A prospective cohort study on the laparoscopic repair of inguinal hernia in cases of ventriculoperitoneal shunt for hydrocephalus

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Introduction
Ventriculoperitoneal shunt (VPS) is still the most common surgical procedure performed in management of hydrocephalus in pediatric-age group to drain cerebrospinal fluid from the ventricles toward the peritoneal cavity aiming to decrease the intracranial pressure. The reported incidence of inguinoscrotal complications may be as high as 10–20% in patients with VPS. Some concerns still present about the use of laparoscopy in children with noncomplicated VPS to avoid shunt-related complications.

Aim
To evaluate the efficiency of laparoscopy in management of pediatric inguinal hernia in patients with noncomplicated VPS. Our primary outcomes were shunt preservation, recurrence, and incidence of postoperative complications, including shunt blockage, infection, and/or signs of increased intracranial tension.

Patients and methods
This prospective study included 12 children with pediatric inguinal hernias who were operated for VPS for management of hydrocephalus, admitted, and managed in Pediatric Surgery Unit, Tanta University Hospital, from July 2019 to July 2021. All included infants were followed up for 6 months.

Results
Our study included 12 patients with pediatric inguinal hernia who were operated with VPS for the treatment of hydrocephalus with a mean age of 30.5 months. Seven (58.3%) cases were recurrent. Operative time ranged between 18 and 48 min with mean of 28.75 min. All patients were discharged after 24 h of surgery. No meningitis or signs of increased intracranial tension were detected early postoperatively, also, there was no recurrence or port-site hernias were detected 6 months postoperatively.

Conclusion
Laparoscopic muscular arch repair with peritoneal closure of pediatric inguinal hernia in patients with noncomplicated VPS is feasible, safe, and provides minimally invasive approach with excellent results, especially in recurrent cases with better cosmesis.

Keywords:
hydrocephalus–ventriculoperitoneal shunt, inguinal hernia, laparoscopy

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Introduction

Hydrocephalus is a common disease in pediatric neurosurgical practice. Hydrocephalus results in a mismatched production and absorption of cerebrospinal fluid (CSF). The treatments of choice are CSF-diversion shunts, either an internal shunt (endoscopic third ventriculostomy) or an external shunt [ventriculoperitoneal shunt (VPS)]. Several factors were reported for the development of pediatric inguinal hernia in patients with VPS, including excess fluid in the peritoneal cavity, especially in patients with patent processus vaginalis, increased intra-abdominal pressure, and/or abnormal neuromuscular function [1–7].

Little attention was given to the extracranial complications of VPS insertion in children. There are few case reports that discuss the relation between a VPS and inguinal complications such as hernia, hydrocele, and/or catheter migrations into the scrotum. The reported incidence of inguinoscrotal hernia may be as high as 10–20%. Children who received a VPS when younger than 5 years were more likely to have IH; the highest risk was during the first 2 years after VPS surgery. There were many fears about the utilization of laparoscopy in noncomplicated VPS patients, including fear of shunt infection, which may be complicated with encephalitis and/or meningitis,

abdominal insufflation may hinder shunt drainage, or carbon dioxide insufflated to the abdomen may escape to the ventricular system [8,9].

