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Original article

Effect of Fixed Node Maneuver on Migration of Lumboperitoneal Shunt: A pilot study

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ABSTRACT

Background: Shunt migration after Lumboperitoneal [LP] shunt procedures can occur upward into the spinal subarachnoid space and downward into the abdominal cavity. Cranial migrations are less common than downward migration into the abdominal cavity. Defects of the fixation devices in the shunt system are considered the main cause.

Aim of the work: To evaluate fixed node maneuver, a new technique to avoid shunt migration.

Patients and methods: Among many cases of shunt installations, we selected 30 patients who received a first-time shunt installation for different causes [pseudotumor cerebri [24 cases], primary cerebrospinal fluid [CSF] rhinorrhea [5 cases] and one case for persistent postoperative lumbar CSF leak]. All cases underwent LP shunt with fixed node in group [A; 15 patients] and the traditional mode of fixation in group [B; 15 patients], with evaluation of postoperative clinical improvement and shunt migration.

Results: Clinical improvement occurred in 27 [90%] patients. However, shunt migration was recorded in 2 [13.3%] patients of the second group [B], while in group [A], no recorded shunt migration.

Conclusion: We advocated clinical efficacy of fixed node maneuver of lumboperitoneal shunt to avoid shunt migration.

Keywords: Cerebrospinal fluid shunts; Ventriculoperitoneal; Thecoperitoneal; Tidal phenomena; Shunt.

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INTRODUCTION

Idiopathic intracranial hypertension [IIH] or pseudotumor cerebri (PTC), usually affects obese females in their childbearing age. It presents by signs and symptoms of increased intracranial tension [papilledema without hydrocephalus], elevated opening pressure on lumbar puncture with normal imaging and cerebrospinal fluid [CSF] studies. There are no well-established guidelines regarding disease management. However, CSF diversion surgery [shunt] is the most widely curative surgical intervention[1].

Thecoperitoneal shunt is a diversion of cerebro-spinal fluid [CSF] from the lumbar cerebrospinal sac to the cavity of the peritoneum. It is generally a safe and effective technique. Shunt provides rapid and significant reduction of intracranial tension. LP shunts were advocated as ventricles in patients with IIH are often very small, making shunt insertion difficult[2]. However, relative complications might occur such as post-spinal headache, bleeding, nerve irritation or palsy, infection, pneumocephalus, acquired malformation [e.g., Chiari malformation] and migration of the shunt[3]. Such shunt migration of catheter in LP shunt is a relatively common event. Shunt malfunction due to fracture [or migration] of peritoneal or lumbar catheter was reported in about 12-23% in previous studies[4]. Shunt migration is usually due to improper anchoring or if the anchoring suture are relatively loose or due to defects in the devices of fixation in the shunt systems [5]. So that a new technique for shunt fixation could reduce the rate of shunt migration.

Here, we presented our experience about fixation of LP shunt catheter by a fixed node, regardless the site of fixation [spine, muscle or subcutaneous tissues] using a gentle suture. The node fixation aiming primarily to prevent catheter displacement [migration].

AIM OF THE STUDY

Evaluation and description of a new technique of LP shunt fixation to overcome shunt migration problems.

PATIENTS AND METHODS

From December 2017 to May 2019, we carried out shunts for 30 patients with LP shunt surgical intervention for different causes [pseudotumor cerebri, 24 cases, primary CSF rhinorrhea, 5 cases and one case for persistent postoperative lumbar CSF leak]. All cases underwent LP shunt at Sayed Galal University Hospital and other neurosurgical centers at Egypt. The patients were classified into 2 groups: the first one with fixed node [group A] and the second one with the traditional mode of fixation [group B], with evaluation of postoperative clinical improvement, malfunction of the shunt, abnormal (over- and under)-drainage, and shunt migration. After excluding those patients with shunt revision, we assessed the clinical outcome for 30 subjects with first-time installation of the shunt [15 subjects with a fixed node maneuver and 15 subjects without fixed node maneuver] [Table 1].

