Comparative Study between Non–laparoscopic and Laparoscopic-Assisted Distal End Placement in Ventriculoperitoneal Shunt in Adults

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ABSTRACT

Background: *The traditional management of hydrocephalus is still the placement of ventriculoperitoneal (VP) shunts. However, the majority of patients require one or more revisions over their lifetime. Revisions may be required for infections, proximal site malfunction, or distal catheter complications. Distal malfunction is a common complication in ventriculoperitoneal shunts and distal shunt revisions, especially in patients with previous abdominal pathologies as well as in obese patients.* ***Aim of the study****: To review the indications, techniques, complications, and long-term outcome of laparoscopy-guided distal shunt placement or revision for patients with and without a positive abdominal history and compare these results to those of patients operated without laparoscopic guidance.* ***Methods:*** *between January 2012 and December 2016, a retrospective study of 105 distal shunt procedures were performed in our institute, 29 of which were laparoscopically guided, and 76 were not. Of the 105 procedures, 88 were placement of new shunt systems, and 17 were distal revisions. A total of 17 procedures were performed in 13 patients with a history of abdominal surgery; 8 procedures were operated with laparoscopic guidance.* ***Results:*** *there were no significant difference between the laparoscopy group and the nonlaparoscopy group regarding the short-term complications and outcome rates. Among the patients with new shunts, the long-term distal malfunction rate was lower in the laparoscopy group compared with the nonlaparoscopy group (4% vs 10.3%, respectively; P = .17). The short-term shunt infection rate was similar between the 2 techniques for the entire study population, while long-term infection rate is higher in laparoscopic patients.* ***Conclusions:*** *In distal V-P shunt placement or shunt revision laparoscopy is not routinely indicated. However, in patients with previous abdominal surgeries, a laparoscopy-guided procedure may lower the rate of distal malfunction of the shunt.*

Keywords: *Ventriculoperitoneal shunt, Laparoscopy; Minilaparotomy; Distal revision; Complications.*

INTRODUCTION

Ventriculoperitoneal shunt us considered as effective treatment for hydrocephalus. The peritoneum is usually used as draining organ, but shunts may drain to the pleura or cardiac atrium[1,2]. Several techniques are used to place the distal end of the shunt into the peritoneal cavity, such as exposing various layers of the abdominal wall and sticking a trocar into the peritoneum, or performing a minilaparotomy, followed by placement of the distal end into the peritoneum. Delayed risk of abdominal organ perforation, or a delayed risk of mechanical distal malfunction may occur with shunt surgery. We present our experience with laparoscopic-assisted shunt placement and distal shunt revisions and compare the outcome and complications of this technique with other techniques in selected patient populations.

PATIENTS & METHODS

Patients undergoing VPS procedures between January 1, 2012 and December 31, 2016 in Cairo University hospitals were included in this study. 105 distal shunt procedures were performed in our institute, 29 of which were laparoscopically guided, and 76 were not. Of the 105 procedures, 88 were placement of new shunt systems, and 17

were distal revisions. A total of 17 procedures were performed in 13 patients with a history of abdominal surgery; 8 procedures were operated with laparoscopic guidance.

Data of these patients including imaging studies, laboratory studies, reason for the operation (including etiology of the hydrocephalus), type of procedure performed, method of abdominal shunt handling (laparoscopic, trocar based, or minilaparotomy), intraoperative findings, technical problems during operation, length of procedure, postoperative complications, and long-term complications (including the need for distal shunt revisions and infections)were collected. Abdominal history is considered positive if the patient showed past history of abdominal operation (appendectomy, cholecystectomy or others).

Other cases that were considered as having a positive abdominal history were patients with inflammatory bowel disease, patients with multiple (more than 2 times) previous shunt insertions to the abdomen, and patients with a history of peritonitis secondary to any reason. The data were recorded on Excel spreadsheets. Differences of outcome and complications between treatment options were evaluated. a probability value (p value) less than 0.05 was considered statistically significant. P-value of 0.06 was considered marginally significant. All statistical calculations were done using computer program Microsoft Excel version 7 and PASW version 17 for Microsoft Windows.

Inclusion criteria

The study included all patients older than 18 years who underwent placement of a peritoneal catheter. The proximal site of the shunt was ventricular. Distal shunt revisions procedures were also included if the peritoneal end is dealt with.

Exclusion criteria

Patients less than 18 years old, shunts with non peritoneal distal end, shunt revisions not dealing with the peritoneal end. Patients with non ventricular proximal end.

