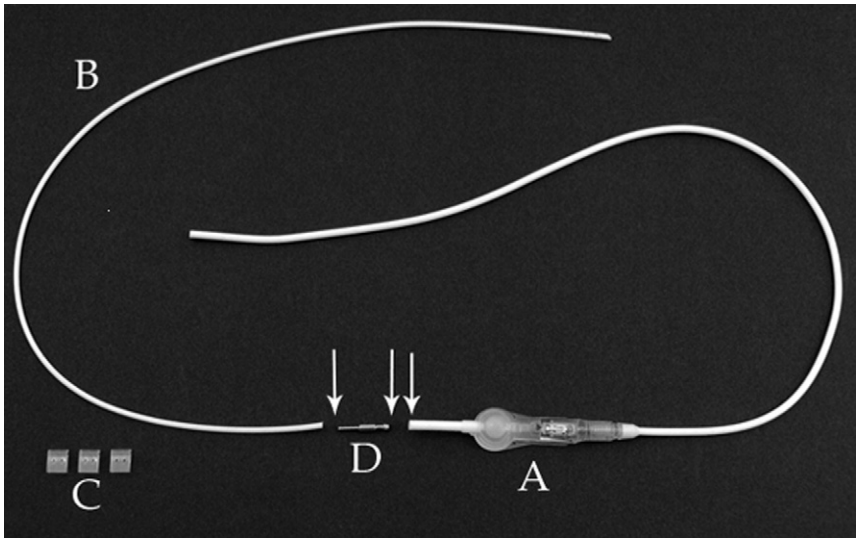

Figure 1. Lumboperitoneal shunt pack. (**A**) Distal catheter. The valve with SiphonGuard and an integrated distal catheter. (**B**) Proximal catheter. Lumbar subarachnoid catheter. (**C**) Three silicon fixing wings used for stabilization of the proximal catheter and valve. (**D**) Stepped stainless-steel connector: proximal catheter being connected at the proximal site (single arrow) and distal catheter at the distal site (double arrows).

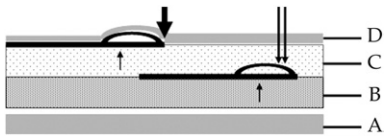

Figure 3. Schema of incision and valve placement. In conventional lumboperitoneal shunt procedures, the subcutaneous fat is incised and the valve is placed on the muscle layer or in the subcutaneous fat (double arrows), i.e., the location of the valve is deeper and the space created is larger, resulting in an obscure location and instability of the valve. In our method, the subcutaneous fat is not incised and the valve is placed between the skin and subcutaneous fat (thick arrow), thus improving valve stability and facilitating easy manipulation. Prior to position change, the procedure can be achieved without the need for bipolar coagulation, suction devices, and various kinds of retractors. Thin arrow shows the schema of the valve. (**A**) Spinal subarachnoid space, (**B**) spinal muscle layer, (**C**) fat layer, (**D**) epidermis and dermis.

od; the rest of the cases were carried out using our novel technique.

The LP shunt pack (LP-2006, Medos SARL, Codman & Shurtleff, Inc., Raynham, MA, USA) (**Figure 1**) was mainly used for our LP shunt procedures. The pack contains 3 components: the valve with SiphonGuard (Medos SARL, Codman & Shurtleff, Inc.) (**Figure 2**), an integrated distal catheter and a proximal catheter (a lumbar subarachnoid catheter) (Kaneka Medix Co., Tokyo, Japan), and 3 silicone fixing wings.

In principle, the valve (integral connector valve with SiphonGuard) is placed toward the rear, adjacent to the spinal needle insertion point, such that it is stabilized in the regular position. To place the valve just under the subcutaneous space, the epidermis and dermis should be incised over 2 to 3 cm, and a small space should be created between the dermis and subcutaneous fat for insertion of the valve (**Figure 3**). Through this space, a reasonably and manually curved needle passer (Disposable Cath Passer, Codman & Shurtleff, Inc.) is passed through the subcutaneous space to the abdominal marker that indicates the area to be dissected, and the distal catheter is pulled through (**Figure 4**). Minimal space is required for setting the valve, and therefore, a fixation device is unnecessary. In addition, the reservoir may be easily felt under the skin (**Figure 4**). To prevent lateral displacement of the valve, the proximal and distal catheters should be joined by a connector (Kaneka Medix Co.) as close to the puncture point as possible (**Figure 4G**). This may facilitate measurement of valve pressure in the anteroposterior view of a conventional plain abdominal radiograph (**Figure 5**).

Redraping is not required throughout the procedure because the entire operative area has already been draped (**Figure 4**). The patient is carefully transferred from the lateral to the supine position by surgeons and nursing assistants. Although a position change may be troublesome, the supine position may be preferable during abdominal manipulation because the midline anatomy is easy to visualize. In our method, bipolar coagulation and suction devices were not required until the position change, and therefore, these instruments remain sterile for commencement of the abdominal procedure.

A total of 40 LP shunt procedures for normal-pressure hydrocephalus carried out in our institution thus far. The first 12 proce-

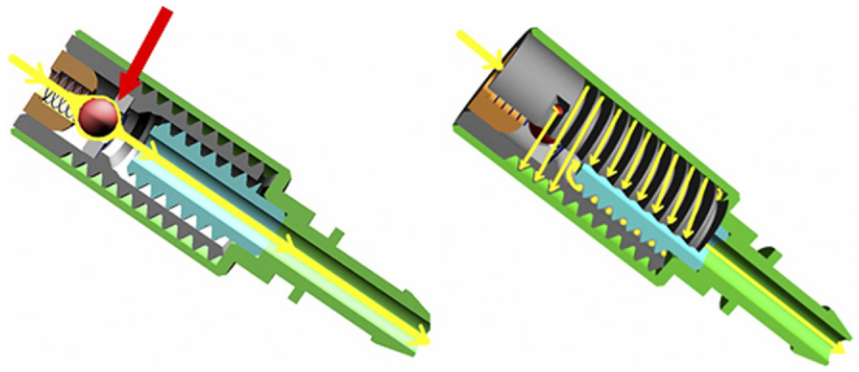

Figure 2. The SiphonGuard antisiphon device is a new and unique device for preventing excessive cerebrospinal fluid (CSF) flow during position changes. The ruby ball (red arrow) is balanced off the seat between 2 opposing springs. Primary and secondary pathways are initially open. Increasing the CSF flow rate, the primary flow pathway (yellow arrows on the left) is gradually closed under flow control by the ruby ball. This pathway closes at about 120 ml/h, after which the opened secondary flow pathway (yellow arrows to the right) remains patent. CSF travels down an outer spiral, flows upward along an inner spiral, and exits just below the ruby ball.