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Case Series

Unusual distal migrations of ventriculoperitoneal shunts: a six-patient pediatric case series with literature review

Sunny Gupta*, Avinash Sharma, Anand Sharma, Avdhesh Shukla

Department of Neurosurgery, Gajra Raja Medical College, Gwalior, Madhya Pradesh, India

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***Correspondence:**
Dr. Sunny Gupta,
E-mail: dr.maddy2011@gmail.com

ABSTRACT

Distal migration of ventriculoperitoneal (VP) shunts to atypical sites is an uncommon but potentially serious complication. This retrospective case series presents six pediatric patients (aged 0-3 years) with unusual distal shunt migrations managed at a tertiary neurosurgical center between 2018 and 2025. Three infants exhibited scrotal migration through a patent processus vaginalis (PPV), two children presented with transanal extrusion following bowel perforation, and one infant had vaginal extrusion. Management included shunt revision with PPV ligation, shunt removal with antibiotic therapy, and definitive cerebrospinal fluid (CSF) diversion procedures, including endoscopic third ventriculostomy (ETV). All patients recovered without long-term morbidity. This study highlights the clinical importance of early recognition and prompt management of distal catheter migration, emphasizing preventive strategies, including optimizing catheter length and surgical correction of a PPV.

Keywords: Ventriculoperitoneal shunt, Distal migration, Scrotal swelling, Congentialhydrocephalus

INTRODUCTION

Ventriculoperitoneal (VP) shunting remains the most frequently performed procedure for CSF diversion in pediatric hydrocephalus. Despite its effectiveness, it carries a high rate of complications, with shunt malfunction, infection, and migration representing the major causes of shunt failure.[1] Distal migration of the shunt catheter into unusual anatomical locations is rare but clinically significant.[2,3] Reported sites include the scrotum, bowel, bladder, vagina, and thoracic cavity.[4-6] Among these, scrotal migration is predominantly seen in male infants due to a persistent PPV, while transanal or vaginal extrusions often result from bowel perforation or visceral erosion.[7-10]

Such migrations pose risks of infection, meningitis, and sepsis, requiring urgent recognition and management. This case series describes six pediatric patients with rare distal VP shunt migrations and reviews the relevant literature to elucidate mechanisms, risk factors, management principles, and preventive strategies.

CASE SERIES

This retrospective descriptive study was conducted at a tertiary neurosurgical center between January 2018 and January 2025. Six consecutive pediatric patients presenting with unusual distal VP shunt migration were included. Data collected included patient demographics, etiology of hydrocephalus, duration between shunt insertion and presentation, site of migration, microbiological findings, management strategies, and outcomes.

Radiological findings were reviewed by two neurosurgeons and a pediatric radiologist. Institutional ethics approval was obtained, and parental consent was secured for publication of de-identified case data and images.

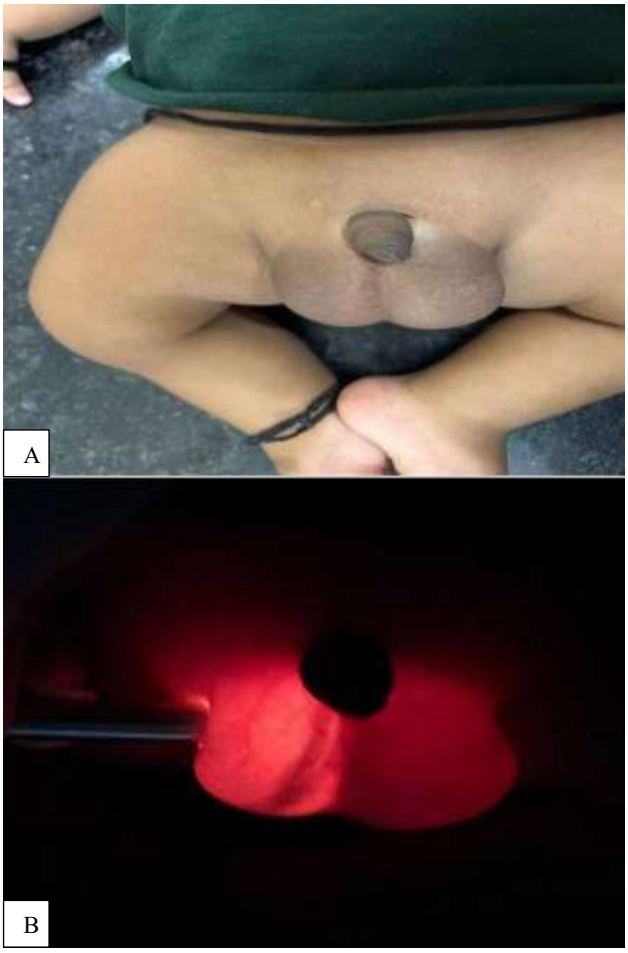

Figure 1 (A and B): Transillumination test showing right scrotum with fluid collection and shunt.

