Review Article

What is new in the management of distal VP shunt catheter extrusion through the anus: A brief review of recently published literature

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ABSTRACT

The objectives of the current study were to briefly review the demographics, clinical characteristics, and outcomes of the surgical procedures performed for the cases managed for the trans-anal extrusion of the distal ventriculo-peritoneal (VP) shunt catheter. The current literature review focused on cases published between January 1, 2021, to December 31, 2024.

The relevant literature/articles were retrieved through an online database search. This literature review included n=50 cases (males n=27 and females n=23) of distal VP shunt catheter extrusion through the anus. In approximately four-fifths (n=40) of cases, the indication for primary VP shunt insertion was congenital hydrocephalus. Approximately two-thirds (n=31) of cases involved were ≤ 24 months at the extrusion of the distal VP shunt catheter. Approximately two-thirds (n=32) of extrusions of distal VP shunt catheter occurred within 12 months of the initial VP shunt catheter insertion or last shunt revision. The main complaint reported was the extrusion of the distal shunt catheter through the anal canal. For 96% (n=48) of the cases, the entire shunt system or the distal shunt catheters were removed with or without external ventricular drainage (EVD). Most cases recovered well, but this review also noted one death. Distal ventriculo-peritoneal shunt catheter extrusion through the anus, primarily reported in children ≤ 5 years, though cases have also been reported in older children, adults, and older individuals. For management, the preferred approach was the removal of the entire or distal shunt catheter with or without external ventricular drainage and delayed re-VP shunt catheter insertion.

Key words: Children; Complication, Extrusion, Hydrocephalus, Infants, Protrusion, Surgery, Ventriculoperitoneal shunt, Revision

Ventriculo-peritoneal (VP) shunt catheter insertion is one of the preferred surgical procedures for effectively treating hydrocephalus [1-3]. VP shunt catheter placement can lead to several complications, including the distal catheter extrusion through natural orifices [3-8]. The perforation of hollow viscera, such as the gastrointestinal tract (GIT), urinary bladder, or uterus by the distal VP shunt catheter, and its migration inside the hollow viscera most often clinically present with catheter extrusion through the natural openings [8-12]. Literature supports that extrusion (protrusion) of the distal shunt catheter through the anus occurred relatively more frequently than the extrusion through the mouth, urethra, or vagina [8-12].

It is also important to know that extrusion of the distal catheter through the natural openings is not a rule; in some cases, the distal catheter remains inside the lumen of hollow viscera [11, 13-17]. This manuscript follows the guidelines of the Preferred Reporting Items for Systematic reviews and Meta-analyses (PRISMA) [18]. Furthermore, ethical clearance from an institutional review board was not required, as this paper is a brief review of already published literature. This paper analyses the demographics, clinical features, and results of the surgical therapy executed upon n=50 cases managed for the distal VP shunt catheter extrusion through the anus and were reported/published by various authors between January 01, 2021, to December 31, 2024 [19-54].

MATERIAL AND METHODS

This current article is a brief descriptive review of recently published literature that included the cases managed for the trans-anal extrusion of the distal VP shunt catheter. Relevant manuscripts were searched and retrieved from several websites, including PubMed, PubMed Central, Scopus, Web of Science, Cochrane Library, and Google Scholar. The literature search was limited to the period between January 1, 2021, and December 31, 2024, and preferred for the manuscripts available in English, but also included articles

Access this article online

Received – 28th September 2025
Initial Review – 12th October 2025
Accepted – 25th October 2025

DOI: 10.32677/ijch.v12i10.7885

Quick Response Code

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published in languages other than English. Various search terms employed for online search for the manuscripts were "ventriculoperitoneal shunt extrusion/protrusion", "peritoneal shunt migration/extrusion", "CSF shunt extrusion", "trans-anal extrusion of shunt catheter", and "extrusion of the distal shunt catheter through the anus and or rectum or anal canal".

The details collected and tabulated from the articles included patient age and sex, indication for primary VP shunt catheter insertion, age at the time of diagnosis of shunt catheter extrusion, clinical presentation and findings, radiological investigations conducted, therapeutic surgical procedures provided, and any post-operative morbidities and mortalities were also noted. This review exclusively included the cases of bowel perforation caused by the distal VP shunt catheter, its migration inside the bowel lumen (colon/rectum), and clinical presentation with extrusion of the shunt catheter through the anus. Trans-anal extrusion of the VP shunt catheter cases presented at conferences, unpublished cases, and articles lacking complete desired information were excluded. Additionally, cases diagnosed with migration of the distal shunt catheter within the bowel lumen, but without trans-anal extrusion, were also excluded from the review. This current review adhered to the PRISMA guidelines, and since it is a review of previously published literature, institutional ethics clearance was not necessary.

