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Lumboperitoneal Shunt Preference in Treatment of Patients with Normal Pressure Hydrocephalus

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Abstract

Objective: To demonstrate the advantages of Lumboperitoneal (LP) shunt surgery applied to patients with normal pressure hydrocephalus (NPH).

Methods: Preoperative, intraoperative and postoperative data of 20 patients who underwent LP shunt surgery for NPH between 01/01/2012 and 07/04/2022 at the Neurosurgery Clinic of Ordu University Training and Research Hospital were analyzed. The demographic, clinical and laboratory data of the patients as well as their medical records were reviewed. Patients who underwent LP shunt with the diagnosis of normal pressure hydrocephalus in our clinic were screened retrospectively, and the success rates and complications after the surgical intervention applied to these patients were recorded.

Results: Statistically significant improvements were recorded in Modified Ranking Scale Scores and Mini-Mental State Examination Scores at the end of the first year. The incidence of Gait Disturbance did not differ significantly by gender, The incidence of dementia did not differ significantly by gender, The incidence of urinary incontinence showed a significant change according to gender While all of the women diagnosed with normal pressure hydrocephalus had urinary incontinence in the preoperative period, this rate was seen in only 66.7% of the men. Gait disturbance improved in 80%, urinary incontinence in 60%, and cognitive functions in 60% of patients. No neurogenic complication developed in our operated patients. Wound infection occurred at the abdominal incision site in only two patients (10%). Subcutaneous hematoma occurred in the abdominal region in one patient (5%).

Conclusion: LP shunt surgery has a lower complication rate than VP shunt surgery and is a more easily applicable surgical technique. LPS surgery is a safe and minimally invasive treatment method. It has lower complication rates compared to VPS . LPS surgery is an effective surgical technique. It can be used as an alternative to the VPS procedure in the treatment of NPH patients

Key words: Lumboperitoneal shunt, Normal pressure hydrocephalus, Cerebro-spinal fluid

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INTRODUCTION

Normal pressure hydrocephalus (NPH) is a syndrome described by Adams and Hakim in 1965. This syndrome is predominantly seen in the elderly and its major symptoms are gait disturbance, dementia, and urinary incontinence (1). NPH rarely presents with symptoms of mania, depression or psychosis, and these psychiatric disorders may complicate the diagnosis (2). The aim of shunt surgery is to transfer cerebrospinal fluid (CSF) to the peritoneum, pleura or atrium through a shunt system. Historically, although ventriculoperitoneal shunt (VPS) surgery was widely performed, Lumboperitoneal shunt (LPS) surgery, which is a minimally invasive technique, has become the more preferred method today (3). LPS is one of the common and effective surgical treatment methods used today and is used in the treatment of normal pressure hydrocephalus, pseudotumor cerebri, and CSF fistula (4). LPS can be applied relatively easily and the operation time of LPS is shorter. The risk of subdural hematoma, intracranial hemorrhages, seizures, and shunt dysfunction, which are complications that may occur after all shunt surgery treatments, is lower. In addition, there is a randomized controlled trial showing which procedure is more effective and safer (5). Ventricular catheter placement may be difficult in patients with small ventricles. Therefore, LPS surgery may be preferred in patients with small ventricles (6,7,8,9,10).

Lumboperitoneal shunt is an effective and safe procedure for communicating hydrocephalus (6,11). The improvement of the patient's symptoms after lumbar puncture is valuable for diagnosis. Brain magnetic resonance imaging (MRI) and Computed tomography (CT) should be carefully evaluated in the preoperative period. LPS systems consist of 3 main parts: lumbar catheter, valve and a peritoneal catheter (12). LPS surgery provided high clinical success rates in all patients included in our study. Clinical outcomes such as improvement in preoperative symptoms and improved quality of life were comparable to VPS procedures (13). The diagnosis of INPH remains controversial since the lack of widely accepted and standardized criteria (5). As a result of their study, Xie D. et al. showed that LPS and VPS have similar curative effects in the treatment of normal pressure hydrocephalus, but LPS can prevent intraparenchymal hemorrhage caused by ventricular puncture (14). Over the past few decades, a great deal of attention has been given with the respect to the best treatment for INPH. There are some studies suggesting no significant differences among the different shunts used, which are mainly retrospective design (15). Hong Wei Yang et al. showed in an experimental study that deletions in CWH43 cause idiopathic NPH (16). Massimiliano Todisco et al. showed in a study that postoperative reduction of PWM (periventricular white matter) hyperintensities may be a useful MRI marker surrogate for the clinical efficacy of LPS (17). Tong Sun et al. showed in their study that the presence of RBCs in the preoperative CSF is a risk for early shunt obstruction in patients with a diagnosis of PHH (post-hemorrhagic hydrocephalus) treated with LPS (18).

