Laparoscopic management of pediatric and adolescent patients with intra-abdominal complications of ventriculoperitoneal shunt

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Background/purpose **Ventriculoperitoneal (VP) shunt is the most common operative procedure performed in the treatment of hydrocephalus. The aim of this procedure is to drain CSF from the ventricles to the peritoneal cavity, thus to decrease the intracranial pressure. Numerous complications as a result of this technique are reported in the literature and are most commonly located around the peritoneal end of the shunt tube. The standard approach for management is laparotomy and correction of the complication. This approach, although solves the problem, causes the formation of adhesions, which are also not devoid of consequences. The aim of this study is to present our experience and outline the role of laparoscopy in the management of intraabdominal complications of VP shunt in pediatric and adolescent patients.**

Patients and Methods **Over a period of 4 years, 14 patients were managed and recruited in this study. All patients were presented with recurrent abdominal signs and symptoms or elevated intracranial pressure. All patients were managed laparoscopically according to the final diagnosis.**

Results **Fourteen patients (9 men and 5 women) with abdominal complications of VP shunt catheter were managed. Their ages at operation were ranged from 10 months to 15 years. All patients were investigated, diagnosed and managed laporoscopically. The median operative time of the laparoscopic procedure varied according to the diagnosis. It was 120 minutes in pseudocysts, 45 minutes in recurrent congenital inguinal hernias, 100 minutes in adhesive intestinal obstruction and 35 minutes in subcutaneous cyst and 30 minutes in umbilical fistula. Follow up period extended for 24 months after the procedure and all patients had complete resolution of their presenting abdominal or neurological symptoms. The length of the postoperative hospital stay ranged from one day in recurrent congenital hernias up to 4 days in the other procedures. There were no intra- or postoperative complications related to the laparoscopic technique.**

Conclusion **Laparoscopic is a very useful diagnostic and therapeutic tool in dealing with intra-abdominal complications of VP shunt with high safety and an excellent outcome.** ***Ann Pediatr Surg*** **14:16–20 © 2018 Annals of Pediatric Surgery.**

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Keywords: hydrocephalus, laparoscopic management, ventriculoperitoneal shunt

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Introduction

Ventriculoperitoneal (VP) shunt is the most common operative procedure performed in the treatment of hydrocephalus. The aim of this procedure is to drain cerebrospinal fluid (CSF) from the ventricles to the peritoneal cavity, thus decreasing the intracranial pressure. The peritoneal cavity is considered the best site to drain CSF because of its capacity for absorption and low rate of complications [1]. Numerous complications as a result of this technique are reported in the literature and are located most commonly around the peritoneal end of the shunt tube [2]. The rate of occurrence of these complications ranges between 5 and 47% [3,4]. These complications include subcutaneous collection of CSF, peritoneal pseudocyst formation, CSF ascites, extraperitoneal retraction of the catheter, and the development of incisional and inguinal hernias [4–6]. Complications less commonly reported in the literature include gastric perforation and catheter disconnection, as well as pleural, bladder, and scrotal irritation [7–9]. These complications may present either as local abdominal signs or with elevated intracranial pressure.

Obstruction of the distal end of the catheter has to be treated as a surgical emergency because it results in an increase in the intracranial pressure, leading to associated complications that include considerable morbidity and possible death [4].

The standard approach for management is laparotomy and correction of the complication. This approach, although solves the problem, leads to the formation of adhesions, which are also not devoid of consequences [10]. With the advent of minimally invasive techniques, these complications currently are managed laparoscopically [11,12].

The aim of this study was to present our experience and outline the role of laparoscopy in the management of intra-abdominal complications of VP shunt in pediatric and adolescent patients.

Patients and methods

This is a prospective study conducted on patients admitted in the Pediatric Surgery Unit of General Surgery Department, Tanta University, and affiliated hospitals during the period from January 2013 to May 2017. The study was approved by the Ethical Committee of Tanta Faculty of Medicine and informed consent was obtained from patients' guardians. Fourteen patients

