

*Case Report*

# Scrotal Migration of The Distal End of The Ventriculoperitoneal Shunt: Is There a Role for Early Closure of Patent Processus Vaginalis in The Pediatric Population?

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## Abstract

**Background:** Ventriculoperitoneal shunt (VP) insertion is one of the surgical treatments for patients with hydrocephalus. Infection, malfunction, catheter migration, hernia development, equipment failure, CSF subcutaneous collection and peritoneal pseudocyst formation are considered to be the main complications of this procedure.

**Case Description:** A 6-months-old boy known to have congenital aqueductal stenosis with VP shunt insertion at the age of 1 month, presented with scrotal swelling and generalized hypotonia. He was found to have catheter migration into the scrotum.

**Conclusion:** Scrotal migration of the distal end of the ventriculoperitoneal shunt is a rare but threatening complication that can present with either signs of hydrocephalus or scrotal swelling or hydrocele. Accordingly, we recommend performing a scrotal exam with an ultrasound early upon evaluation of any infant presenting with scrotal swelling or hydrocele after VP shunt insertion. There haven't been clear recommendations in the literature concerning closure of patent processus vaginalis upon placing a VP shunt in patients below the age of 3 months. Thus, we question whether early closure could help reduce the complications of catheter migration in infants.

**Keywords:** Ventriculoperitoneal Shunt; Cerebrospinal Fluid; Aqueductal Stenosis; Testicles

## Introduction

Hydrocephalus is the accumulation of Cerebrospinal Fluid (CSF) within different compartments of the ventricles, either due to an obstructive or non-obstructive etiology which entails the use of Ventriculoperitoneal (VP) shunt as a primary treatment modality. The shunt is constructed by two parts; a proximal part which shunts CSF from the ventricles and a distal part to the peritoneum. It is estimated that approximately 30,000 shunts are performed annually in the United States [1-4]. A multitude array of complications may arise and predominantly include hematomas, infections and alterations in drainage and shunting [4,5]. The shunt is aimed to drain the excess fluid from the brain to the peritoneum, in an effort to relieve the intracranial pressure. Yet, intra-abdominal complications arise indefinitely due to the shunt's proximity to the peritoneum rendering the likelihood of altering its functionality [6]. Thus, the distorted shunt contributes to a high failure rate pertaining to the pediatrics population that ranges between 40% to 50% within the 1<sup>st</sup> year [2,3,7]. In addition, surgical cases conveyed that around 18% of the children required at least three shunt revisions with a positive correlation between revision frequency and failure rate [8-14]. Shunt migration, being an idiosyncratic sequelae after VP shunt

insertion was found to affect also the urinary system, in which an extrusion of the shunt was present in the urethra [13].

### Case Report

We present a case of a 6-month-old boy, known to have congenital aqueductal stenosis for which a right occipital VP shunt at the age of 1 month was done, ultra-small valve, medium pressure. The patient remained in a stable condition and showed no complications after shunt placement. However, he started to show scrotal swelling associated with sunset eyes 5 days after surgery. Mother also noted VP shunt catheter in the scrotum with no other signs or additional symptoms. On physical exam, head circumference was above 95<sup>th</sup> percentile at the time, the patient had generalized hypotonia and the catheter could be palpated in the scrotum. Patient was diagnosed with bilateral inguinal hernia and he underwent bilateral inguinal hernia repair. Intraoperative findings showed VP shunt catheter passing through the right hernial sac into the scrotum with both testicles normal in size. After surgical repair and catheter replacement, the patient recovered well and was discharged home in a good condition.

### Discussion

Ventriculoperitoneal shunt surgery has been the mainstay of treatment for hydrocephalus since 1898 whereby infection and shunt malfunction attribute to a significant number of hospital readmissions with 50 million dollars of economic expenditure per year [11]. Shunt malfunction can be seen in patients with myelomeningocele who persist in manifesting neurological deficits despite surgical treatment [9]. In 1908, Kausch introduced the use of peritoneal cavity for CSF absorption [8]. However, more than 50% of patients require shunt revision due to intraabdominal complications which occur most commonly near the peritoneal end of the shunt catheter [6]. An example may include neurotrauma patients who need frequent follow ups post-placement due to risks of shunt failure 16.5% to 47% of shunt complications have been attributed to abdominal complications [15]. Cases of migration of distal peritoneal portion of the shunt out of the peritoneal cavity into the subcutaneous soft tissue causing CSF collection and pressure build up leading to malfunction have also been reported [1]. There are multiple theories explaining the cause behind catheter migration. One states that it is due to increased intra-abdominal pressure especially in obese patients leading to gradual extrusion [1]. Another theory explains that using catheters with hydrophilic surface and less friction could contribute to migration [12].