METHODS

The clinical data of 20 patients diagnosed with NPH who were treated with LPS surgery in the Neurosurgery Department of Ordu University Training and Research Hospital, covering the last 10 years, were retrospectively analyzed. These data are follow-up examination findings obtained from

medical charts and neuroradiological examinations of patients. Demographically, age, gender, clinical symptoms of the patient and Lumbar puncture opening pressure, imaging of brain tissue, complications, pre and postoperative outcome scale scores (Modified Rankin Score (mRS) and Mini Mental Status Examination (MMSE) score) were evaluated. We had 20 NPH patients included in the study, of which 8 (40%) were female and 12 (60%) were male. The mean age was 75 years. (Min=62, Max=86) years.

Clinical Manifestation

Gait disturbance was the most common symptom and was present in 90% of our patients. This was followed by dementia (80%) and urinary incontinence (60%). The classic triad of this syndrome was detected only in 60%. In addition to these symptoms, headache was present in 60% of patients and dizziness was present in 20%.

Imaging Examination

CT and MRI were routinely performed on each patient for diagnosis and follow-up, and the size of the ventricles and the structure of the brain parenchyma were examined. The presence of pathologies that may cause obstruction in the CSF circulation pathways and intracranial masses that may cause increased intracranial pressure were investigated.

Patient Selection

A rutine lumbar puncture was performed in all patients who presented with clinical and radiological symptoms suggesting NPH. The opening pressure in the LP ranged from 100 to 260 mm H_2O. Lumbar punctures were repeated for 2 days and 30 ml of CSF was drained each time. Patients with significant clinical improvement after LP were considered candidates for LPS.

Surgical Technique

All patients were given general anesthesia and endotracheal intubation was performed. C-arm fluoroscopy was used to detect the L4-5 intervertebral space. All patients were typically placed in the lateral decubitus position. Afterwards, the patients were stained sterile and covered with a sterile drape. Lumbar and abdominal skin incisions were made. The proximal end of the lumboperitoneal shunt was placed in the lumbar spinal subarachnoid space. CSF flow was observed. This catheter was combined with a medium pressure shunt pump. The upper end of the distal catheter, which was advanced through a tunnel opened under the skin, was connected to the shunt pump. The lower end of the distal catheter was sent to the peritoneum. Both surgical incisions were closed in accordance with the anatomical method.

Statistical Analysis

Categorical data were expressed as frequency (n) and percentage (%). Frequency analysis was used to summarize and report the data. Likelihood Ratio Chi-Squared test was used to test for association between two nominal variables. All comparisons were two-tailed and p-value less than 5% was considered statistically significant. Statistical analyses were performed using the SPSS v28 (IBM Inc., Chicago, IL, USA) statistical software.

RESULTS

At the end of the first year of our patients who underwent LPS surgery, 80% of gait disturbance, 60% of cognitive functions and 60% of urinary incontinence improved. No neurogenic complication developed in our operated patients (Table 1). Wound infection occurred at the abdominal incision site in

only two patients (10%). Subcutaneous hematoma occurred in the abdominal region in one patient (5%). These patients received iv antibiotic treatment and medical treatment. No shunt revision was required in any patient. At the end of the 6th month, the complaints of headache and dizziness resolved in all our patients.

The incidence of Gait Disturbance did not differ significantly by gender (p=0.763), The incidence of dementia did not differ significantly by gender (p=0.651), The incidence of urinary incontinence showed a significant change according to gender (p=0.001), Urinary incontinence was seen in all women, while it was seen in 66.7% of men.