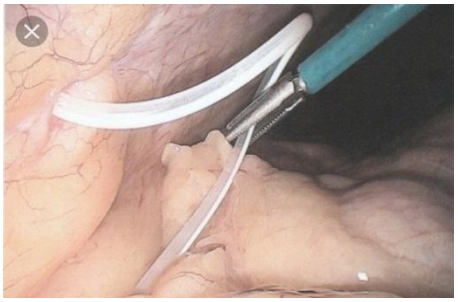

Fig. 1: the distal end of the shunt with laparoscopic assistance

Surgical Technique

The cranial and abdominal part of the operation is performed at same time except in revision cases in which only the abdominal part was revised. Pneumoperitoneum is created using a closed technique with a Verres needle. Carbon dioxide is insufflated to a pressure of 12 mm Hg. A 5-mm subumbilical trocar is inserted, and a 5-mm videoscope is used. An additional 5-mm trocar is inserted for cases in which an intra-abdominal intervention of the distal tubing is needed. The peritoneal cavity is inspected, and a suitable place for the insertion of the distal part of the shunt is selected, usually in the right hypochondrium. The distal tubing is inserted and localized under videoscopic inspection, and distal CSF flow is verified (either spontaneously or after shunt valve pumping). The videoscope is then removed. The peritoneum is deflated, and the trocars are removed. Abdominal skin incisions are closed with intracutaneous absorbable stitches.

RESULTS

A total of 105 procedures were performed during the study period on 84 patients who fulfilled the inclusion criteria. They included 46 men and 38 women; average age was 60 years (range, 19-88). Of these 105 operations, 88 involved the placement of new shunt systems, and 11 were distal revisions only. 6 procedures included a proximal revision in addition to the distal revision at the same operation. Altogether,

29 (28%) distal shunts were placed with laparoscopic aid. The remaining 76 (72%) cases had the distal end placed either by using a trocar (35%) or by a minilaparotomy (65%). There were no significant differences in patients' ages, percentage of positive abdominal history, and length of operation between the laparoscopy-aided and other subgroups.

Table1: Showed distribution of patients in various groups.

		All proc	edures	+v abd	History
	No	Lap	Other	Lap	Other
Total	105	29	76	8	9
New shunts	88	21	67	5	8
Sh rev	17	8	9	3	1

Outcome and complications

The average follow-up time was 15 months for the laparoscopy group and 20 months for patients treated using other techniques. The main outcome variables that were evaluated and compared between the laparoscopic and the other techniques were infection rate, distal malfunction, and intraoperative findings. The short-term shunt infection rate was similar between the 2 techniques for the entire study population. Long-term shunt infections, however, were more common in the laparoscopy group (10%) compared with the group that used other techniques (3.4%), although the difference did not reach a level of significance. Early distal malfunctions occurred in 2 patients in the laparoscopy group and in 1 patient operated using a different technique. Long-term distal malfunctions were less common in the laparoscopy group. Distal malfunction occurred in 4 patients because of migration of the distal end to the extraperitoneal area in the nonlaparoscopy group and none among the laparoscopy patients. There were no intra-abdominal injuries during any of the procedures.

Patients with a positive abdominal history

17 operations were performed on 13 patients with a positive abdominal history. Eight operations in 6 patients were performed using a laparoscope (3 patients appendectomy, one patient open cholecystectomy and 2 laparoscopic cholecystectomy). Adhesions freed with adhesiolysis and the shunt's end was placed in an area free of adhesions. There were 2 distal malfunctions—both in patients who underwent appendectomy in the past: one patient had multiple adhesions and the other had none at all. Technical difficulty in entering the camera mandated an additional incision through which the camera could be inserted in one patient.

9 operations in 7 patients were done without laparoscopic assistance (3 patients appendectomy, one patients cholecystectomy, shunt infection with secondary peritonitis, one patient cholecystectomy and abdominal hysterectomy and one gastrostomy). There were no technical difficulties during surgery in this group. There was one distal malfunction in a patient with a gastrostomy. Shunt removed in case of peritonitis. The infection rate was lower compared with the laparoscopy group; however, 2 cases in the laparoscopy group had recurrent low-grade infection and so the infections were probably unrelated to the laparoscopy procedure per se.

Distal shunt revisions

Of the 17 distal revisions, 8 were laparoscopically assisted. The indications for distal revisions were preperitoneal placement in 3 cases, removal of migrated shunt in 1 case, and distal malfunction in the remaining cases. No intraoperative technical difficulties were encountered in the laparoscopy group, but 2 cases in the non-laparoscopy group required a new minilaparotomy for distal insertion because of local peritoneal adhesions at the previous abdominal incision. The short- and long-term complication rates were not significantly different between the 2 groups. In 4 patients with positive abdominal history, 3 patients were operated laparoscopically.

