Open Journal of
Clinical & Medical
Case Reports

Volume 9 (2023)
Issue 44

Case Report ISSN: 2379-1039

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?

Houssein Darwish*; Sarah kawtharani; Mohamad Housheimy; Hiba Fadlallah; Charbel Moussallem; Marwan Najjar*

***Corresponding Author: Houssein Darwish & Marwan Najjar**
Neurosurgery Division, American University of Beirut Medical Center, Lebanon.
Email: hd17@aub.edu.lb & mn12@aub.edu.lb

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 pseudo cyst 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 hasn'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 (VP); Infection; Migration.

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 Ventriculo-

peritoneal (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]. A multitude array of complications may arise, and predominantly include hematomas, infections, and alterations in drainage and shunting [2,3]. 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. Thus, the distorted shunt contributes to a high failure rate pertaining to the pediatrics population, that ranges between 40% to 50% within the 1st year [4-6]. In addition, surgical cases conveyed that around 18% of the children required at least three shunt revisions [1], with a positive correlation between revision frequency and failure rate [7]. Shunt migration, being an idiosyncratic sequalae after VP shunt insertion, was found to affect also the urinary system, in which an extrusion of the shunt was present in the urethra [8].

Case Presentation

We present the 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 started to show scrotal swelling associated with sunset eyes. Mother also noted VP shunt catheter in the scrotum. On physical exam, head circumference was above 95th 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.

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 [10]. In 1908, Kausch introduced the use of peritoneal cavity for CSF absorption [11]. 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 [9]. 5% to 47% of shunt complications have been attributed to abdominal complications [12]. 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 [13]. 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 [13]. Another theory explains that using catheters with hydrophilic surface and less friction could contribute to migration [14]. The very first scrotal migration was reported by Ramani et al in 1974 [1]. Local manifestations of the scroto-inguinal migration include a reducible scrotal swelling, scrotal penetration, and hydrocele [1]. 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 95th percentile and neurologic symptoms manifested by generalized hypotonia. The migration of the shunt to the scrotum is theorized to be due to a patent processes vaginalis aided by the peristaltic movements

of the intestines [1]. The processes vaginalis normally forms the tunica vaginalis that covers the testes and completely separates the inguinal canal and scrotum from the abdominal area [1]. It was estimated that 60-70% of infants below the age of 3 months still have a patent processes vaginalis [2]. 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 [3]. 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 have 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 [4]. This shows that right sided VP shunt migration into the scrotum in 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 processes 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.

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

Publication	Patient number	Age at VP shunt insertion	Time of shunting	Side	Symptom at presentation	Treatment
Bawa et al. [5]	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. [4]	5	3 weeks	23 months	Right	Scrotal swelling	Herniotomy
Taha et al. [6]	6	1 month	2 months	Right	Scrotal swelling	Herniotomy + shunt repositioning
Alkhudari et al. [7]	7		6 months (corrected age of 3 months)	Right	Scrotal swelling + projectile, non-bloody, and non-bilious vomiting	Spontaneous reduction
Elizabeth et al. [8]	8	2 months	12 months	Right	Indirect hernia + scrotal swelling	Herniotomy and Repositioning of VP shunt tube were done.
Ozveren et al. [9]	9	3 days	24 hours	Bilateral	Scrotal swelling	Herniotomy and repositioning
Fuwa et al. [10]	10	22 days	1 year	Left	Scrotal swelling + bulging of the scalp	Herniotomy + repositioning + shunt revision
Oktem et al. [11]	11	10 months	6 months	Right	Scrotal swelling	Repositioning + processes 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	

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 processes vaginalis upon shunt insertion in the pediatric population to decrease the risk of catheter migration?.

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Manuscript Information: Received: December 01, 2023; Accepted: December 27, 2023; Published: December 29, 2023

Authors Information: Houssein Darwish*; Sarah kawtharani; Mohamad Housheimy; Hiba Fadlallah; Charbel Moussallem; Marwan Najjar*
Neurosurgery Division, American University of Beirut Medical Center, Lebanon.

Citation: Darwish H, kawtharani S, Housheimy M, Fadlallah H, Moussallem C, Najjar M, et al. 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. Open J Clin Med Case Rep. 2023; 2179.

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