RESULTS

The current manuscript is a brief descriptive review of recently published literature regarding the management of the distal VP shunt catheter extrusion through the anus, ranging from January 1, 2021, to December 31, 2024. Search for relevant manuscripts, exclusion of duplicated and incomplete articles, and selection of articles for current review are detailed in the PRISMA flow diagram in ***Figure 1***. This literature review included n=50 cases (n=27 males and n=23 females) of distal VP shunt catheter extrusion through the anal canal. ***Table 1*** provides the demographics of the included cases, the indications for primary VP shunt catheter insertion (causes of hydrocephalus), the patient's age, the therapeutic surgical procedures executed for shunt catheter extrusion, and the outcomes expressed in terms of postoperative morbidities and mortality. In ***Table 1***, the cases are listed in their order of publication, with the case published in January 2021 as the first. Congenital cause of hydrocephalus (n=40) was the most common indication for primary VP shunt catheter insertion. Approximately two-thirds (n=31) of patients diagnosed with trans-anal extrusion of a distal shunt catheter were 24 months old or younger. In approximately two-thirds (n=32) cases, shunt catheter extrusions occurred within 12 months of the initial VP shunt insertion, or the last shunt revision done, if any.

For most of (n=47) the case, the primary complaint reported was the distal VP shunt catheter extrusion through the anal canal. Trans-anally extruded distal VP shunt catheters were also detected during routine clinical examinations in n=46 of the cases reviewed. Clinical features suggestive of meningitis were also found in n=6, and one of the cases had features of peritonitis. Cerebrospinal fluid (CSF) samples also detected pathogens on culture in n=11 cases. The diagnosis of trans-anal extrusion of the distal VP shunt catheter was clear in all the cases. Radiological investigations were also ordered for further confirmation by some of the authors and included cranial computed tomography (CT) scans (n=9), and abdominal CT scans (n=12). In 96% (n=48) of instances, either the entire shunt system or the distal VP shunt catheters were removed, with or without external ventricular (EVD). In five cases, postoperative complications were also observed; however, most of the cases recovered well. This review also documented one death. Nine of the manuscripts, not included in the current literature review, are detailed in ***Table 2.*** A summary of the results obtained from the current literature review is also provided in ***Table 3***.