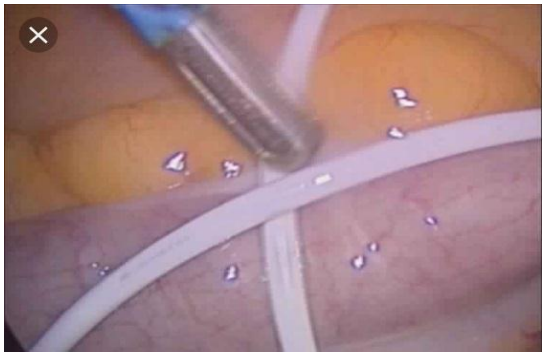

Fig. 2: putting the distal end under vision

DISCUSSION

Placement of a VPS is a common procedure in neurosurgery, although the complication rate is high. The 2 main complications in the pediatric population are infection (10%) [1] and mechanical failure (70%)[2], whereas mechanical failure occurs more rarely among adults (10%-40%)[3]. Distal mechanical malfunctions comprise 25% to 30% of all mechanical failures [4] and include preperitoneal placing of the distal end, malabsorption with secondary ascites, and obstruction of the distal end secondary to intra-abdominal adhesions and pseudocysts [5,6,7]. Other rare complications include chronic erosions of the colon, bladder, and liver [8,9,10]. Immediate injuries to the abdominal viscera are extremely rare. Common techniques for placing the distal ends of shunts include open minilaparotomies and the use of trocars to penetrate abdominal wall layers and the peritoneum. The main drawbacks of these techniques are technical difficulties in obese patients and an uncontrolled placement of the distal end. This may pose a special problem in obese patients and in patients with peritoneal adhesions, such as those with a history of abdominal surgery. Over the past 2 decades, the use of laparoscopic surgery in many surgical procedures for treating intra-abdominal pathologies has gained popularity. The main advantages are smaller incisions and thus smaller peritoneal and fascia openings, less surgically induced trauma, faster postoperative recovery, and fewer secondary peritoneal adhesions [11,12]. Using laparoscopy in distal shunt procedures enables placement of the abdominal end of the shunt under vision and in a distended peritoneum, this helps to lower the risk of immediate injury to abdominal viscera and lower the incidence of preperitoneal placement of the distal shunt end. Other advantages are adhesiolysis in cases of peritoneal adhesions and verification of CSF flow in the peritoneum, although spontaneous CSF flow may not be visible when the abdomen is distended possibly because of the abdominal pressure (10-15 mm Hg) lowering differential pressure on the shunt valve and precluding spontaneous flow. Thus, pumping of the valve may be needed to verify distal CSF flow.

Laparoscopic-assisted placement of new shunt systems

Laparoscopic-assisted peritoneal shunt insertion have been studied by many authors. Bani and Hassler analyzed the results of that technique in 39 children [13], of whom 19 had previous laparotomies (5 for nonshunt reasons). There was no laparoscopy-related morbidity, and postoperative pain and analgesics use were decreased compared with non–laparoscopy-aided cases. Schubert et al.[14] prospectively studied 50 children and adults who underwent laparoscopically assisted distal shunt placement and compared their results with a historical cohort of matched 50 patients undergoing distal shunt placement through a minilaparotomy. In these studies results showed that laparoscopy is slightly a longer procedure than non-laparoscopic ones but the laparoscopy group had a significantly lower distal malfunction rate. The authors suggested that the main reason for this is visual control of the catheter position and its function when assisted by laparoscopy and recommend its use in very obese patients or in those who had previously undergone abdominal surgery. The results of our study agree with their results and with others from smaller groups[16-19]. The long-term distal malfunction rate in general and the preperitoneal placement rate of the distal end in particular were lower in the laparoscopy group (but still non-significant). We suggest that in addition, the small abdominal wall incision and the small peritoneal opening lower the migration rate of the distal end to the abdominal wall, and that the performance of adhesiolysis in cases of peritoneal adhesions lowers the rate of distal malfunction.

Laparoscopic-assisted distal shunt revision

Abdominal complications of shunt procedures occur in 5% to 47% of cases [18]. These include obstruction, catheter disconnection and migration to the peritoneal cavity, infections, ascites, pseudocysts, injury of abdominal viscera, and hernias (may be inguinal or through the peritoneal entry point of the catheter). Laparoscopy has been used to treat pseudocysts, remove dislodged catheters, reposition distal tips placed in preperitoneal spaces, and release distal tips from adhesions [1,9,15-20]. These complications may be treated by externalization of the distal end and by repositioning via a minilaparotomy or, in some pathologies, by a formal laparotomy (such as for treating pseudocysts). A more logical attitude, however, would be to deal with the problem laparoscopically. Laparoscopy may also be used for repositioning misplaced distal ends under direct visualization, for releasing distal tips entrapped in peritoneal adhesions, and for performing adhesiolysis at the same session and opening pseudocysts without the need of extensive laparotomies.

Out of 4 patients with a positive abdominal history, 3 patients were operated with laparoscopic assistance. This means that laparoscopy may be used for more potentially problematic cases [19]. On the other hand, most procedures in cases of distal revision because of simple distal malfunction in patients with a negative abdominal history were performed without laparoscopy guidance, with similar short- and long-term results and complications. Thus, routine laparoscopy does not seem to be indicated for distal revisions in patients with a negative abdominal history. The cost of a shunt revision must be taken into account when choosing surgical approaches [18,20]. About 50% of shunt-related admissions and costs are due to revisions [21,22]. As such, we speculate that the increased costs emerging from laparoscopic instrumentation and the addition of another surgeon to the operating team may be offset by the decreased rate of distal malfunction in the laparoscopy group.

CONCLUSIONS

The non-laparoscopic techniques are satisfactory for distal shunt placement in the peritoneum. laparoscopy-aided shunt surgery may be preserved for removal of dislodged distal catheters or in patients with a history of multiple distal shunt revisions, previous abdominal surgery (especially laparotomies) and patients with chronic inflammatory bowel diseases. It also help in distal procedures in severely obese patients.

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