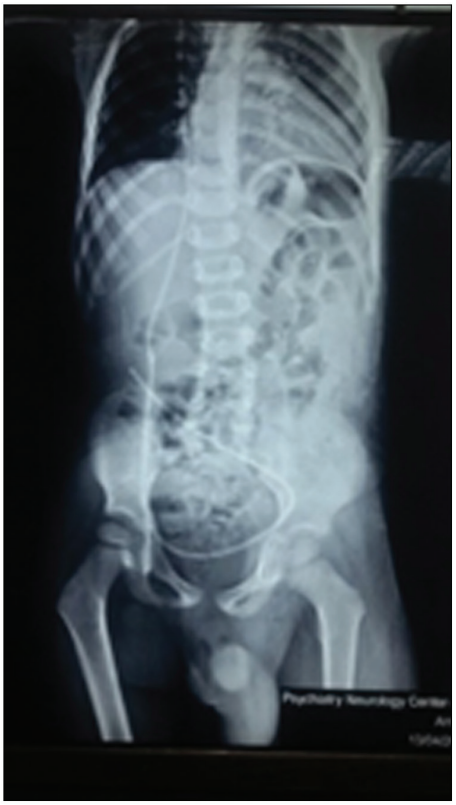
Patients and methods

This prospective case study was carried out in the Pediatric Surgical Unit in collaboration with neurosurgery and pediatrics departments, Tanta University Hospital, during the period from July 2019 to July 2021, on 12 patients with pediatric inguinal hernia who underwent VPS for treatment of hydrocephalus. The study was approved by Ethical Committee of the Faculty of Medicine, Tanta University. A written informed consent was taken from the parents and/or guardians. The procedure was explained in detail, and in a clear simple language, all possible complications were explained. We included all patients with pediatric inguinal hernia who underwent VPS for treatment of hydrocephalus. Cases with a history of shunt infection, abdominal cyst, peritoneal failure, other VPS-related complications, and major congenital anomalies that may affect the outcome were excluded. All patients were subjected to thorough clinical examination and laboratory investigations as needed. Thorough assessment by a pediatrician, neurosurgeon, and pediatric surgeon to all patients and a plan of management was achieved according to each patient. Abdominal and inguinoscrotal ultrasound was done to all cases to confirm the presence of hernia with special comment on the presence of free intra-abdominal fluid that indicates functioning VPS and exclude any intra-abdominal VPS-related complications. Abdominopelvic plain radiograph was done to visualize VPS intra-abdominally (Figs 1, 2).

Operative techniques

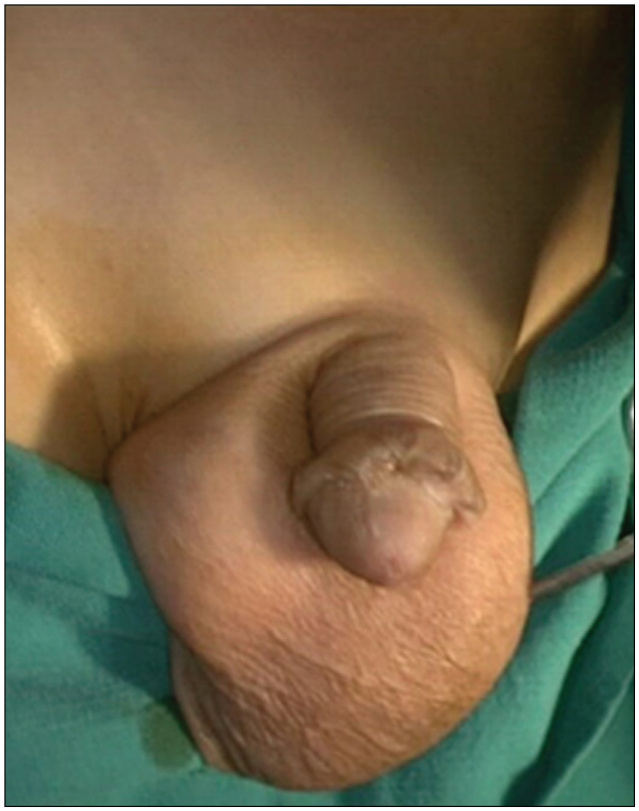
Under general anesthesia with endotracheal intubation with muscle relaxants, all patients were in a supine position. A dose of fourth-generation cephalosporin (100–150 mg/kg) was given to all patients one hour before incision according to pediatrician and neurosurgeon recommendation. A 5-mm umbilical port was introduced by an open technique to establish pneumoperitoneum with special attention to be away from the site of shunt insertion in the abdomen (Fig. 3). The abdomen was insufflated at 8–10 mmHg pressure, with a flow rate of 1.5 l/min. Laparoscopic exploration was done and the site of VPS was noted (Fig. 4). Two other 5-mm working ports were placed in the right and left lumbar area at the level or high above the umbilicus according to patients' age. All cases were subjected to peritoneal disconnection by using a 5-mm hook connected to low-voltage-cutting monopolar diathermy to avoid minimal bleeding or by scissor. After complete disconnection, a muscular-arch

Figure 1



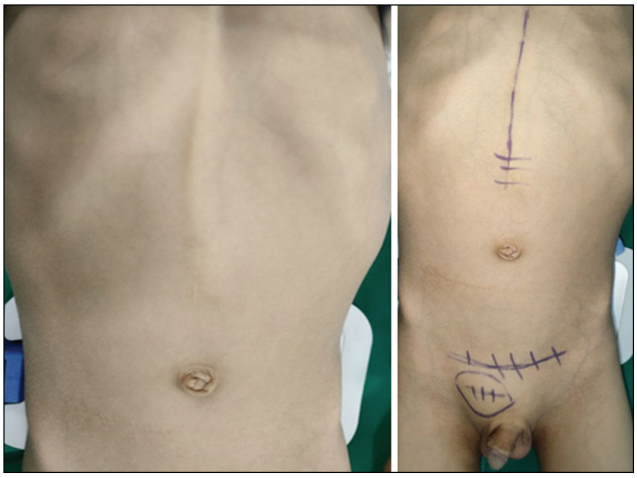
Chest, abdomen, and pelvic radiograph showing VPS pathway. VPS, ventriculoperitoneal shunt.

