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Original Research Article

Management of trans-anal extrusion of distal ventriculoperitoneal shunt catheter in children

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ABSTRACT

Background: The objectives of this study were to review the demographics, clinical characteristics, surgical procedures executed, and the outcome of children operated upon for trans-anal extrusion of the distal VPS (ventriculoperitoneal shunt) catheter.
Methods: Case records of children under 12-years, operated upon for the trans-anal extrusion of the distal VPS catheter, were reviewed in detail.
Results: This study comprised of, n=25 children and included, n=14 boys and, n=11 girls. The interval from the primary VPS insertion/VPS revision to the diagnosis of trans-anal extrusion of the distal VPS catheter ranged from 2 to 49-months, with a mean of 10.04 **(**11.58 SD/ months. Clinically, all children presented with trans-anal extrusion of the distal VPS catheter. None of them had clinical features of peritonitis, intestinal obstruction, or meningitis. Operative procedures performed in the following order of frequency; (a) removal and immediate revision of the peritoneal/distal VPS catheter n=15 (60%), (b) removal of entire VPS catheter and delayed re-VPS insertion n=4 (16%), (c) removal of peritoneal/distal VPS catheter, external ventricular drainage (EVD) followed by delayed re-VPS insertion n=3 (12%), (d) removal of entire VPS catheter and immediate re-VPS insertion n=1 (4%) and (e) removal of entire VPS catheter alone n=2 (8%).
Conclusions: Trans-anal extrusion of the distal VPS catheter is well-known, but rare complication of the VPS insertion done in children. In sixty percent of children, removal and immediate revision of the peritoneal/distal VPS catheters were done safely by mini-laparotomy. During the management, formal abdominal explorations were neither executed nor required in any case.

Keywords: Children, Complication, Extrusion, Hydrocephalus, Infants, Shunt revision, Ventriculoperitoneal shunt

INTRODUCTION

Ventriculoperitoneal shunt (VPS) implantation is a well-accepted and one of the preferred surgical procedures for the management of hydrocephalus, and carried out worldwide and across all age groups.[1-5] VPS implantation is associated with a wide variety of complications, and many of them require shunt revisions.[2,6-9] Bowel perforation by the distal VPS catheter is also a known complication of VPS insertion. The colon is the most common site for bowel perforation. Perforation of the colon, followed by extrusion of the distal VPS catheter via rectum/anal canal, is known and reported in 0.1 to 2.5% of the cases.[7,9-12] Although bowel perforation is there, most cases of trans-anal extrusion of VPS catheter presented without causing peritonitis. [9-12] The finding of peritonitis following bowel perforation by distal VPS catheter is rare and not the rule.[13] "Chhabra hydrocephalus shunt system" is currently being used in more than 50 countries.[14] This manuscript is a

retrospective study carried out in n=25 children, operated upon for trans-anal extrusion of the distal VPS catheter during the 26-years from 1996 to 2021. To the best of the author's knowledge, the present report included the largest number of cases operated upon for the trans-anal extrusion of the distal VPS catheter.

METHODS

The present study is a retrospective single-institution study. It was conducted in infants and children aged up to 12-years operated upon for trans-anal extrusion of the distal VPS catheter. This study was carried out at the author's Department of Pediatric Surgery, Gandhi medical college and associated Kamla Nehru and Hamidia Hospitals, Bhopal - Madhya Pradesh, India, and conducted between January 01, 1996, to December 31, 2021, for 26-years. This study is descriptive in nature, and results are also presented as percentage, mean, range and standard deviations. Ten children were treated for per-rectal extrusion of the distal VPS catheters from January 1996 to December 2005, were earlier published by the present authors in 2007, were also included in this report. Case records of children were reviewed for their age, sex, indication for insertion of the VPS catheter, interval, clinical characteristics, diagnostic modalities used, surgical procedures executed, post-operative complications, and the outcome. VPS catheter initially implanted in children at other hospitals but presented to the author's department for the surgical treatment for the above-said VPS complication (n=2), were excluded from this study. Chhabra "slit n spring" valve, regular reservoir hydrocephalus shunt system" (G Surgiwear Limited, Shahjahanpur, Uttar Pradesh, India) is in use for the insertion for the treatment of hydrocephalus in infants and children as a routine, irrespective of the causes of hydrocephalus or the age of children, at the author's department of pediatric surgery.