Figure 1. PRISMA flow diagram for literature search

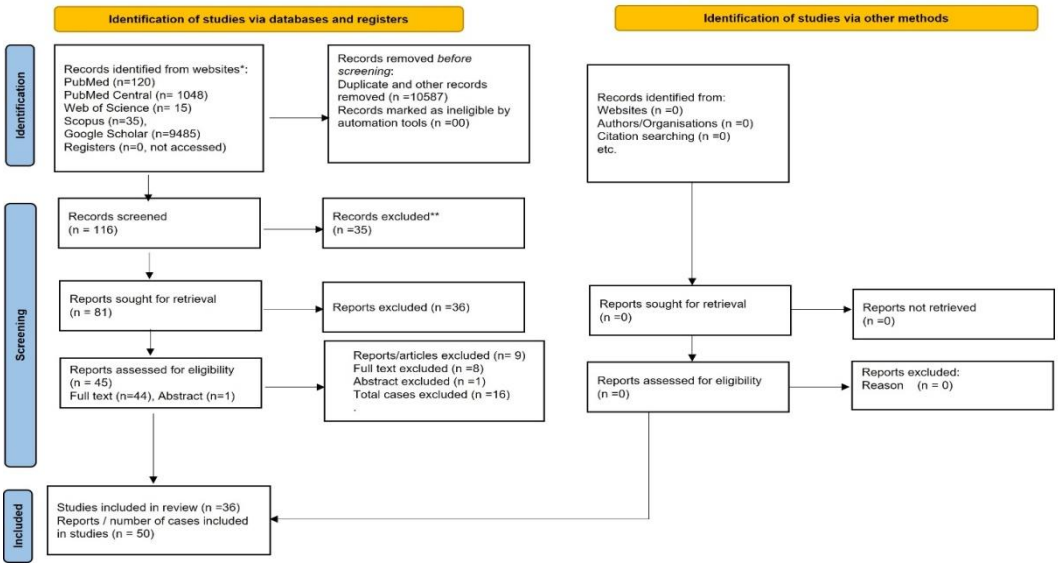

Table 1: Summary of cases (n=50) included for literature review

Case No.	Author (s) Year Published Reference No.	Indication for VPS insertion	Sex	Age VPS insertion	Age trans-anal extrusion	Interval	VPS (R)	Operation procedures executed	Technique	Colon repaired (Yes / No)	Remark
1.	İştemen, et al. 2021 [19]	Hydrocephalus with NTD (Congenital)	F	Neonate	18 mo	17 mo	No	(i) Removal of entire VPS catheter and (ii) Immediate re-VPS catheter insertion	PC Endosc	Yes	R
2.	İştemen, et al. 2021 [19]	Hydrocephalus (Post-infectious)	M	Neonate	30 mo	29 mo	No	(i) Removal of entire VPS catheter and EVD, (ii) Removal of EVD, (re-VPS catheter insertion not required)	PC Endosc	Yes	R
3.	**Alhendawy, et al. 2021 [20]**	Hydrocephalus with NTD (Congenital)	F	2 mo	13 yr	2 weeks	Yes	(i) Removal of distal VPS catheter and EVD, (ii) Delayed V-A shunt insertion	PC	No	R
4.	**Zegarra, et al. 2021 [21]**	Hydrocephalus (Idiopathic)	M	82 yr	82 yr	3 days	No	NA (Operative detail clearly not-mentioned)	Lap	Yes	R
5.	**Shah KR. 2021 [22]**	Hydrocephalus with NTD (Congenital)	F	12 mo	10 yr	9 yr?	No	(i) Removal of entire VPS catheter and EVD, (ii) Delayed V-A shunt insertion	PC	No	R
6.	**Sinha, et al. 2021 [23]**	Hydrocephalus (Post-infectious)	M	6 mo	24 mo	6 mo	Yes	(i) Removal of distal VPS catheter, (ii) Ventricular catheter converted as EVD, (iii) Delayed re-VPS insertion	PC	No	R
7.	**Sinha et al. 2021 [23]**	Hydrocephalus (Congenital)	M	30 mo	36 mo	6 mo	No	(i) Removal of distal VPS catheter, (ii) Ventricular catheter converted as EVD, (iii) Delayed re-VPS insertion	PC	No	R
8.	**Sinha et al. 2021 [23]**	Hydrocephalus (Congenital)	M	21 mo	24 mo	3 mo	No	(i) Removal of distal VPS catheter, (ii) Ventricular catheter converted as EVD, (iii) Delayed re-VPS insertion	PC	No	R