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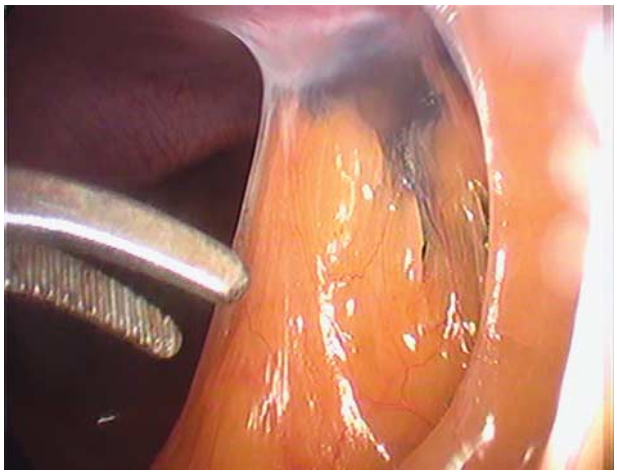
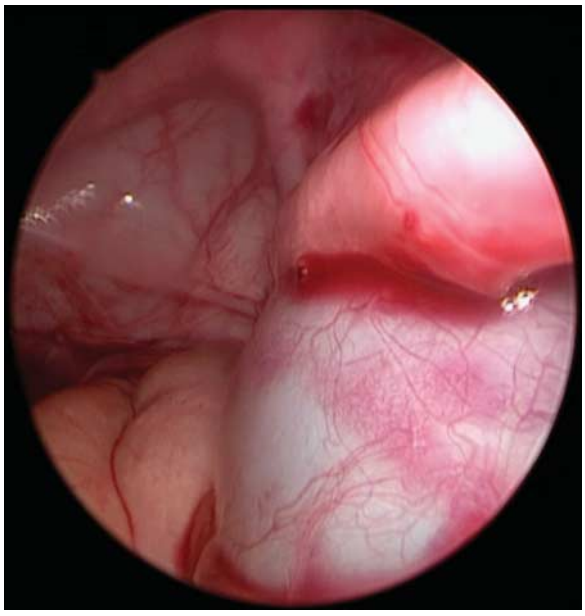
Fig. 1



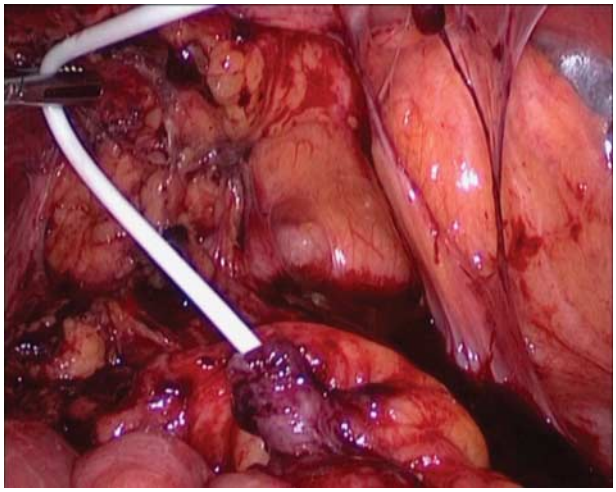
Adhesiolysis with monoplolar electrocautery.

Fig. 2



A pseudocyst containing cerebrospinal fluid.

Fig. 3



Aspiratin of pseudocyst, excision of the cyst wall, and freeing up of the catheter.

Fig. 4

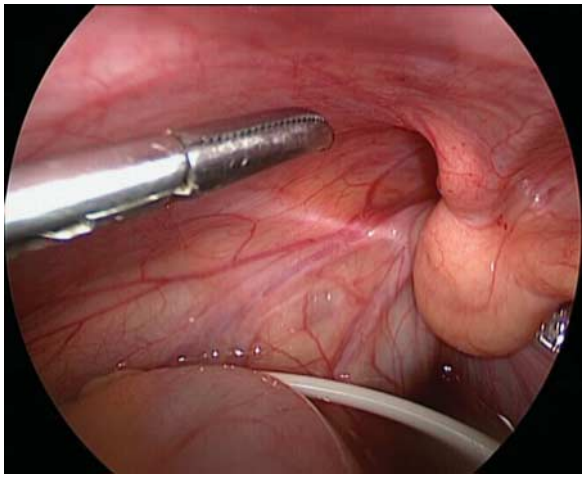
Repositioning of shunt catheter in the peritoneal cavity.

under the age of 15 years were recruited in this study. They were admitted following referral from the neurosurgical team and presented with different abdominal complaints such as persistent abdominal pain (five cases), intestinal obstruction (four cases), abdominal distention and mass (four cases), recurrent inguinal swelling (four cases), and CSF discharge from the umbilicus or manifestations of increased intracranial tension (seven cases). All patients underwent a complete clinical assessment including a thorough history taking, abdominal examination, and neurological examination. Investigations were based on their presentation and included routine laboratory investigations, plain radiography of the abdomen, abdominal ultrasound, and computed tomography (CT) scans of the head and abdomen. According to the clinical findings and the results of investigations, a proper diagnosis was achieved and treatment plan was designed accordingly. All patients were managed laparoscopically.

