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Management of idiopathic intracranial hypertension with a programmable lumboperitoneal shunt: Early experience

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ABSTRACT

Objective: To evaluate the clinical outcomes and complications rate among idiopathic intracranial hypertension (IIH) patients who underwent lumboperitoneal (LP) shunt insertion with a programmable Strata valve.
Methods: We retrospectively evaluated patients who underwent LP shunt with a programmable Strata valve insertion at the University of Ottawa Civic Hospital from November 2012 to June 2013. The demographic data, clinical symptoms, opening pressure, pre-operative and post-operative visual fields, neuroimaging, visual acuity, disc status, and complications were recorded and analyzed.
Results: Seven female patients with IIH underwent insertion of an LP shunt with a programmable Strata valve. The mean opening pressure was 35.8 cm H_2O. The initial valve setting was 1.5, and four patients required post-operative valve pressure adjustment. All patients showed significant improvement in objective visual testing at follow-up as well as less frequent headaches. None of the patients developed intra- or post-operative complications.
Conclusion: LP shunts with programmable Strata valve systems are a potential alternative to conventional LP and programmable ventriculoperitoneal shunt systems as well as optic nerve sheath fenestration, due to their potential in avoiding brain injury, lower failure and complication rates, lower intracranial hypotension incidence, and flexibility in adjusting valve pressure settings post-operatively evading under- and overdrainage complications. They should be considered for the management of IIH instead of early design LP systems and VP shunts. A randomized multi-center trial should be conducted to compare the efficacy of these surgical techniques.

1. Introduction

The use of lumboperitoneal (LP) shunts has been well documented as a treatment modality for patients with idiopathic intracranial hypertension (IIH). There are a number of advantages to LP shunts when compared with other treatment modalities for IIH, such as stereotactic ventriculoperitoneal shunts (VP) and optic nerve sheath fenestrations (ONSF). LP shunts avoid intracranial risks, such as cerebral hemorrhage, seizures, and shunt malposition. Additionally, LP shunts may be preferable for patients with small ventricles because of the ease of shunt insertion [1,2].

Early designs of LP shunt systems were composed of a valveless silastic tube, and the diversion of cerebrospinal fluid (CSF) is entirely dependent on the resistance and gravity encountered through the silicon catheter. One criticism of LP shunts is the potential development of low-pressure symptoms caused by CSF overdrainage. Therefore, it was necessary to incorporate a valve into the LP shunt system, which was established by Murtagh in 1967 in order to decrease the incidence of such a complication [3]. A limitation of these valves was the fixed pressure setting established at the time of surgery, which may result in under- or overdrainage complications post-operatively, requiring subsequent shunt revision(s).

The development of low-pressure symptoms requiring LP shunt revision has been reported to be as high as 25% [4]. However, with the recent advances in modern technology, such as the introduction

Abbreviations: IIH, idiopathic intracranial hypertension.

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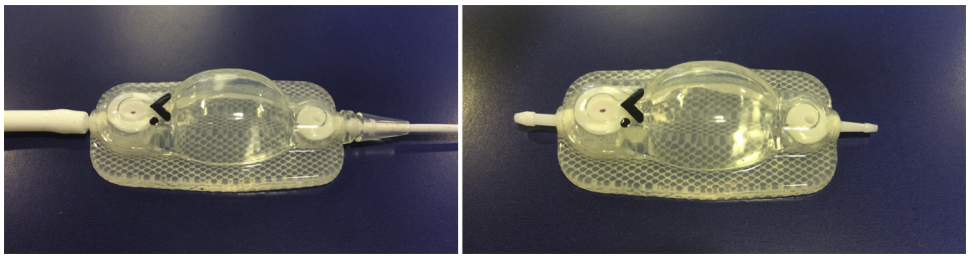

Fig. 1. Photographs of the programmable Strata valve (Medtronic, Inc.).

of programmable valves and small lumen peritoneal catheters, the incidence of intracranial hypotension has decreased, and it is now possible to adjust the valve pressure setting post-operatively to avoid symptoms of over- or underdrainage [1,5]. Therefore, the use of these programmable LP shunts has drastically reduced the need for subsequent revision procedures [1,2,4].

Various programmable valve LP shunt systems have been introduced to the market, and each has its advantages and disadvantages. The Strata LP valve (Medtronic, Inc.) incorporates a ball-and-cone pressure valve (Fig. 1). With this shunt, flow control depends on the resistance of the ball and cone and the degree of resistance determines the performance level of the valve. In addition, retrograde flow is prevented by the ball and cone [2]. The valve pressure setting can be adjusted easily using an external magnet to reach the desired pressure setting. Therefore, it is essential to check and adjust the valve pressure setting in patients after the exposure to large magnetic fields like magnetic resonance imaging (MRI).