9.	**Heng, et al. 2021 [24]**	Hydrocephalus (post-hemorrhagic)	M	10 mo	15 mo	5 mo	No	(i) Removal of entire VPS catheter, (ii) Delayed re-VPS insertion	PC	No	R
10.	**Lim, et al. 2021 [25]**	Hydrocephalus (Congenital)	M	6 mo	11 mo	4 mo	No	(i) Removal of entire VPS catheter, (ii) Delayed V-A shunt insertion	PC	No	R
11.	**Bal'afif, et al. 2021 [26]**	Hydrocephalus (Congenital)	F	NA	12 mo	NA	No	(i) Removal of entire VPS catheter,	PC	No	R
12.	**Santos, et al. 2021 [27]**	Hydrocephalus (Congenital)	F	Neonate	7 yr	7 yr?	No	(i) EVD, entire VPS catheter passed per-rectally, (ii) Delayed re-VPS insertion	-	No	R
13.	**Santos, et al. 2021 [27]**	Hydrocephalus (Congenital)	F	24 mo	6 yr	4 yr	No	(i) Removal of entire VPS catheter and EVD, (ii) Revision of EVD	PC	No	Death
14.	**Pant, et al. 2021 [28]**	Hydrocephalus with NTD (Congenital)	M	6 weeks	6 mo (median)	5 mo?	No	(i) Removal of distal VPS and EVD, (ii) Delayed re-VPS insertion/VPS (R)	PC	No	R
15.	**Pant, et al. 2021 [28]**	Hydrocephalus with NTD (Congenital)	F	6 weeks	6 mo (median)	5 mo?	No	(i) Removal of distal VPS and EVD, (ii) Delayed re-VPS insertion/VPS (R)	PC	No	R
16.	**Jonuzi, et al. 2021 [29]**	Hydrocephalus (Congenital)	F	12 mo	11 yr	10 yr	No?	(i) Removal of part of distal VPS catheter (ii) Repositioning of remaining distal VPS	Lap	Yes	R
17.	**Bosy, et al. 2021 [30]**	Hydrocephalus (Congenital)	M	Neonate	15 yr	1 Day	Yes	(i) Removal of distal VPS and EVD, (ii) Delayed V-A shunt insertion	Lap	Yes	R
18.	**Mukherjee, et al. 2022 [31]**	Hydrocephalus (Congenital)	M	3 mo	11 mo	2 mo	Yes	(i) Removal of entire VPS catheter and EVD, (ii) Delayed ventriculostomy (ETV)	PC	No	R
19.	**Huda, et al. 2022 [32]**	Hydrocephalus (Congenital)	M	6 mo	24 mo	18 mo	No	(i) Removal of entire VPS catheter and EVD, (ii) Delayed re-VPS catheter insertion	PC	No	R
20.	**Ghosh, et al.**	Hydrocephalu	M	36 mo	60 mo	24 mo	No	(i) Removal of	PC	No	R

	2022 [33]	s (Congenital)						entire VPS catheter, (ii) Delayed re-VPS catheter insertion			
21.	**Jain, et al. 2022 [34]**	Hydrocephalus (Congenital)	M	Neonate	12 mo	11 mo	No	(i) Removal of entire VPS catheter	Lap	Yes	R
22.	**Sil, et al. 2022 [35]**	Hydrocephalus (Post-infectious)?	M	18 mo	24 mo	6 mo	No	(i) Removal of entire VPS catheter and EVD, (ii) Delayed re-VPS insertion and others	PC	No	R
23.	**Khizar, et al. 2022 [36]**	Hydrocephalus with NTD (Congenital)	M	12 mo	41 mo	29 mo	No	(i) Removal of distal VPS catheter, and EVD, (ii) Delayed re-VPS catheter insertion,	PC	No	R
24.	**de Macêdo, et al. 2022 [37]**	Hydrocephalus (Congenital)	F	24 mo	19 yr	6 yr	Yes	(i) Removal of part of VPS catheter and EVD, (ii) Expulsion of distal VPS catheter, (iii) Delayed re-VPS catheter insertion	PC	No	R
25.	**Paes, et al. 2022 [38]**	Hydrocephalus with NTD (Congenital)	F	Neonate	43 mo	NA?	Yes	(i) Removal of entire VPS catheter, (Re-VPS insertion not required)	PC	No	R
26.	**Hassan, et al. 2023 [39]**	Hydrocephalus (Congenital)	M	6 mo	24 mo	18 mo	No	(i) Removal of part of distal VPS catheter, (ii) Proximal VPS catheter converted as an EVD, (iii) Delayed VPS (R) done	PC	No	R
27.	**Moges, et al. 2023 [40]**	Hydrocephalus with NTD (Congenital)	F	1 mo	4 mo	3 mo	No	(i) Removal of entire VPS catheter and EVD, (ii) Delayed re-VPS insertion	PC	No	R
28.	**Moges, et al. 2023 [40]**	Hydrocephalus (Congenital)	F	1 mo	6 mo	5 mo	No	(i) Removal of entire VPS catheter and EVD, (ii) Delayed re-VPS insertion	PC	No	R
29.	**Moges, et al. 2023 [40]**	Hydrocephalus with NTD (Congenital)	F	4 mo	11 mo	7 mo	No	(i) Removal of entire VPS catheter, (Re-VPS insertion not required)	PC	No	R
30.	**Moges, et al. 2023 [40]**	Hydrocephalus with NTD (Congenital)	F	4 mo	13 mo	9 mo	No	(i) Removal of entire VPS catheter, (Re-VPS	PC	No	R