Laparoscopic technique

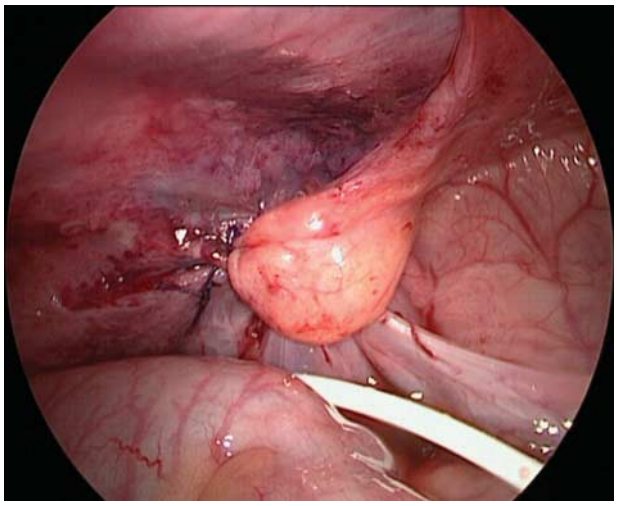
A dose of prophylactic fourth-generation cephalosporin 100 mg/kg was given to all patients with induction of general anesthesia. The patient was placed in the supine position with tilting of the head to the right or left depending on the position of the shunt tube in the previous surgery. We used open technique for introduction of 5 mm umbilical port for a 30° scope. The abdominal cavity was inspected first and then two 3 or 5 mm ports were introduced according to the patient's age. The site of the trocars varied according to the diagnosis.

Fig. 5



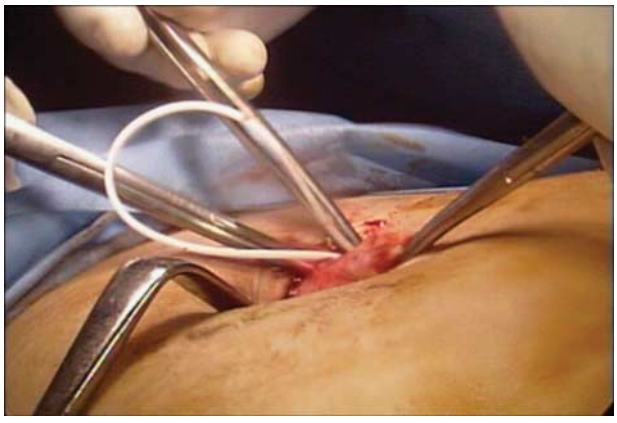
Recurrent congenital inguinal hernia.

Fig. 6



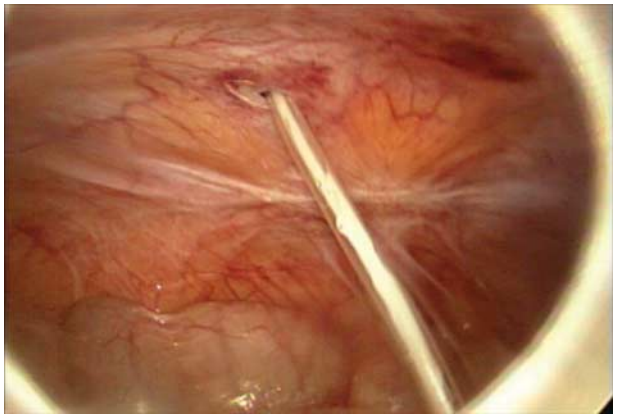
Dissection and division of the hernial sac and ligation with absorbable sutures.

Fig. 7



Aspiration of subcutaneous cyst and extraction of the shunt catheter.

Fig. 8

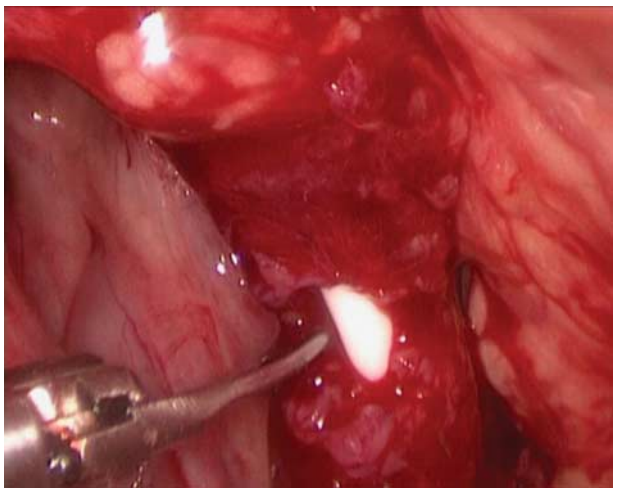


Repositioning of the shunt catheter under laparoscopic vision.