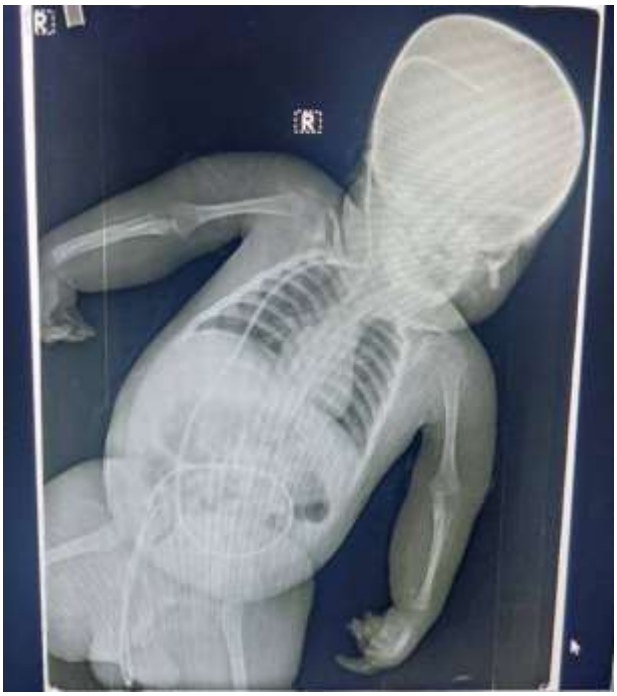

Figure 2: Plain X-ray (anteroposterior view) showing distal VP shunt catheter coiled in the right scrotum.

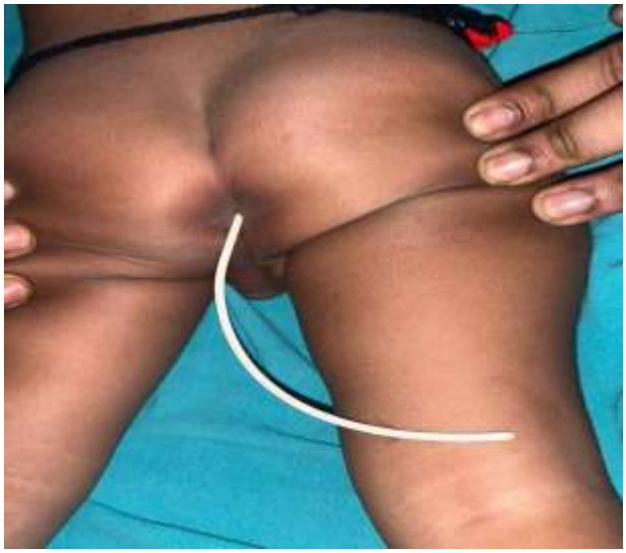

Figure 3: Extrusion of distal VP shunt catheter through anus.

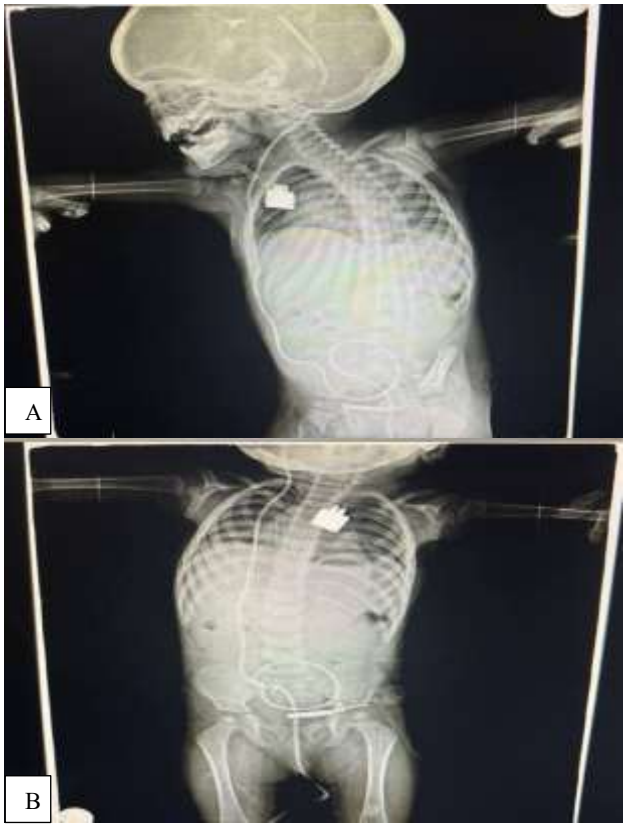

Figure 4 (A and B): X-ray (anteroposterior view) showing the VP shunt coursing from cranial vault to abdominal cavity with distal migration out of anus.