Mini laparotomy, an open technique, was used for the insertion of the peritoneal/distal VPS catheter into the peritoneal cavity in all the cases. A supra-umbilical right transverse incision was used for the mini-laparotomy; peritoneal catheters were inserted inside the peritoneal cavity under the direct vision, to prevent injury to the bowel and other viscera. The author's department never used a trocar for the placement of the peritoneal part of the VPS catheter into the peritoneal cavity.

For removal and revision of the peritoneal part of a VPS catheter, mini-laparotomy through the previous abdominal scar was used for abdominal exploration. The VPS catheter was identified and pulled up for a few cm, and divided. The distal peritoneal catheter was gently pulled distally by pulling the extruded part downwards. CSF flow and patency of the proximal VPS catheter were checked and the nature of CSF was observed, whether it was clear or otherwise. Once sure of the patent proximal shunt system and absence of the CSF infection, an adequate length of a new peritoneal catheter was connected and secured via a connector, and it was inserted inside the peritoneal cavity under the direct vision.

For removal of the entire VPS system for non-functional shunts, a cranial incision was used for exploration of the shunt tubing. A ventricular catheter was disconnected from the shunt chamber and observed for CSF flow and its colour. If the ventricular catheter was working and draining CSF, the same was kept in place as EVD, and if not working, it was removed. The distal part of the VPS catheter was pulled upwards for a few cm and divided just distal to the chamber. The chamber of the VPS system was also removed. A divided distal segment was pulled gently downwards by pulling the per-rectally extruded part of the catheter.

Informed consent was obtained from all the parents of participants.

RESULTS

During the study period of 26-years, n=994 primary VPS catheters were implanted for treatment of hydrocephalus in infants and children under the age of 12-years (Figure 1). During the follow-up period, n=25 (2.51%) children presented with the trans-anal extrusion of the distal VPS catheter. This study consisted of, n=14 (56%) boys and, n=11 (44%) girls. Demographic details of the above, n=25 children are provided in Table 1. In table 1, the cases are listed in the order of the initial VPS insertion executed.

Indications for the primary VPS catheter insertion for above, n=25 children are detailed in Figure 2. Three-fourths of children, the indication for initial VPS implantation was congenital hydrocephalus, and for one-fourths of children, it was secondary hydrocephalus due to TBM. Two children also had a history of VPS revision before trans-anal extrusion of the distal VPS catheter.

The age of children at the time of diagnosis of trans-anal extrusion of the distal VPS catheter are provided in Figure 3. Age of children ranged from 5 to 90-months, with a mean of 28 (24.90 SD) months. One-thirds, (n=8) of them were infants at the time of clinical presentation/diagnosis of trans-anal extrusion of VPS catheter. Approximately half (n=12) of them were 13 to 36 months at the time of diagnosis of trans-anal extrusion of the distal VPS catheter.

The interval from the primary VPS insertion/VPS revision to the diagnosis of trans-anal extrusion of the distal VPS catheter are provided in Figure 4. The interval ranged from 2-months to 49-months, with a mean of 10.04 (11.58 SD) months. Two-thirds (n=16) of children, clinically presented within 6-months after the VPS insertion.

Clinically, all the children presented with the chief complaint of extrusion of the distal VPS catheter through the anus (Figure 5 A-F). The mean duration of trans-anal extrusion of the distal VPS catheter was 1.68 days, the median was 1-day and ranged from 1 day to 6 days. Five children also had features of raised intracranial pressure. The distal end of VPS catheters, were draining clear CSF in, n=20 of children. Five children had blocked (non-functional) VPS system, and not draining CSF from distal end. None of them had clinical features of peritonitis, intestinal obstruction, or meningitis. Trans-anally extruded distal VPS catheter was evidenced in all the cases, and clinical diagnosis was obvious. The radiological investigations carried out for the entire case, none of the children evidenced free gas under the diaphragm or peritoneal fluid collection. Plain x-ray head, chest and abdomen also detected trans-anally extruded VPS catheter (Figure 6 A-D). The VPS catheter continuity was also detected as maintained for all the children.