The very first scrotal migration was reported by Ramani, et al., in 1974 [14]. Local manifestations of the scroto-inguinal migration include a reducible scrotal swelling, scrotal penetration and hydrocele [13]. Although shunt malfunction or infection as shunt complications due to scrotal migration is rare, our patient showed signs of shunt malfunction manifested by hydrocephalus with a head circumference above the 95<sup>th</sup> percentile and neurologic symptoms manifested by generalized hypotonia. The migration of the shunt to the scrotum is theorized to be due to a patent processus vaginalis aided by the peristaltic movements of the intestines [14]. The processus vaginalis normally forms the tunica vaginalis that covers the testes and completely separates the inguinal canal and scrotum from the abdominal area [14]. It was estimated that 60-70% of infants below the age of 3 months still have a patent processus vaginalis [4]. Bristow, et al., stressed on the use of Doppler imaging in the case of an acute scrotal swelling to differentiate shunt migration from testicular torsion [5]. Although X-ray is commonly used to visualize a VP shunt, it is important to avoid radiation exposure in infants.

Through the literature review (Table 1), we identified 14 patients whose age ranges from 3 days to 4 years presenting 6 months on average after VP shunt insertion. 11 of 14 had right sided scrotal migration, 2 had left scrotal migration and 1 had bilateral migration. Symptoms at presentation differed between scrotal swelling only, to signs of hydrocephalus or both. Another literature review done by Hauser, et al., in 2020 identified 48 patients with a median age of 13.5 months (ranging from 3 days to 65 years old), of which 35 patients (75%) had a distal VP shunt migration into the right scrotum [3]. This shows that right sided VP shunt migration into the scrotum is not an uncommon complication in patients undergoing VP shunt insertion. Scrotal migration of the distal end of the VP shunt requires surgical intervention even though spontaneous repositioning can occur with manual reduction of the hernia to prevent recurrence. The primary goal is to reposition the distal end of the catheter back into the peritoneum with repair of the hernia and closure of the patent processus vaginalis. Shunt revision will be required in cases of shunt malfunction. However, there is no data to show the risks of infection associated with repositioning of the catheter without replacing the distal catheter [16].

| Publication                     | Patient Number | Age at VP Shuntinsertion | Time of Shunting                     | Side      | Symptom at Presentation                                            | Treatment                                                |
|---------------------------------|----------------|--------------------------|--------------------------------------|-----------|--------------------------------------------------------------------|----------------------------------------------------------|
| Bawa, et al., <sup>5</sup>      | 1              | 3 months                 | 4 months                             | Right     | Scrotal swelling                                                   | Herniotomy + shunt replacement                           |
|                                 | 2              | 4 years                  | 3 months                             | Right     | Scrotal swelling                                                   |                                                          |
|                                 | 3              | 10 months                | 5 months                             | Right     | Scrotal swelling                                                   |                                                          |
|                                 | 4              | 4 years                  | 4 months                             | Right     | Scrotal swelling                                                   |                                                          |
| Hauser, et al., <sup>4</sup>    | 5              | 3 weeks                  | 23 months                            | Right     | Scrotal swelling                                                   | Herniotomy                                               |
| Taha, et al., <sup>6</sup>      | 6              | 1 month                  | 2 months                             | Right     | Scrotal swelling                                                   | Herniotomy + shunt repositioning                         |
| Alkhudari, et al., <sup>7</sup> | 7              | -                        | 6 months (corrected age of 3 months) | Right     | Scrotal swelling + projectile, non-bloody and non-bilious vomiting | Spontaneous reduction                                    |
| Elizabeth, et al., <sup>8</sup> | 8              | 2 months                 | 12 months                            | Right     | Indirect hernia + scrotal swelling                                 | Herniotomy and repositioning of VP shunt tube were done. |
| Ozveren, et al., <sup>9</sup>   | 9              | 3 days                   | 24 hours                             | Bilateral | Scrotal swelling                                                   | Herniotomy and repositioning                             |
| Fuwa, et al., <sup>10</sup>     | 10             | 22 days                  | 1 year                               | Left      | Scrotal swelling + bulging of the scalp                            | Herniotomy + repositioning + shunt revision              |
| Oktem, et al., <sup>11</sup>    | 11             | 10 months                | 6 months                             | Right     | Scrotal swelling                                                   | Repositioning + processus vaginalis repaired             |
|                                 | 12             | 2.5 months               | 5 months                             | Right     | Scrotal swelling                                                   |                                                          |
|                                 | 13             | 9 days                   | 4 months                             | Right     | Scrotal swelling                                                   |                                                          |
|                                 | 14             | 2.5 months               | 24 hours                             | Left      | Scrotal swelling                                                   |                                                          |

**Table 1:** Review of management of scrotal migration of distal catheter of VP shunt.

## Conclusion

Scrotal migration of the distal end of the ventriculoperitoneal shunt is a rare but threatening complication that can present with signs of hydrocephalus or scrotal swelling or hydrocele. Accordingly, performing a scrotal exam and an ultrasound early upon evaluation of an infant presenting with such signs after VP shunt insertion is recommended. However, should we perform early closure of patent processus vaginalis upon shunt insertion in the pediatric population to decrease the risk of catheter migration.

## Conflict of Interests

The authors have no conflict of interest to declare.

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