Table [1]: Characteristics of subjects with or without fixed node maneuver

Characteristics	All patients [n=30]	Group A [n=15]	Group B [n=15]	p-value
Gender				
Male	12 [40%]	2 [13.3%]	10 [66.7%]	0.003
Female	18 [60%]	13 [86.7%]	5 [33.3%]	
Preceding disease				
Pseudo tumor cerebri	20 [66.7%]	10 [66.7%]	10 [66.7%]	0.59
CSF rhinorrhea	9 [30%]	4 [26.6%]	5 [33.3%]	
Spinal CSF leak	1 [3.3%]	1 [6.3%]	0 [0%]	

Surgical procedures for installation of LP Shunt:

All surgical interventions were carried out, while the patient in the prone position and under general anesthesia for the spinal stage then supine position for the abdominal stage. [a] The spinal stage [prone position]: an incision 3 cm in length was made vertically or horizontally (according to surgeon preference) over L2-3 or L3-4 levels for the insertion of spinal subarachnoid catheter (the proximal incision). A 14-gauge, Touhy needle was then inserted into the CSF space with or without the aid of fluoroscopy guidance. Inside such space, a small-diameter proximal catheter was inserted and advanced up to 10 cm inside the space. Gentle nodding of the catheter with fixation of the node to the spine, muscle or subcutaneous tissue by gentle sutures. A second incision was made on the anterior superior iliac spine or on the flank using a Nilton catheter to safely pass the LP catheter inside it. Tunneling of the LP catheter at the flank with suturing and covering the wound to go to the second stage on the supine position [Figures. 1, 2].

[b] The abdominal stage [supine position]: After turning the patient from prone position to the supine position with new sterilization the distal catheter was inserted into the peritoneum through an incision made at McBurney's point or the periumbilical area.

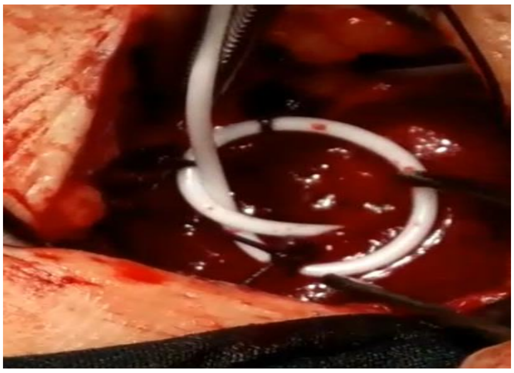

Figure [1]: Lumboperitoneal shunt using the fixed node maneuver by doing a simple gentle node with fixing it by 3 or 4 sutures to the fascia, muscle or around the spinous process.

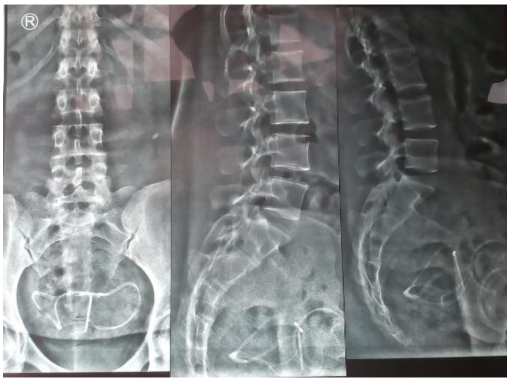

Figure [2]: Lumboperitoneal shunt migration into the pelvis.

Parameters of evaluation:

According to the aim of the surgery of every patient [for CSF rhinorrhea, pseudotumor cerebri or spinal CSF leak], the clinical outcome of the study was described subjectively by the patient himself or objectively by the surgeon at the day of discharge or at the first follow up visit. For statistical purposes, the outcome was categorized into one of three groups: [1] Full improvement (disappearance) of symptoms, [2] Incomplete (partial) partial improvement, [3] symptoms remain as before intervention (i.e., no improvement). Post-operative complications were documented and special stress was expressed on 1) the incidence of shunt malfunction, 2) abnormal drainage (over-/ under-drainage) symptoms; [3] infection; [4] shunt revision; and [5] the revision rate [accumulated number of shunt revisions/number of total shunt operations]. A shunt function test was used to confirm the malfunction, operative data work for the same purpose. Abnormal drainage on the other side was confirmed by clinical examination or results of follow up imaging. Infection was judged clinical with/without isolation of microorganism. In addition, to clinical outcome, the patient data such as his/her age, sex, primary disease, and opening pressure were assessed, documented and compared between groups to search for any associations with surgical procedure.

Statistical Analysis: Numerical variables were expressed in mean and standard deviation and compared using the Student's t-test, while categorical parameters expressed in frequency and percent and compared using the Chi square [χ^2] test or Fisher's exact test. A $p<0.05$ indicate a statistical significance. All statistical analyses were carried out using statistical package for social science (SPSS) version 16 (SPSS Inc., Chicago, USA).

Ethical consideration: The study protocol was approved by the local research and ethics committee, Al-Azhar University. In addition, an informed written consent was obtained from each patient after full explanation of the study procedures. The patient's right regarding withdrawal without any drawbacks was confirmed and their confidentiality was assured.