Operative procedures executed for the management of trans-anal extrusion of the distal VPS catheter in above, n=25 children are provided in Table 1. Operative therapy offered for the correction of trans-anal extrusion of distal VPS catheter are also detailed in Figure 7. Two-thirds, (n=15) of children were managed by removal and immediate revision of peritoneal/distal VPS catheter, and one-fifths of children were managed by removal of VPS catheter with or without EVD, injectable antibiotics and delayed re-VPS catheter insertion. During the postoperative period, the bowel perforation healed spontaneously, as none of the children developed the features of peritonitis after the management of trans-anal extrusion of the VPS catheter. Bowel perforation was not repaired in any of the cases.

The complications were also documented in, n=4 children, and it was observed during the postoperative/follow-up period and were CSF leakage from the abdominal operative site, (n=1), shunt tract infection (n=1), meningitis (n=1), and shunt block, (n=1). CSF leakage from the abdominal site, shunt tract infection, and shunt block were managed with further VPS revision. A child who was complicated with meningitis was treated with shunt removal, EVD and medical therapy. Present review also documented, n=4 (16%) deaths. Two deaths were related to the VPS revisions, one was due to the poor general condition, and another was related to the medical illness. The first child (case 8) died due to a medical illness, and she died during the re-admission in the follow-up period. The second child (case 14) had trans-anal extrusion of the distal VPS catheter twice and required VPS revisions on both the occasions. He died due to poor general condition in the follow-up period. The third child (case 15), after a month of VPS revision done for trans-anal extrusion of his VPS catheter, was admitted again for shunt tract infection. He was treated well with the removal of his entire VPS catheter and delayed re-VPS insertion. During the postoperative period, he died of sudden respiratory failure due to aspiration of feeds. The fourth child (case 16) developed meningitis after the VPS revision, he died in the course of the management.

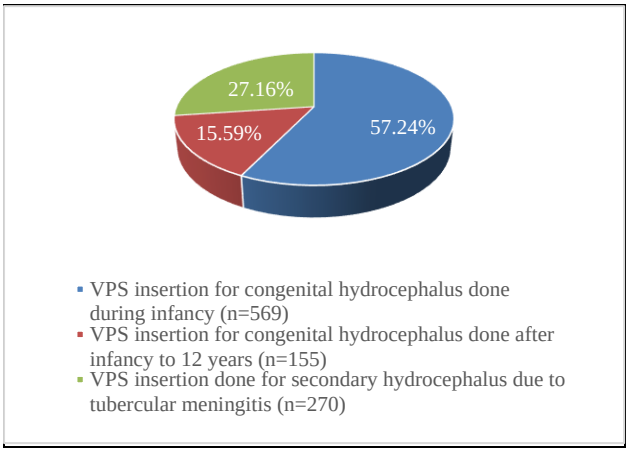

Figure 1: Primary VPS catheter inserted from January 1996 to December 2021, (n=994).

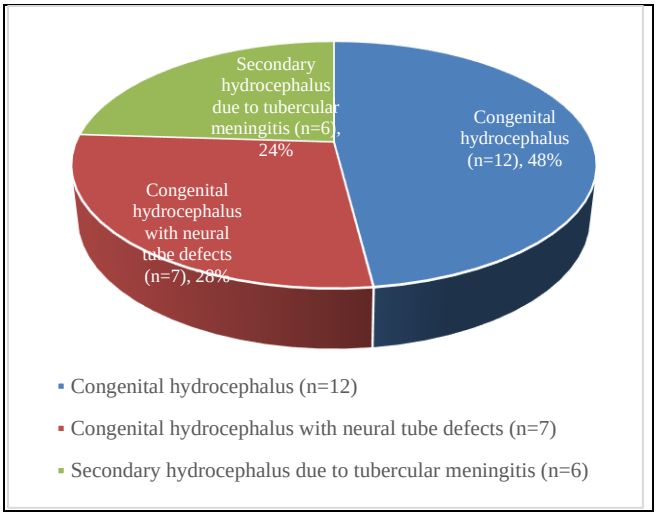

Figure 2: Indication for primary VPS insertion in children presented with trans-anal extrusion of distal VPS catheter.