Fig. 9

Umbilical fistula discharging cerebrospinal fluid.

Fig. 10



Dissection of the fistulous tract and freeing up the catheter.

Four patients had mechanical intestinal obstruction due to adhesions to the abdominal wall. Adhesiolysis was performed using laparoscopic scissors and bipolar electrocautery (Fig. 1) and the catheter was repositioned in the peritoneal cavity. Four patients presented with a cyst containing CSF. In two patients, the pseudocyst was aspirated using a laparoscopic suction device, the cyst wall was excised, and the catheter was freed up and repositioned in the peritoneal cavity (Figs 2–4). In the third case, no definite cyst wall was found and the intestinal adhesions were taken down to free the catheter, which was repositioned in the subhepatic region. In the fourth one, a large infected amalgamated cyst was found making laparoscopic dissection technically unsafe. This case was converted, complete excision of the cyst was performed, and the catheter was removed and reinserted 3 months later after subsidence of the abdominal infection. Four patients presented with recurrent inguinal hernias. In these cases, the hernial sac was disconnected using sharp dissection with laparoscopic scissors or monopolar hook diathermy using cutting mode at the internal ring and a muscular arch repair stitch taking the conjoint tendon to the ileopubic tract to narrow the internal ring was performed, followed by peritoneal closure using absorbable sutures (Vicryl, Ethicon, USA, 2, 3, or 4/0) (Figs 5 and 6). One patient who presented with right abdominal wall swelling proved to be subcutaneous cyst with shunt displacement. Aspiration of the cyst and complete excision of its wall were performed by repositioning the shunt catheter in the peritoneal cavity under laparoscopic vision and closure of the defect to avoid recurrence (Figs 7 and 8). One case presented with umbilical fistulous tract discharging CSF. Laparoscopic dissection of the fistulous tract was performed using laparoscopic scissors; the tract was opened and the catheter was freed up and repositioned under laparoscopic vision in the right iliac fossa and the umbilical defect was closed using nonabsorbable sutures (Figs 9 and 10).

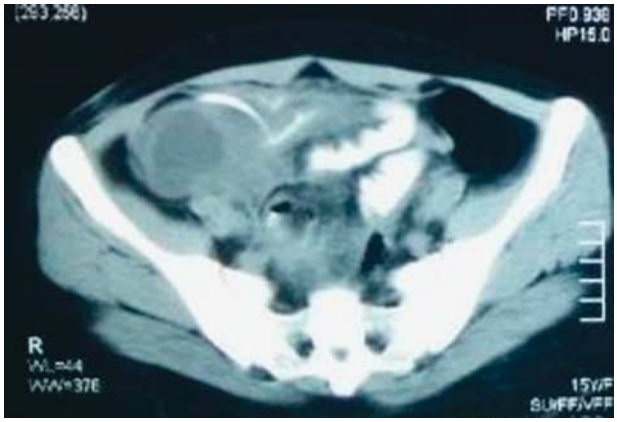
Results

Over a period of 4 years, 14 (nine men and five women) patients with abdominal complications of VP shunt catheter were managed. Their ages at operation ranged from 10 months to 15 years (Table 1). All patients were investigated, diagnosed, and managed laparoscopically. Plane abdominal radiographs showed shunt tube coiled in a soft tissue mass that displaces adjacent bowel loops (six cases), air fluid level denoting intestinal obstruction (four cases), and catheter in inguinal hernia (two cases). Abdominal ultrasound showed a well-defined sonolucent mass (cyst), with posterior acoustic enhancement containing the catheter tip (four cases), and a subcutaneous cyst (one case). CT examination showed a cyst containing homogeneous water density fluid, in which the shunt tip was identified within the cyst (four cases) (Fig. 11). The mean operative time of the laparoscopic procedure varied according to the diagnosis. It was 120 min in abdominal pseudocysts, 45 min in recurrent inguinal hernias, 100 min in adhesive intestinal obstruction, and 35 min in subcutaneous cyst (Table 2). All patients were completed laparascopically except one patient with large amalgamated infected abdominal pseudocyst; it was converted to laparotomy with complete excision of the cyst and removal of the catheter until the abdominal infection subsided. A new catheter was then inserted 3 months later. In all other cases, operations were completed laparoscopically. Complications were resolved and the catheter was functioning well and repositioned safely in the abdominal cavity under direct vision. Follow-up period ranged from 3 to 24 months with a mean of 27.1 months; all patients had complete resolution of their presenting abdominal or neurological symptoms. The length of the postoperative hospital stays ranged from 1 day in recurrent hernias to 4 days in the other procedures. There were no intraoperative or postoperative complications related to the laparoscopic technique.