Figure 2



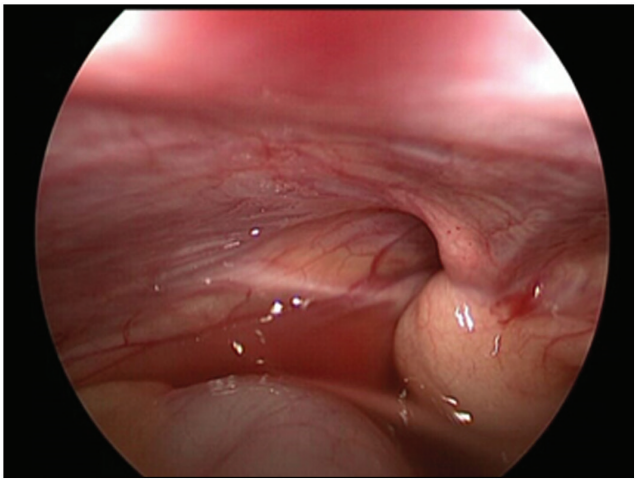
Male patient aged 3 years with VPS presented with left inguinoscrotal hernia. VPS, ventriculoperitoneal shunt.

Figure 3



Male patient aged 5 years with VPS, presented with recurrent right inguinal hernia operated twice by inguinal and Pfannenstiiel incisions. (a) Visible track of the distal part of shunt tube with a supraumbilical midline scar. (b) Marking the site of shunt before port placement with marking incisions of previous attempts of repair and shunt-insertion site. VPS, ventriculoperitoneal shunt.

Figure 4

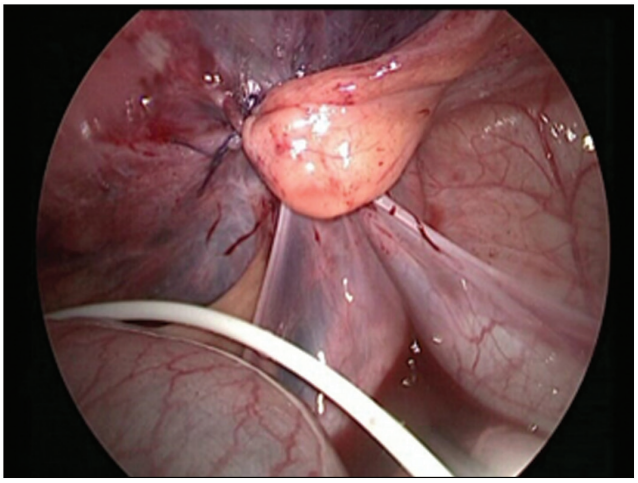


Laparoscopic exploration of left-sided hernia. Note VPS position and CSF in peritoneal cavity. CSF, cerebrospinal fluid; VPS, ventriculoperitoneal shunt.

repair was done by one figure of eight 3/0 Vicryl suture to narrow the internal ring. Finally, peritoneal closure was done in a purse-string manner (Fig. 5). Special attention was paid not to overmanipulate the intra-abdominal part of VPS to avoid any postoperative complications. Also, no irrigation or suction was done. Fascia closure of all port sites was done in all cases to avoid port-site hernia and CSF leakage.

All patients were discharged 24 h postoperatively after feeding tolerance, and both pediatric and neurosurgical assessment was done to assure the absence of any signs of increased intracranial tension, malfunctioned VPS, or sepsis. A continued parenteral antibiotic for 5 days

Figure 5



After complete closure.

was advised to all patients to avoid VPS infection. CT brain or CSF aspirate were reserved for cases with suspected VP-shunt malfunction or infection. All cases were followed for 6 months postoperatively.

Results

Our study included 12 patients (19 hernias) presented with pediatric inguinal hernia who were operated with VPS for treatment of hydrocephalus; the mean age at shunt insertion was 2.7 months ranging from 1.5 to 4.5 months. The mean age at laparoscopic inguinal hernia repair was 30.6 months that ranged from 9 to 66 months. We had a male predominance (nine cases, 75%). In total, 7/12 cases (58.33%) were operated before by open inguinal approach.

Clinically, we had right inguinal hernia in seven (58.3%) cases, left inguinal hernia in three (25%) cases, and bilateral inguinal hernia in two (16.66%) cases. Ultrasonography could detect all clinically evident hernias and could detect patent processus vaginalis in two cases and failed in three cases that were diagnosed and operated during laparoscopy (Table 1).

The mean operative time was 28.75 that ranged from 18 to 48 min. No intraoperative complications could be detected. Postoperatively, there were no signs of meningitis or increased intracranial tension. No cases required a postoperative CT brain or CSF sampling, with no need for shunt revision during the follow-up period.