Case 1

A 6-month-old male infant presented with progressive right scrotal swelling three weeks after VP shunt placement for posthemorrhagic hydrocephalus following intraventricular hemorrhage in the neonatal period. The parents reported an initially soft, non-tender swelling that

gradually increased in size and transilluminated brightly. The infant was afebrile and otherwise neurologically stable. On examination, a fluctuant scrotal mass with palpable tubing could be felt along the inguinal canal.

Ultrasonography confirmed a tubular echogenic structure within the tunica vaginalis, and a plain abdominal X-ray demonstrated coiling of the distal catheter in the scrotal sac. The diagnosis of scrotal migration through a patent processus vaginalis (PPV) was made. Surgical exploration via an inguinal approach revealed an open processus vaginalis with the peritoneal catheter lying freely within the scrotum and surrounded by a small amount of clear CSF. The distal tubing was withdrawn, shortened appropriately, and repositioned into the peritoneal cavity, followed by PPV ligation. Postoperative recovery was uneventful, and at both 6-month and 1-year follow-up visits, the child remained neurologically intact with no recurrence of swelling or shunt malfunction.

Case 2

A 5-month-old male, who had undergone VP shunt insertion for congenital aqueductal stenosis, developed a painless right scrotal swelling approximately one month postoperatively. Parents denied fever or irritability. Examination revealed a reducible, non-tender swelling, raising suspicion of communicating hydrocele versus shunt migration. Imaging studies, including abdominal radiography, demonstrated peritoneal catheter descending through the right inguinal canal into the scrotum.

During operative exploration, a patent processus vaginalis was identified, through which distal catheter had herniated into the scrotum. The tubing was intact and not adherent to surrounding tissue. Herniotomy with PPV closure was performed, and the catheter was repositioned with a shortened intraperitoneal length to prevent recurrence. The patient made an excellent recovery and remained asymptomatic at both 6- and 9-month follow-ups, with stable ventricular size on cranial ultrasonography.

Case 3

A 2-month-old male infant developed sudden right scrotal swelling associated with mild tenderness only five days following VP shunt insertion for congenital hydrocephalus. There was no fever, vomiting, or neurological deterioration. On physical examination, the scrotum was tense and slightly erythematous. Transillumination was positive, and a tubular structure was palpable extending from the inguinal region into scrotum.

Radiography confirmed that the distal catheter had migrated into the scrotum. Emergency surgical exploration was performed, revealing a wide patent processus vaginalis and coiled shunt catheter within the tunica vaginalis cavity, surrounded by clear CSF without evidence of infection or bowel involvement. The catheter was removed, trimmed, and re-implanted into the peritoneal cavity with concomitant PPV ligation. The patient recovered uneventfully and was discharged on the third postoperative day. At 6- and 9-month follow-up visits, he remained asymptomatic with normal neurological milestones and no evidence of recurrence.

Case 4

An 18-month-old female presented to emergency department with fever, irritability, and extrusion of the distal shunt catheter through the anus. The mother reported passage of a thin white tube during defecation two days earlier. The child had undergone VP shunt placement for congenital hydrocephalus six months prior. Exam revealed a small amount of serosanguinous discharge around extruded tubing, without peritonitis/abdominal tenderness.

Abdominal X-ray demonstrated the distal shunt traversing the peritoneal cavity and exiting via the rectosigmoid region (Figure 4). A diagnosis of bowel perforation with transanal extrusion was made. Under general anesthesia, the shunt was removed in total, and the peritoneal cavity was irrigated thoroughly. Intraoperative findings confirmed a 0.5-cm perforation in the sigmoid colon, which was repaired primarily by the pediatric surgery team. Broad-spectrum intravenous antibiotics were initiated, and CSF cultures were monitored until sterile. Following infection control, a new VP shunt was inserted on contralateral side after 14 days. The patient recovered fully, and at 1-year follow-up, she remained neurologically stable with no evidence of infection or recurrence.