								insertion not required)			
31.	**Moges, et al. 2023 [40]**	Hydrocephalus (Post-infectious)	F	15 mo	24 mo	9 mo	No	(i) Removal of entire VPS catheter and EVD, (ii) Delayed re-VPS catheter insertion	PC	No	R
32.	**Moges, et al. 2023 [40]**	Hydrocephalus (Post hemorrhagic)	F	3 mo	36 mo	32 mo	No	(i) Removal of entire VPS catheter and EVD, (ii) Delayed re-VPS catheter insertion	PC	No	R
33.	**Moges, et al. 2023 [40]**	Hydrocephalus (Congenital)	M	4 mo	8 mo	4 mo	No	(i) Removal of entire VPS catheter, (No consent for re-VPS catheter insertion)	PC	No	NA
34.	**Basehi, et al. 2023 [41]**	Hydrocephalus (Congenital)	M	Neonate	24 mo	7 mo	Yes	(i) Removal of entire VPS catheter and EVD, (ii) Delayed re-VPS catheter insertion	PC LAP	No	R
35.	**Shiferaw, et al. 2023 [42]**	Hydrocephalus with NTD (Congenital)	M	Neonate	19 mo	18 mo	No	(I) Removal of part of distal VPS catheter, (ii) Proximal VPS catheter converted as an EVD, (iii) Delayed re-VPS insertion done	PC	No	R
36.	**Rodarte, et al. 2023 [43]**	Hydrocephalus (Congenital)	M	Neonate	19 mo	6 mo?	Yes	(i) Removal of distal/entire VPS catheter + EVD, (ii) Delayed re-VPS catheter insertion	PC	No	R
37.	**Adel, et al. 2023 [44]**	Hydrocephalus with NTD (Congenital)	M	6 mo	11 mo	5 mo	No	(i) Removal of entire VPS catheter and EVD, (ii) Delayed re-VPS catheter insertion	PC	No	R
38.	**Wassila B. 2024 [45]**	Hydrocephalus (Congenital)	F	4 mo	15 mo	9 mo	No	ii) Removal of distal VPS catheter and (ii) Immediate / Delayed VPS (R) done	NA	NA	R
39.	**Awwad, et al. 2024 [46]**	Hydrocephalus (Congenital)	M	8 mo	19 mo	4 mo	Yes	(i) Removal of entire VPS catheter and EVD,	Lap	Yes	R
40.	**Zarra, et al. 2024 [47]**	Hydrocephalus (Congenital)	M	6 mo	9 mo	3 mo	No	(i) Removal of distal VPS catheter, (ii) Proximal VPS catheter	PC LAP	Yes	R

								converted as EVD, (iii) Delayed VPS (R) done			
41.	**Karshe, et al. 2024 [48]**	Hydrocephalus (Congenital)	M	7 mo	9 mo	2 mo	No	(i) Removal of entire VPS catheter, (ii) Immediate re-VPS insertion	Lap	Yes	R
42.	**Mirjalali, et al. 2024 [49]**	Hydrocephalus (Post-traumatic)	M	36 yr	38 yr	12 mo	Yes	(i) Removal of entire VPS catheter	PC	No	R
43.	**Kencana, et al. 2024 [50]**	Hydrocephalus (Congenital)	F	Neonate	1 mo	1 mo	No	(i) Removal of entire VPS catheter, (re-VPS insertion not done/not required)	Lap	No	R
44.	**Rojas Urrea, et al 2024 [51]**	Hydrocephalus (Brain tumor)	M	25 mo	36 mo	11 mo	No	(i) Removal of part of distal VPS catheter, (ii) Proximal VPS catheter converted as EVD, (iii) Delayed re-VPS insertion	PC	No	NA
45.	**Allsbrook, et al. 2024 [52]**	Hydrocephalus (Congenital)	F	NA	29 yr	36 mo	Yes	(i) Removal of part of distal VPS catheter, (ii) Proximal VPS catheter as EVD, (ii) Delayed V-A shunt done	LAP	Yes	R
46.	**Abdelhameid et al. 2024 [53]**	Hydrocephalus (Congenital)	M	Neonate	18 mo	18 mo	No	(i) Removal of entire VPS catheter, (ii) Immediate re-VPS insertion	NA	NA	R
47.	**Abdelhameid et al. 2024 [53]**	Hydrocephalus (Congenital)	F	Neonate	24 mo	22 mo	Yes	(i) Removal of entire VPS catheter, (ii) Immediate re-VPS insertion	NA	NA	R
48.	**Abdelhameid et al. 2024 [53]**	Hydrocephalus (Congenital)	F	Neonate	10 mo	10 mo	No	(i) Removal of entire VPS catheter, (ii) Immediate re-VPS insertion	NA	NA	R
49.	**Abdelhameid et al. 2024 [53]**	Hydrocephalus (Congenital)	F	Neonate	12 mo	12 mo	No	(i) Removal of entire VPS catheter, (ii) Immediate re-VPS insertion	NA	NA	R
50.	**Shbani et al. 2024 [54]**	Hydrocephalus (Post-traumatic)	F	6 mo	17 yr	12 mo	Yes	(i) Removal of entire VPS catheter and EVD, (ii) Delayed VA shunt insertion	Lap	Yes	R