RESULTS

Clinical improvement occurred in 27 [90%] patients of all the studied patients, which was noticed among group A to be 100% and 80% in group B. The shunt migration was recorded in 2 [13%] patients of the second group [B], while in group [A], no recorded shunt migration.

Table [2]: Results of the studied patients with or without fixed node maneuver.

Characteristics	All patients [n=30]	Group A [n=15]	Group B [n=15]	p-value
Opening pressure [cmH_2O]	21.1±13.1	21.0±12.2	21.6±20.8	0.90
Clinical improvement	27[90%]	15[100]%	12[80%]	0.07
Shunt migration	2[6.6%]	0	2[13%]	0.14

DISCUSSION

The lumboperitoneal shunt carries many advantages when compared to the ventriculo-peritoneal [VP] shunt. These advantages are: 1) escaping the cranial surgery, low complication rate [e.g., intracranial hemorrhage [ICH]], and CSF leakage]. On the other side, there are sparse reports on complications [such as low back pain associated with sciatica or not, lordoscoliosis, tightness of hamstring, foot deformities or lumbar hyperlordosis] associated with old shunt systems or techniques. These comorbidities were explained by arachnoiditis of conus medullaris and lower lumbar roots[6]. In addition, subarachnoid hemorrhage and intra-cerebral hematoma have been reported after a LP shunt [7]. Overall after shunt surgery, migration as a complications, occurred less frequently. Migration – when occurred- could include any possible site of the body, and although cranial migration is rare, it was reported in previous work[8].

Migration after LP shunt could occur upward [into the spinal subarachnoid space] or downward [into the abdominal cavity]. Abdominal migrations occurs more frequently than upward migration. A rare cranial migration of the catheter in the posterior fossa has been reported[9]. As the LP shunt tube has no cilia or legs for motility, so that factors predisposing for shunt migration must be kept in mind. Upward migration supported by high intra-abdominal pressure and strong force created by the movements of lumbar spine[5] but cannot explain abdominal migration which is the common, so we must seek for another mechanism.

From our point of view, this phenomena of migration can be explained in the background of two tidal phenomena: the first tides are created by spinal factor which is the CSF pulsations making what is called CSF tidal phenomena which can explain cases of cranial migration of the shunt; the second [abdominal factor] is controlled by many movements [visceral movements or respiratory movements] creating another tidal phenomena, which can explain the abdominal migration of the shunt. Each tide has 2 phases, one positive pushing the tube and another one negative with suckling of the tube. According to the difference and/or synchronization between these two tidal phenomena the movement of the shunt tube will be directed. Other authors had reported more than a mechanism to be responsible for the migration; positive force of intra-abdominal pressure, negative intra-ventricular suction pressure and tortuous subcutaneous track. It seems that it is not enough fixation to lock and slip clips[10]. Defects of the fixation appliances in the shunt system are reflected as the main cause of migration[5]. Thus, we are trying a new method for fixation which is very simple as illustrated above in figure 1. In this maneuver, prone position then supine position is better than the lateral position, as the prone is better for accessing the CSF and the supine is better for accessing the peritoneal cavity, so we can call it anatomical surgery.

Regarding the sequale of LP shunt migration it will lead to shunt malfunctioning, but in some cases of mild shunt displacement from the spine with exposing some pores of the tube may lead to over drainage which was noticed in a unique case of intracranial hypotension [IH] after lumboperitoneal [LP] shunt installation in which another mechanism leads to the leakage of CSF, from the side hole of the catheter to the epidural space of lumbar region [11]. So, that the node is done not only for fixation but also to avoid over-drainage as it also is done near the spinal inlet to avoid leakage from the side hole of the shunt.

Regarding shunt migration in the present work, it was recoded to be absent in the group [A] with the new maneuver, but was recorded to be 20 % in the group [B], while previous studies showed that 12–23% of LP shunt patients had abnormal function of the shunt resulting from migration [or fracture] of either lumbar or peritoneal catheter[4].

Regarding the unisystem versus multisystem LP shunt, in this study we had preferred the unisystem shunt as it logically less liable for disconnection and migration, but other surgeons like Joon et al.[12] had used a multisystem.

The node is done with simple and gentle curve to avoid kinking. Logically, there is possibility of tube obstruction [not recorded in our study], so special ring may be used to protect the node from kinking.

The strength point of the current study is that it describes a new simple, safe, inexpensive maneuver who presented good results. Thus, it is recommended to add this small step as a routine in LP shunt. However, the study had limiting steps: first, it was carried out over unisystem shunt only. Second, it included small number of patients and its results could not be generalized. Thus, it is recommended to carry out future studies on wide scale to evaluate the maneuver over multisystem shunts.

Conflict of interest:

None

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