Case 5

A 3-year-old female presented with refusal of feeds and fever, with visible extrusion of the catheter from the anus. CT imaging confirmed intraluminal migration with distal extrusion. Stool cultures grew Escherichia coli, confirming enteric contamination. Shunt removal and antibiotic therapy were performed, followed by ETV as a definitive procedure. At 6 month and then at one-year follow-up, the child remained shunt-free and neurologically intact.

Case 6

A 6-month-old female, previously treated for post-infectious hydrocephalus, presented with a rare and alarming finding-extrusion of the distal catheter through the vaginal introitus. The event was noticed by the mother while cleaning the child. The infant had mild fever but no abdominal distension or vomiting. Physical examination confirmed the presence of shunt tubing at the vaginal opening, without active bleeding or discharge.

Pelvic ultrasound and CT imaging revealed that catheter had migrated from the peritoneal cavity into pelvis, coursing along the fallopian tube and uterine cavity before exiting through the vagina. There was no evidence of bowel perforation. Shunt system was removed under sterile conditions, and broad-spectrum IV antibiotics were

initiated. Pediatric gynecological assessment confirmed that vaginal mucosa was intact after removal. Following negative CSF cultures, a new VP shunt was inserted on contralateral side after 10 days. Infant's recovery was uneventful, and at 9-month follow-up she remained asymptomatic with normal developmental progress.

Table 1: Summary of six cases.

Cases	Age (in months)/sex	Presentation	Migration site	Management	Outcome
1	6/ M	Right scrotal swelling	Scrotum	Shunt revision + PPV ligation	Good
2	5/ M	Right scrotal swelling	Scrotum	Shunt revision	Good
3	2/ M	Right scrotal swelling day 5 post-op	Scrotum	Reposition + herniotomy	Good
4	18/ F	Tube protruding per anus	Bowel → anus	Shunt removal + revision	Recovered
5	3 years / F	Fever, refusal of feeds, anal extrusion (*E. coli*)	Bowel → anus	Shunt removal + ETV	Recovered
6	6/ F	Vaginal extrusion	Vagina	Shunt removal + antibiotics +diversion	Recovered

DISCUSSION

Distal migration of VP shunt catheters to atypical anatomical sites, though rare, represents a significant clinical entity in pediatric neurosurgery. Scrotal migration, the most common form, is facilitated by a patent processus vaginalis, which persists in approximately 80-90% of male infants at birth.[2-4] Increased intra-abdominal pressure and catheter length contribute to distal migration. Preventive strategies include preop identification and ligation of a PPV during shunt placement, limiting catheter length, and meticulous fixation of peritoneal end.[4,5] Transanal extrusion results primarily from bowel perforation, reported in 0.1-0.7% of shunt procedures.[6-8] Proposed mechanisms include chronic irritation, pressure necrosis, or sterile inflammation leading to visceral wall erosion.[9] Such cases carry a high risk of ascending infection and meningitis, warranting immediate shunt removal and broad-spectrum antibiotic coverage.[10,11] Vaginal extrusion, as seen in one of our cases, is exceedingly uncommon and may result from catheter traversal through uterus and fallopian tubes.[12,13] Prompt recognition is essential to prevent contamination and preserve reproductive anatomy. Imaging modalities such as plain radiography and CT scanning aid in localizing catheter and identifying visceral involvement.[14] Infected/ contaminated shunts should be externalized or removed, and replacement performed only after CSF sterility confirmation.[15] ETV provides a suitable alternative in select patients, eliminating need for permanent shunt hardware.[16] Recent reviews emphasize that multidisciplinary care-including pediatric surgery consultation in transvisceral migrations-improves outcomes.[17] Prophylactic measures such as appropriate catheter length, perioperative antibiotics, and intraoperative visualization of peritoneal placement remain critical.[18]

The small sample size limits this series. However, outcomes align with global experience and current best practices.

CONCLUSION

Unusual distal migrations of VP shunt catheters, though infrequent, pose a serious threat in pediatric hydrocephalus management. Early recognition of clinical signs such as scrotal swelling or catheter extrusion from natural orifices is vital. Management should prioritize immediate shunt removal or externalization in contaminated cases, coupled with targeted antimicrobial therapy. Preventive strategies-especially PPV ligation, optimized catheter length, and adherence to sterile techniques-significantly reduce the risk of recurrence. Our series underscores the importance of vigilance, timely diagnosis, and multidisciplinary management for favorable outcomes.

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