Table 2: Manuscript (n=9) excluded from the current literature review

Reference.	Number of cases	Literature retrieved	Reason for exclusion
Das *et al* [55], 2021	1	Full text	Incomplete case details
Bickle I [56], 2021	1	Full text	Incomplete case details
Faheen *et al* [57], 2022	4	Full text	Incomplete case details
Khan *et al* [58], 2022	1	Full text	Incomplete case details
Paul *et al* [59], 2022	2	Full text	Incomplete case details
Nazwar *et al* [60], 2023	1	Full text	Incomplete case details
Sahin *et al* [61], 2023	1	Abstract	Full text not retrieved
Usman *et al* [62], 2023	1	Full text	Incomplete case details
Venkati *et al* [63], 2024	4	Full text	Incomplete case details

Table 3: Summary of the literature review
(Distal ventriculoperitoneal shunt (VPS) catheter extrusion through the anus)

Description	Description	Total (%)
Cases	Number of cases	50
Sex distribution	Male	27 (54)
	Female	23 (46)
	Male to female ratio (27/23)	1.17:1
Indication: VPS insertion	Congenital hydrocephalus	40 (80)
Age: VPS insertion	Infants	38 (76)
	13 to 60 months	8 (16)
Age: Trans-anal extrusion	Infants	16 (32)
	13 to 60 months	23 (46)
	6 to 20 years	8 (16)
Interval	0-6 months	21 (42)
	7-12 months	11 (22)
	13-24 months	7 (14)
VPS revisions	History of shunt revisions	13 (26)
Chief complaints	Extrusion of distal VPS catheter	47 (94)
Clinical findings (signs)	Extruded shunt catheter	46 (92)
	Meningitis	6 (12)
	Peritonitis	1 (2)
Radiological Investigations	Cranial Computed Tomography	9 (18)
	Abdominal Computed Tomography	12 (24)
Surgical procedures done	Removal of entire VPS without EVD	17 (34)
	Removal of entire VPS with EVD	15 (30)
	Removal of part of distal VPS and proximal catheter converted as EVD	15 (30)
Colon / bowel repaired	Yes	11 (22)
	No	34 (68)
Surgical techniques	Percutaneous	31 (62)
	Laparotomy	8 (16)
	Percutaneous + others	4 (8)
Shunt revision	Delayed re-VPS catheter insertion	21 (42)
	Delayed VPS revision	3 (6)
	Delayed Ventriculo-Atrial shunt	5 (10)
Complications	Postoperative	5 (10)
Mortality	Postoperative	1 (2)

DISCUSSION

The distal end of a VP shunt catheter can migrate into and through various body parts, including the lungs, thoracic cavity, heart, major blood vessels, intact abdominal wall, through the umbilicus, inguinal canal, scrotal area, liver, and kidney, among others [64-72]. Complications related to the peritoneal shunts are more frequently documented in children than adults [73-74]. Shunt revisions are required more often in children than in adults and others [73, 75, 76]. Additionally, shunt revisions are commonly needed within the first 12 months after VP shunt placement. Extrusion of the distal VP shunt catheter through the anal canal to the exterior is more commonly reported than its extrusion through the mouth, urethra, or vaginal orifice [9-12].