Table 1 Patient demographics and presentation

Demographics	*N*=14
Age (years)	
<1	2
1–6	9
6–15	3
Sex	
Male	9
Female	5
Presentation	
Increased intracranial tension	7
Persistent abdominal pain	5
Adhesive intestinal obstruction	4
Abdominal pseudocyst (mass)	4
Recurrent congenital inguinal hernia	4
Subcutaneous cysts	1
Umbilical cerebrospinal fluid discharge	1

Fig. 11



Computed tomography of the abdomen showing a cyst containing homogeneous water density fluid, in which the shunt tip was identified within the cyst.

Table 2 Operative data

Operative time (min)	
Abdominal pseudocysts	120
Recurrent inguinal hernia	45
Adhesive intestinal obstruction	100
Subcutaneous cyst	35
Umbilical fistula	30
Conversion	
Large amalgamated cyst	1 case

Discussion

The overall abdominal complication rate in VP shunt patients remains high, ranging between 5 and 47% [6].

The most common intraperitoneal complications are VP shunt obstruction, shunt disconnection, intestinal perforation, adhesive intestinal obstruction, CSF ascites, pseudocyst formation, development of inguinal hernia, and chronic peritoneal infection [6,13–15].

The occurrence of complications is warranted by development of abdominal signs and symptoms or the recurrence of intracranial hypertension. The abdominal signs include the following: the presence of an abdominal mass in case of CSF cyst formation; obstructive symptoms if the catheter twists around an intestinal loop; or an acute abdomen in cases of perforation or peritonitis [3,16]. In some cases there may be ascites, an inguinal hernia, or hydrocele. The catheter rarely causes perforation of the abdominal wall with external CSF leakage [17–20].

Seven of our patients presented with elevated intracranial tension, typically with headaches, vomiting, and fatigue. Persistent abdominal pain was seen in five cases and abdominal distention and mass in four cases, whereas adhesive intestinal obstruction was the presentation in four cases. Moreover, four cases of recurrent inguinal hernias presented with inguinal swelling, bilateral in one case and unilateral in three cases. CT proved very useful in our cases, as it not only facilitated the diagnosis but also allowed visualization of the fragment of the VP shunt displaced into the abdomen or pelvis.

Until recently, distal VP shunt catheter complications were managed with a laparotomy incision and often removal of the existing shunt to be replaced later on. In addition to the inconvenience of a large incision and longer hospitalization due to more postoperative pain, the patients were at high risk of developing adhesions and their related complications [21] and wound dehiscence and sometimes even burst abdomen.

Currently, laparoscopic techniques are used not only for shunt placement but also for revision [3,6,12,22,23]. Our series reinforces the feasibility and safety of laparoscopic management for distal catheter complications. The advantages of the laparoscopic approach include a shorter hospital stay because of less postoperative pain, and early return of bowel movements and a better cosmetic outcome. The catheter is positioned under direct vision with less bowel manipulation, thus reducing the risk for bowel injury and the development of adhesions [3]. Laparoscopy allowed us to replace the shunts in the abdominal cavity under direct visual guidance and to direct it to the proper position.

In addition, laparoscopy is a diagnostic tool that can be used to exclude any other intra-abdominal process possibly causing abdominal pain. Laparoscopy can be repeated several times in case of further complications because it is less invasive. This is not the case with laparotomy, which is more traumatic [3].

The potential problem that has been raised is retrograde leakage of carbon dioxide into the ventricle. This was not recognized in our series and has not been reported previously. A recent in-vitro study found that none of the valves tested showed any signs of leak associated with increased gaseous back pressure below a pressure of 80 mmHg [24].

Conclusion

Laparoscopy is a very useful diagnostic and therapeutic option in dealing with intra-abdominal complications of VP shunt with high safety and an excellent outcome. It carries several advantages, including decreased risk for adhesions and preservation of the peritoneal space, elimination of the potential for future complications, and a shortened postoperative hospital stay in addition to improved cosmoses due to the minimal access technique.

Conflicts of interest

There are no conflicts of interest.

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