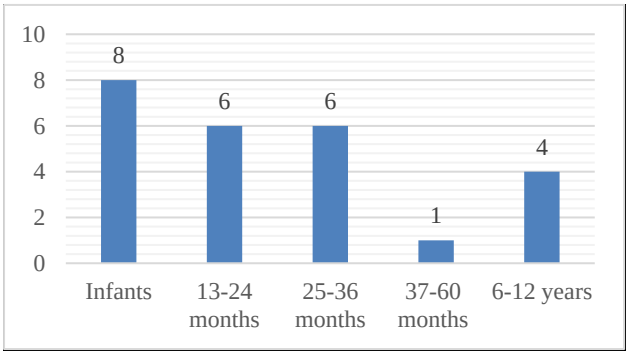

Figure 3: Age of children at clinical presentation/ diagnosis of trans-anal extrusion of the distal VPS catheter.

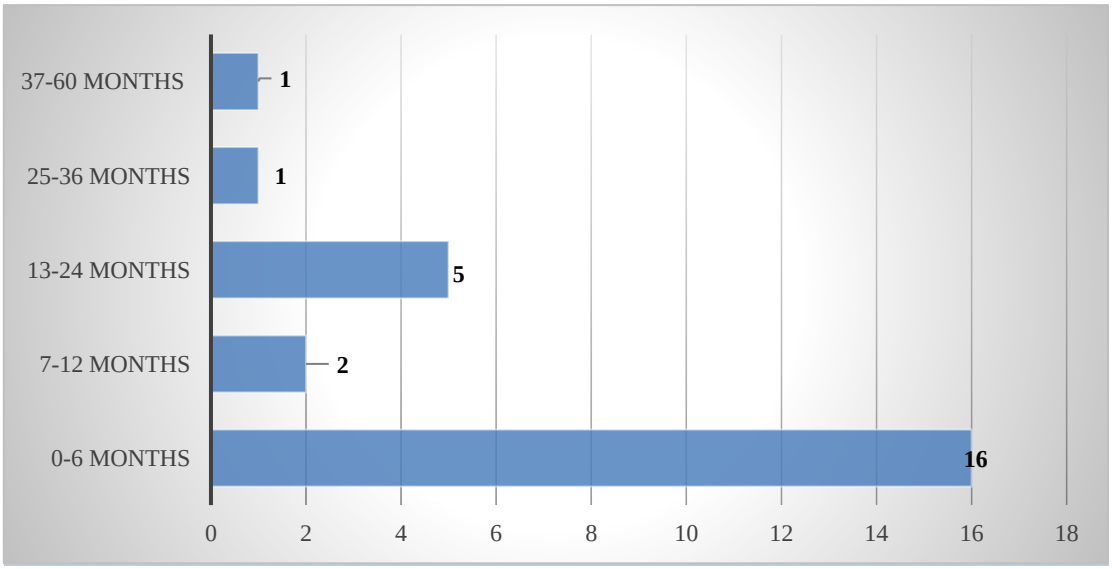

Figure 4: Interval (in months) from primary VPS insertion/revision to the trans-anal extrusion of distal VPS catheter.

Figure 5 (A to F): Clinical photographs of children showing trans-anal extrusion of the distal VPS catheter, clinical photograph of case 14, 19, 20, 21, 23 and 24.