Summary of Evidence: The present manuscript is a brief review of literature published between January 1, 2021, to December 31, 2024, regarding the management of peritoneal shunt catheters that protruded/extruded through the anus. A total of n=36 manuscripts were reviewed, including n=50 cases of trans-anal extrusion of the distal part of the VP shunt catheter [19-54]. Thirty-three of the manuscripts were published in English. Three articles that were published and available in other languages were also included in the current review [27, 43, 45]. All manuscripts included in this study are full-text articles. Four-fifths (n=29) of the manuscripts were published as case reports [19-21, 24-27, 29-33, 35-39, 41-43, 45-52, 54]. Three of the manuscripts were published as case series [34, 40, 53]. The remaining articles included were published as images (n=1), research (n=1), original (n=1), and review articles (n=1) [22, 23, 28, 44]. Nine manuscripts that included n=16 cases of the distal shunt catheter extrusion through the anus were not considered for the present review [55-63]. The full text of one of the manuscripts was not retrieved online [61], while others were excluded for incomplete case details [55-60, 62, 63].

The current literature review included a total of n=50 cases of extrusion of the distal VP shunt catheter through the anus and included n=27; 54% males and n=23; 46% females with a male-to-female ratio of 1.17 to 1. The current review revealed that the congenital causes of hydrocephalus were the most common indication for primary VP shunt catheter insertion, and it was diagnosed in four-fifths (n=40) of the cases [23, 25-27, 29-34, 37, 39, 40, 41, 43, 45-47, 50, 52, 53]. Among the above, n=11 of the cases had associated neural tube defects [19, 20, 22, 28, 36, 38, 40, 42, 44]. In four cases, the indication for VP shunt catheter insertion was post-infectious hydrocephalus [19, 23, 35, 40]. In two cases, the indication for shunt insertion was traumatic hydrocephalus / post-hemorrhagic hydrocephalus [49, 54]. Intra-cranial tumor causing hydrocephalus was the indication for shunt placement in one of the cases [51].

In three-fourths (n=38) of the cases, the initial VP shunt catheters were implanted during infancy [19, 20, 22-25, 27-32, 34, 36, 38-48, 50, 53, 54]. VP shunt catheters were inserted during the neonatal period in approximately one-third (n=16) cases [19, 27, 30, 34, 38, 40-43, 50, 53]. In n=13; 26% of cases, their shunt catheter required revisions before the extrusion of the distal VP shunt catheter through the anus [20, 23, 30, 31, 37, 38, 41, 43, 46, 49, 52, 53, 54]. Approximately, four-fifths (n=39) of the distal shunt catheter extrusions from the anus occured in children aged ≥ 5 years. Thirty-one of the cases were ≥ 2 years at the time of diagnosis and treatment provided for shunt catheter protrusion through the anus [19, 23-28, 31, 32, 34, 39, 40, 42-48, 50, 53, 54, 55]. Five of the cases were 11 to 20 years old [20, 29, 30, 37, 54], and only one of the cases was over the age of 80 years [21].

This current review found that the distal VP shunt catheter extrusion through the anus occurred within 12 months of the shunt placement or the last shunt revisions, if any in n=32; 64% of the cases [20, 21, 23-25, 28, 30, 31, 34, 35, 40, 41, 43-51, 53, 54]. The shunt catheter extrusion occurred ≥ 24 months of shunt insertions in approximately four-fifths (n=39) of the cases [19-21, 23-25, 28, 30-35, 39, 40-46, 48-51, 53, 54]. In another n=5 cases, it was noticed and was diagnosed between 25 to 60 months after the shunt insertion [19, 27, 36, 40, 52]. In four of the cases, the interval was 6 to 10 years, when the trans-anal extrusion of the shunt catheter was detected [22, 27, 29, 37].

In most cases (n=47), the primary complaint reported was the extrusion of the distal VP shunt catheter through the anal canal. During routine clinical examination, trans-anally extruded distal shunt catheters were detected in n=46 of the reviewed cases. However, the distal VP shunt catheter was not detected during routine digital rectal examination in n=4 cases [19, 26, 32, 46]. Clinical features of meningitis were documented in six cases [19, 23, 27, 33, 44, 54], while signs of peritonitis were evidenced in one case [54]. Plain skiagrams of the abdomen and or X-ray series were primarily used as the initial radiological investigation. CT scans of the head were obtained for nine cases [19, 25, 26, 32, 33, 36, 41, 45, 51]. CT scans of the abdomen were requested in n=12 cases, for delineation of the path of the distal VPS catheters [19-22, 25, 37, 44, 46, 51, 52, 54]. CSF submitted for cultures and sensitivity also revealed the growth of various organisms in eleven cases [22, 23, 25, 27, 32, 40, 41, 50, 52].