Table 1. Relations of symptoms by age and gender

		Gender						p
		Male		Female		*Total*		
		n	%	n	%	*n*	*%*	
Gait Disturbance	No	1	8.3	1	12.5	*2*	*10.0*	0.763
	Yes	11	91.7	7	87.5	*18*	*90.0*	χ^2=0.091
	Total	*12*	*100.0*	*8*	*100.0*	*20*	*100.0*	
Dementia	No	2	16.7	2	25.0	*4*	*20.0*	0.651
	Yes	10	83.3	6	75.0	*16*	*80.0*	χ^2=0.205
	Total	*12*	*100.0*	*8*	*100.0*	*20*	*100.0*	
Urinary incontinence	No	8	66.7	0	0.0	*8*	*40.0*	**0.001**
	Yes	4	33.3	8	100.0	*12*	*60.0*	χ^2=11.644
	Total	*12*	*100.0*	*8*	*100.0*	*20*	*100.0*	

χ^2:Likelihood Ratio Chi-Square

DISCUSSION

It is characterized by normal pressure hydrocephalus, gait disturbance, urinary incontinence, and dementia (Hakim-Adams syndrome). The three characteristic symptoms of Hakim-Adams syndrome are present in almost 50% of cases, but the present combination of the two symptoms should be considered for diagnosis (19). The pathophysiology of NPH is still not fully understood. A widely accepted theory is low venous compliance in the basal ganglia and thalamus (19). The aim of the treatment is to restore the functional capacity of the patient. Until now, diagnostic tests were not sufficient to establish the diagnosis and predict the postoperative outcome. For the treatment of NPH, VPS, endoscopic third ventriculostomy and LPS are the main treatment options. However, there are some questions that need to be answered about which technique is effective and what type of shunt should be used (20). Preoperative provocative testing with large volume lumbar CSF drainage or extended lumbar drainage has shown positive results in NPH (21,22,23,24,25). LPS surgery is a safe, effective treatment method, it is still up-to-date and used in the treatment of many diseases. Pseudotumor cerebri, post-operative pseudomeningocele, CSF fistula treatment, treatment of NPH and communican hydrocephalus are among these (8,26,27). LPS surgery case series usually includes adult patients in the medical literature. The underlying pathological causes in these patients are hydrocephalus secondary to complications of head trauma, NPH secondary to subarachnoid hemorrhage, and idiopathic NPH (6,28). Patients diagnosed with NPH in the adult age group were included in our study. In our study, it was

decided to treat NPH patients with LPS, considering the response to benefit from LP, the patient's symptoms, and neuroradiological evaluations. CT was preferred in the early period for postoperative control and MRI was preferred for long-term follow-up. Although positive results have been reported, occlusion and shunt dysfunction may occur following LPS surgery, and a shunt revision surgery may be required. Moreover, LPS surgery should be avoided in the presence of cerebellar tonsillar herniation, infection and arachnoiditis (29). Related disadvantages are orthostatic over drainage and difficulty in function evaluation (11). Unsuccessful injection attempts have been reported in a few series (30). Patients with severe kyphoscoliotic deformity and calcified ligamentum flavum should not be selected for LP shunting (11,31). LPS surgery can cause neurological or non-neurological complications. Many surgeons are hesitant to use LP shunts due to the high complication rates reported in several series in previous years and the difficulty in evaluating function (5). The optimal benefit of this procedure can be achieved using appropriate patient selection and meticulous surgical technique (32). One of the biggest advantages of LPS surgery over VP surgery is that it is devoid of the risk of intracranial complications such as intracerebral hemorrhage, seizures and shunt malposition. This advantage is one of the main factors that makes it increasingly preferred (6,8,9).

CONCLUSION

LPS surgery is a safe and minimally invasive treatment method. It has lower complication rates compared to VPS (18). LPS surgery is an effective surgical technique. It can be used as an alternative to the VPS procedure in the treatment of NPH patients (33).

Ethics Committee Approval: Ethics committee approval was received for this study from the Clinical Research Ethics Committee of Ordu University Faculty of Medicine (ethics committee date and no: 2022/114).

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Author Contributions: Concept, Design, Literature search, Data Collection and Processing, Analysis or Interpretation, Writing: H.O.

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