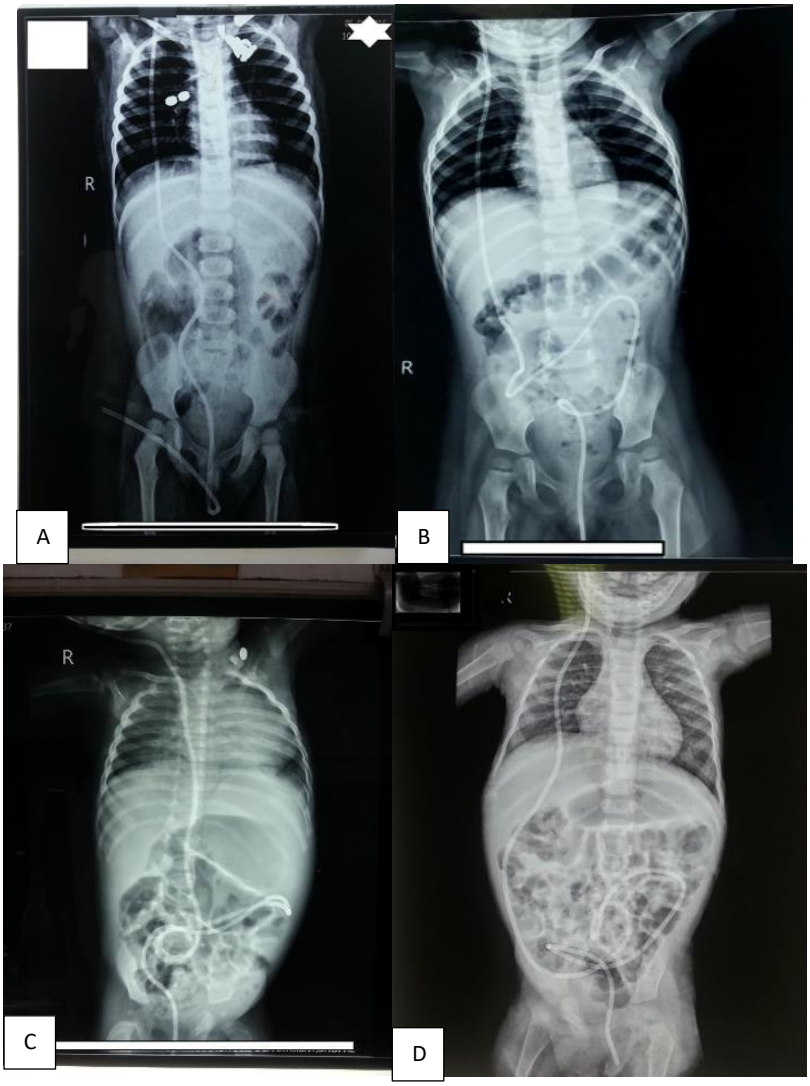

Figure 6 (A-D): Radiological photographs of children showing trans-anal extrusion of distal VPS catheter and shunt catheter continuity. Plain X-ray of the abdomen and chest of case 19, 20, 21 and 25.

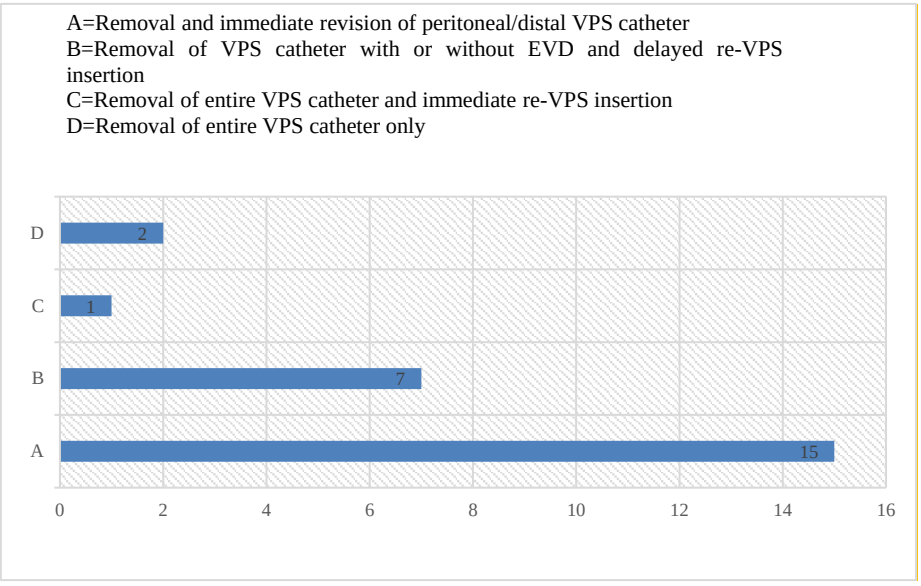

Figure 7: Surgical procedures performed for trans-anal extrusion of the distal VPS catheter.

Table 1: Demographic and other details of infants and children operated for trans-anal extrusion of the distal VPS catheter, (n=25).