In most cases (n=48; 96%), the entire shunt system or the distal catheter was removed, with or without external ventricular drainage [19, 20, 22-28, 30-44, 46-54]. The entire VP shunt system was removed in approximately two-thirds (n=32) of the cases [19-22,24-27, 31-35, 38, 40, 41, 44, 46, 48-50, 53, 54]. Among the above n=32 cases, n=17 of them were managed by removal of the entire VP shunt catheters without EVD [19, 24-26, 33, 34, 38, 40, 48-50, 53]. Among the above n=32 cases, another n=15 of them were managed by removal of the entire VP shunt catheters with EVD. The distal part of the VP shunt catheter was removed, and the

proximal/ventricular catheters were converted to an EVD in n=15 cases [20, 23, 28, 30, 36, 37, 39, 42, 43, 45, 51, 52]. For one of the cases, the part of the distal VP shunt catheter was cut, and the remaining part was relocated in the peritoneal cavity [29]. In one of the cases, the details of the operative procedure were not clear [21].

The bowel perforation caused by the shunt catheter was repaired in n=11; 22% of the cases only [19, 21, 29, 30, 34, 46-48, 52, 54]. In two-thirds (n=34) of the cases, bowel perforations were not repaired and healed spontaneously [20, 22-28, 31-33, 35-44, 49-51]. For five of the cases, the details for the same were not available [45, 53].

In n=31 cases, the percutaneous (PC) technique was utilized by various authors for treating the trans-anally extruded shunt catheters [20, 22-28, 31-33, 35-40, 42-44, 49, 51]. The formal exploratory laparotomy was opted for by various authors for managing n=8 of such cases [21, 29, 30, 34, 46, 48, 50, 54]. A laparoscopic procedure was carried out for the management of one such case [52]. For the management of four of the cases, PC techniques were added with either endoscopic (n=2) or laparoscopic procedures (n=2) [19, 41, 47]. The technical details were not available for n=5 of the cases [45, 53]. A total of n=38 cases required revision procedures, of which on n=21 occasions, various authors preferred delayed re-VP shunt catheter insertion [23, 24, 27, 28, 32, 33, 35-37, 40-44, 51]. Five cases did not require revision procedures [19, 38, 40, 50].

Complications following the various surgical procedures executed for managing trans-anally protruded VP shunt catheters were observed in five of the cases [27, 30, 32, 35, 51]. Most of the cases recovered well. This review observed one death; a six-year-old girl died of septicemia that failed to respond to medications [27].

The current literature review of the recently published cases on the management of the distal VP shunt catheter extrusion through the anus found nothing new than the previous systematic literature review, and it also supports the systematic literature review in the management protocol [9]. The results of the present review also had similar findings in terms of surgical procedures performed and the surgical techniques utilized for managing such cases. On further review of the literature published earlier on the extrusion of the distal VP shunt catheters through the natural orifices also supports that trans-anal extrusion was more frequent than the trans-oral, trans-urethral, or trans-vaginal extrusions [9-12]. Clinical features of peritonitis were rarer than expected. Literature also supports that at least 10 to 15% of the cases may have clinical characteristics of meningitis.

Limitations: Nine of the manuscripts that included n=16 cases of the distal VP shunt catheter protrusion through the anus were excluded from the current review because of incomplete case details, and this was one of the important limitations of this review [55-63]. Another limitation was that this is a short-duration review and included a limited number of cases; therefore, various statistical analyses for systematic review were not performed. Another limitation of the current review was that this research was not registered with any of the registers made for systematic reviews.

CONCLUSION

The distal ventriculoperitoneal shunt catheter extrusion through the anal canal, frequently observed in children under the age of five years, although also detected in older children and adults. Three-fourths of the extrusion of the distal shunt catheter through the anus occurred within the first 24 months of its initial shunt insertion or revision, if any. Removal of the entire shunt system or distal VP shunt catheter, with or without external ventricular drainage, was preferred for managing, majority of such cases with an excellent result.

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Funding: None; Conflicts of Interest: None Stated.

How to cite this article: Ghritlaharey RK. What is new in the management of distal VP shunt catheter extrusion through the anus: A brief review of recently published literature. Indian J Child Health. 2025; 12(10):121-132.