Programmable valves have been used in VP shunts for decades. However, their use in LP shunt procedures is relatively new. Most of the reported literature describes the use of traditional LP shunts in the management of IIH, and there are few reports in the literature describing the use of programmable valve LP shunts in IIH patients. In addition, most of the current literature comparing the efficacy between LP and VP shunt systems does not consider the LP shunts with programmable valves, resulting in an underestimation of this potentially highly effective alternative.

In this account, we report our early experience with programmable LP shunts in the management of IIH at the Ottawa Hospital.

2. Methods

We performed a retrospective review and analysis of the clinical records of patients who underwent programmable Strata (Medtronic, Inc.) LP shunt placement by the senior author (F.A.) at the Ottawa Hospital between May 2012 and June 2013 with a minimum follow up of one year. Our inclusion criteria included adult patients who were newly diagnosed with IIH (based on modified Dandy criteria (Table 1)) [6] with visual impairment and with an LP opening pressure of 25 cm H_2O or more at the time of presentation. Patients with previous CSF diversion or previous cranial or abdominal surgeries were excluded. The study was approved by the Research Ethic Board at the Ottawa Hospital Research Institute (OHRI). Informed consent was obtained from all patients involved in the study. Patient demographics, including age, gender, diagnosis, clinical symptoms, opening pressure, pre- and post-operative visual acuity, visual fields, disc status, neuroimaging, and intra- and post-operative complications were assessed. The initial valve settings and subsequent adjustments were also reviewed.

Table 1
Modified Dandy criteria for idiopathic intracranial hypertension [6].

Symptoms of elevated intracranial pressure (headache, nausea, vomiting, transient visual obscurations, or papilledema)
Absence of localizing signs in neurological examination with the exception of false localizing signs (e.g., abducens or facial nerve palsies)
Patient is awake and alert
Normal CT/MRI findings without evidence of thrombosis
Lumbar puncture opening pressure of >25 cm H_2O and normal biochemical/cytological composition of CSF
No other explanation for raised intracranial pressure

The Strata programmable valve (Medtronic, Inc.) provides the following full range of performance levels (acceptable pressure ranges are given in parentheses): 0.5 setting (0–3 cm H_2O), 1.0 setting (1–6 cm H_2O), 1.5 setting (5.5–11.5 cm H_2O), 2.0 setting (10.5–17 cm H_2O), and 2.5 setting (15.5–22.5 cm H_2O). The valve is composed of a reservoir and proximal and distal occluders that allow for injection, CSF sampling, and proximal or distal flushing. The valve performance level can be verified through the use of a built-in adjustment system or using a radiographic confirmation. The small lumen peritoneal catheter consists of firmer catheter tubing than conventional LP shunts, which reduces the risk of occlusion or kinking. The small inner diameter provides an average flow resistance of 0.1 cm H_2O/cm catheter length at a constant flow rate of 20 ml/h. The flow-limiting properties of the small lumen peritoneal catheter may decrease the risk of overdrainage [2]. The lumbar catheter can reach up to 84 cm in length while the peritoneal catheter can reach up to 120 cm in length.

3. Surgical technique

Patients underwent general anesthesia and endotracheal intubation in the lateral decubitus position with routine skin preparation and draping. Three incisions were made, including a 1-cm lumbar incision (L3–L4), a 5-cm flank incision, and a transverse abdominal incision. A total of 10–20 cm of the lumbar catheter was inserted into the subarachnoid space using a Tuohy needle, and the placement of the catheter was confirmed via CSF flow. A subcutaneous pouch was fashioned using curved mayo scissors to house the valve. Following the dissection of the abdominal wall layers into the peritoneum, a small lumen peritoneal catheter was inserted and tunneled between the lumbar and abdominal incisions. The lateral incision was used to move the catheter through the subcutaneous pouch. The pre-programmed valve was anchored with the use of sutures. Flow confirmation was obtained and all three incisions were closed in layers.

4. Results

Between May 2012 and June 2013, seven female patients underwent placement of an LP shunt with a programmable Strata valve (Medtronic, Inc.) at the Ottawa Hospital (Table 2). The mean patient age was 33.2 years (range 23–46).

Data for pre- and post-operative visual acuity, visual fields, and optic disc status are shown in Table 3. One patient (14.3%) failed to attend the follow-up with their ophthalmologist for a post-operative visual assessment.