Primary diagnosis and operative procedures done						Trans-anal extrusion of distal VPS catheter and its management								
Case No	**Age (m)**	**Sex**	**Primary diagnosis**	**Operative procedure done**	**Operation dd/mm/yy**	**Age (m)**	**Interval (m)**	**VPS (R)**	**Extrusion (days)**	**↑ed ICP**	**Operation dd/mm/yy**	**Operation procedures for trans-anal extrusion of distal VPS catheter**	**Compli-cations**	**Remark**
1.	17	M	Cong Hydroc	VPS	11/05/2001	28	11	No	1	Yes	04/04/2002	Removal and immediate revision of peritoneal part of VPS catheter	No	Well
2.	44	F	TBM Hydroc	VPS	09/08/2001	64	20	No	6	No	02/04/2003	Removal and immediate revision of peritoneal part of VPS catheter	No	Well
3.	4	M	Cong Hydroc, DL-MMC & Neurological deficits	VPS + MMC excision & repair	23/10/2001	6	2	No	1	No	26/12/2001	Removal of entire VPS catheter (re-VPS insertion not done}	No	??
4.	26	F	Cong hydroc	VPS	05/01/2002	28	2	No	1	No	26/02/2002	Removal and immediate revision of peritoneal part of VPS catheter	No	Well
5.	41	M	Cong Hydroc, LS-MMC & Neurological deficits	VPS + MMC excision & repair	03/11/2002	44	3	No	1	No	01/02/2003	Removal and immediate revision of peritoneal part of VPS catheter	No	Well
6.	24	F	Cong Hydroc, LS-MMC & Neurological deficits	VPS + MMC excision & repair	07/06/2003	33	9	No	4	No	06/03/2004	Removal and immediate revision of peritoneal part of VPS catheter	No	Well
7.	11	M	Cong Hydroc, DL-MMC & Neurological deficits	VPS + MMC excision & repair	24/06/2003	14	3	No	4	No	01/10/2003	Removal and immediate revision of peritoneal part of VPS catheter	No	Well
8.	48	F	TBM Hydroc	VPS	13/09/2003	81	33	No	1	No	18/06/2006	Removal and immediate revision of peritoneal part of VPS catheter	CSF leak	Death
9.	10	M	TBM Hydroc	VPS	12/12/2003	12	2	No	2	No	11/02/2004	Removal and immediate revision of peritoneal part of VPS catheter	No	Well
10.	8	F	Cong Hydroc	VPS	31/05/2005	13	5	No	2	No	26/10/2005	(A) Removal of entire VPS catheter (B) Delayed re-VPS insertion done	No	Well

Continued.

Primary diagnosis and operative procedures done						Trans-anal extrusion of distal VPS catheter and its management								
Case No	**Age (m)**	**Sex**	**Primary diagnosis**	**Operative procedure done**	**Operation dd/mm/yy**	**Age (m)**	**Interval (m)**	**VPS (R)**	**Extrusion (days)**	**↑ed ICP**	**Operation dd/mm/yy**	**Operation procedures for trans-anal extrusion of distal VPS catheter**	**Compli-cations**	**Remark**
11.	5	F	Cong Hydroc	VPS	01/10/2005	7	2	No	1	No	13/12/2005	(A) Removal of entire VPS catheter (B) Delayed re-VPS insertion done	No	Well
12.	84	M	TBM Hydroc	VPS	16/02/2006	90	6	No	2	No	19/08/2006	Removal and immediate revision of peritoneal part of VPS catheter	No	Well
13.	30	M	TBM Hydroc	VPS	27/05/2008	34	3	Yes	2	No	03/08/2008	Removal and immediate revision of peritoneal part of VPS catheter	No	Well
14.	18	M	TBM Hydroc	VPS	17/11/2008	34	16	No	1	No	13/03/2010	Removal and immediate revision of peritoneal part of VPS catheter	No	---
	18	M	TBM Hydroc	VPS	17/11/2008	83	49	Yes	1	Yes	03/04/2014	(A) Removal of peritoneal catheter, (B) Proximal VPS catheter as EVD, (C) delayed re-VPS insertion done	No	Death
15.	5	M	Cong Hydroc with LS-MMC without Neurological deficits	VPS + MMC excision & repair	13/01/2009	28	23	No	2	Yes	15/12/2010	Removal and immediate revision of peritoneal part of VPS catheter	Infection	Death
16.	5	M	Cong Hydroc	VPS	10/10/2009	8	3	No	1	No	14/01/2010	Removal and immediate revision of peritoneal part of VPS catheter	Meningitis	Death
17.	5	M	Cong Hydroc with LS-MMC without Neurological deficits	VPS + MMC excision & repair	02/01/2012	7	2	No	2	No	03/03/2012	Removal and immediate revision of peritoneal part of VPS catheter	No	Well
18.	11	F	Cong Hydroc	VPS	22/12/2012	16	5	No	1	Yes	28/05/2013	Removal and immediate revision of peritoneal part of VPS catheter	No	Well
19.	3	F	Cong Hydroc	VPS	19/06/2014	22	19	No	1	No	07/01/2016	(A) Removal of entire VPS catheter (B) Immediate re-VPS insertion done	No	Well

Continued.