A scrotal hematoma was detected in only one (8.3%) case and was treated conservatively, and two (16.66%) cases were complicated by minimal scrotal hydrocele that resolved after 2 weeks postoperatively. There were

Table 1 Demographics and site of hernia

Age	Age at shunt insertion				Age at lap hernia repair	
	Range (months)		Mean (months)		Range (months)	Mean (months)
	1.5–4.5		2.66		9–66	30.5
Sex	Male [*n* (%)]				Female [*n* (%)]	
	9 (75)				3 (25)	
Site of hernia (no of hernias)	Clinical (*N*=14)		US (*N*=14)		Laparoscopy (*N*=19)	
	Right	Left	Right	Left	Right	Left
	8	6	8	6	11	8

Table 2 Intraoperative and postoperative data

Operative time	Unilateral (5 cases)		Bilateral (7 cases)		Total number
	Range (min)	Mean (min)	Range (min)	Mean (min)	
	18–26	21.7	22–48	33.85	12
Post operative complications	Scrotal hematoma		1	8.3%	
	Hydrocele		2	16.66%	12

no recurrence, port-site hernias, or CSF leakage was detected during the postoperative follow-up period (6 months) (Table 2).

Discussion

Laparoscopy has not been extensively used in children with VPS and there was a concern about the safety of insufflation under pressure with the shunt in its place. A paucity of data discussed this issue. Also, there is a relative lack of long-term follow-up to document shunt function over time after abdominal procedures. Now, laparoscopic insertion and/or reposition of VPS gains popularity in management of hydrocephalus in pediatrics. Also, many reports support laparoscopic management of intraperitoneal complications related to VPS. Little attention was given to the extracranial complications of VPS insertion in children. There are a few case reports that discuss the relation between a VPS and inguinal complications such as hernia, hydrocele, and/or catheter migrations into the scrotum. They postulated an incidence that ranged from 10 to 30%. The rate also was higher in children who were operated for the VPS before the age of 12 months [1,2,7,9].

Chen and colleagues had conducted one of the largest studies that compared the incidence of IH development in VP-shunt children to those without a VPS. They had concluded that the incidence of IH in patients with VPS was 13.3%, while it was 4.1% in nonshunt group. They also had discussed the mean time between the VPS insertion and the diagnosis of IH, which was 1.29 years. They also detected that the risk of IH in children with VPS was higher by more than 10fold than that of the nonshunt group during the first 2 years. Regarding the pathophysiology of IH development, the authors hypothesized that it may be related to the increased fluid volume in the peritoneal cavity, resulting in elevation of the intra-abdominal pressure, in conjunction with the presence of patent processus vaginalis. Another support of this hypothesis is that the incidence of IH in patients with VPSs (1.2%) was much lower than those with VPS [8].

We aimed to evaluate the efficiency of laparoscopy in management of pediatric inguinal hernia in patients with noncomplicated VPS. In total, 12 patients with VPS were presented for pediatric inguinal hernia repair. The mean age at shunt insertion was 2.66 months and at laparoscopic repair was 30.85 months. We had seven cases of recurrent inguinal hernia in our study who were operated once or twice before and five cases were not operated for inguinal hernia before.

Regarding the affected side, by clinical examination, 10 (83.3%) cases were unilateral (right six cases, left four cases) and only two cases were bilateral, ultrasound could detect a latent hernia in only two cases. Laparoscopy had a tremendous advantage for detection of latent hernia that could not be detected by ultrasound. This was confirmed in our study, seven (58.33%) cases were detected bilaterally during laparoscopic exploration. Çelik and colleagues had observed a bilateral affection in 20% clinically, while at the time of IH surgery, 75% of patients had bilateral patent processus vaginalis. This observation supports the hypothesis that the presence of a manifested unilateral IH may relieve the elevated intra-abdominal pressure, while the contralateral side remains clinically silent in spite of the presence of patent processus vaginalis. The authors who studied the natural history of the processus vaginalis had suggested that 40–50% only closes during the first year of life [9].

No signs of meningitis or manifestations of increased intracranial tension were detected in our study during the postoperative follow-up period. Many authors advised the use of laparoscopy in insertion, reposition, and/or management of intra-abdominal distal shunt complications as there was no correlation between the uses of laparoscopy [10–12].

Conclusion

Laparoscopic muscular-arch repair with peritoneal closure of pediatric inguinal hernia in patients with noncomplicated VPS is feasible, safe, and provides minimally invasive approach with excellent results, especially in recurrent cases with better cosmesis.

Limitation of the study

This is a single-center study, included small sample size, and it is a noncomparative study.

Financial support and sponsorship

Nil.

Conflicts of interest

No conflict of interest.

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