Primary diagnosis and operative procedures done						**Trans-anal extrusion of distal VPS catheter and its management**								
Case No .	**Age (m)**	**Sex**	**Primary diagnosis**	**Operative procedure done**	**Operation dd/mm/yy**	**Age (m)**	**Interval (m)**	**VPS (R)**	**Extrusion (days)**	**↑ ed ICP**	**Operation dd/mm/yy**	**Operation procedures for trans-anal extrusion of distal VPS catheter**	**Compli-cations**	**Remark**
20.	3	F	Cong Hydroc	VPS	04/04/2015	25	22	No	1	No	16/02/2017	Removal and immediate revision of peritoneal part of VPS catheter	No	Well
21.	3	M	Cong Hydroc	VPS	05/01/2016	18	15	No	1	Yes	27/03/2017	(A) Removal of peritoneal catheter, (B) Proximal VPS catheter as EVD (C) Delayed re-VPS insertion done	No	Well
22.	18	F	Cong Hydroc	VPS	25/06/2016	20	2	No	1	No	01/09/2016	(A) Removal of peritoneal catheter, (B) Proximal VPS catheter as EVD (C) Delayed re-VPS insertion done	No	Well
23.	2	M	Cong Hydroc	VPS	24/06/2017	5	3	No	1	No	10/10/2017	(A) Removal of entire VPS catheter, (B) Delayed re-VPS insertion done	Shunt block	Well
24.	3	M	Cong Hydroc, DL-MMC and Neurological deficits	VPS	23/07/2019	5	2	No	1	No	28/09/2019	(A) Removal of entire VPS catheter (re-VPS insertion not done)	No	??
25.	4	F	Cong Hydroc	VPS	11/01/2020	9	5	No	1	No	08/06/2020	(A) Removal of entire VPS catheter, (B) Delayed re-VPS insertion done	No	Well

Cong=Congenital, EVD=External ventricular drainage, Hydroc=Hydrocephalus, VPS=Ventriculoperitoneal shunt, TBM=Tubercular meningitis, MMC=Meningomyelocele (Myelomenigocele), DL=Dorso-lumbar, LS=Lumbo-sacral, CSF=Cerebrospinal fluid, M= Male, m=months, F=Female, VPS (R)=Ventriculoperitoneal shunt revision,

DISCUSSION

Perforation of the hollow viscera like stomach, small intestine, colon, urinary bladder, and uterus by the distal/peritoneal catheter of the VPS system is a known complication of the VPS placement, and all have been reported in the literature.[12,15-19] Extrusion of the distal VPS catheter via rectum/anal canal is reported in 0.1% to 2.5% of the cases.[7,9-12, 20] In the present study, n=25 of 994 (2.51%) children presented with the trans-anal extrusion of the distal VPS catheter during the follow-up period. This incidence is little higher than the reported by most of the authors and probably attributed to the following; (a) implantation of the whole length of the distal VPS tubing, (b) implantation of VPS catheter for hydrocephalus secondary to the infective causes (TBM), and (c) implantation of VPS catheter for hydrocephalus associated with the myelomeningocele with neurological deficits.

Most of the cases relating to the trans-anal extrusion of VPS catheter are reported as case reports. Literature is scanty on case series for per-rectal extrusion of the distal VPS catheter.[9,11,12,18,20-23] The interval from VPS insertion to the diagnosis of trans-rectal extrusion ranged from a few days to a few years, but was frequently documented within 12-months after the VPS catheter placement.[11,21] In the present study, the interval from primary VPS implantation/VPS revision to the trans-anal extrusion for n=16 (64%) of children was within 6-months, for n=7 (28%) of children it was 7 to 24 months, and for n=2 (8%) children it was more than 24-months.

In present report, the entire cases of trans-anal extrusion of the distal VPS catheter were clinically presented without the features of peritonitis, intestinal obstruction, or meningitis. Literature relating to the management of the above-described complication also documented that most of the cases of bowel perforation with trans-anal extrusion of the distal VPS catheter presented without causing peritonitis. Most probably, there was the formation of the inflammatory tract around the VPS catheter that sealed it from the peritoneum and prevent the occurrence of peritonitis.[9,11,12,18,20,25] Few of the cases of VPS catheter extrusion through the anus also presented with the additional features of meningitis/ventriculitis.[26,27] In all the cases, the clinical diagnosis was obvious due to the presence of a distal VPS catheter protruding out through the anal canal. CSF was also draining from the tip of the extruded distal VPS catheter in n=20 children, while in n=5, it was not draining CSF. X-rays / shunt series were obtained for all the cases, and that confirmed the continuity of the VPS catheter in all the cases. Ultrasonography of the abdomen was done and that revealed perforation of the bowel/colon by the distal VPS catheter and none of the cases documented gas under the diaphragm or peritoneal fluid collections.

In the present study, sixty percent (n=15) of children were treated by removal and immediate revision of the peritoneal/abdominal part of the VPS catheter during the same operative procedure. One-fourths (n=7) of children were managed by the removal of their entire /distal VPS system, with or without EVD and delayed re-VPS insertion. For one child, entire VPS catheter was removed, and a new VPS catheter was re-inserted immediately. In two children, the entire VPS system required removal, delayed re-VPS insertion was advised, but parents refused further surgical intervention, and they lost to regular follow-up.

In the present study, perforation of the large bowel/colon by the distal VPS catheter was suspected on plain x-rays and USG examination of the abdomen. The site of bowel perforation by the distal VPS catheter was rectum in n=15 children and it was confirmed by proctoscopy examination. In the remaining, n=10 children, it was probably transverse colon or other parts of the colon/ rectum, and it was not confirmed. During the management of trans-rectal extrusion of the distal VPS catheter, formal abdominal exploration was neither performed nor required in any of the cases. The perforation of the bowel healed spontaneously after the removal of the distal extruded part of the VPS catheter. Many of the authors suggested and safely managed their cases by removal of the entire VPS system with or without placement of the EVD, course of antibiotics, and delayed re-VPS insertion.[11,18,21,25]

The exact etiology is not known, why there is perforation of the hollow viscera including colon/rectum by the peritoneal catheter of the VPS system. Various factors play a vital and contributory role in the occurrence of the perforation of the hollow viscera, followed by extrusion of the distal VPS catheter through the natural orifices, including the trans-anal extrusion. Factors responsible for bowel perforation followed by trans-anal extrusion of the distal VPS catheter in children are; thin bowel wall, weakened bowel musculature especially in children associated with neural tube defects with neurological deficits, implantation of the whole length of the peritoneal catheter within the peritoneal cavity, chronic peritoneal irritation, and infection in the cases of VPS implanted for hydrocephalus caused by meningitis, and history of abdominal surgery/previous VPS revisions.

In general, the incidence of perforation of the hollow viscera, including the bowel/colon by the distal VPS catheter is reported in 1% or less in most of the published series. It is difficult to predict which of the cases are going to have extrusion of the VPS catheter through the natural orifices, when, and why? Some of the measures that may probably help in the reduction of the incidence of the above-said complication in children are; (a) keeping most distal part of VPS catheter in suprahepatic space, and (b) reduction in length of the distal VPS catheter (intraperitoneal catheter) to the minimum. Most important is to suspect the bowel perforation early, and manage it well, accordingly. The finding of CSF infection and meningitis is more dangerous, it also requires more

intensive therapy, and it also requires a longer duration for treatment.

CONCLUSIONS

Trans-anal extrusion of the distal VPS catheter is a well-known but rare complication of the VPS insertion done for the treatment of hydrocephalus in children. In sixty percent of children, removal and immediate revision of the peritoneal/distal VPS catheter were done safely through mini-laparotomy. During the management, formal abdominal explorations, neither executed nor required in any of the cases. Bowel perforation healed spontaneously within a few days after the removal of trans-anally extruded VPS catheter. Surgical procedures offered for the management of trans-anal extrusion of the distal VPS catheter were also associated with complications and mortality.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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