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Migration of A Ventriculoperitoneal Shunt into An Inguinal Hernia Sac in An Infant. A Case Report and Review of The Literature

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1. Abstract

Hydrocephalus is a common congenital malformation, and ventriculoperitoneal shunts are commonly used in the treatment of hydrocephalus. Ventriculoperitoneal shunt or catheter migration to various body sites has been reported. We report a 7-month male infant in whom a shunt catheter migrated through an inguinal hernia into the scrotum. The Complications of Ventriculoperitoneal shunt are also reviewed.

2. Introduction

Insertion of ventriculoperitoneal shunt is the most used method to treat hydrocephalus. Normally, the proximal end of the shunt is placed in the ventricle, and the distal end is placed into the abdominal cavity. The Ventriculoperitoneal shunt drains excess cerebrospinal fluid into the peritoneal cavity, where it is absorbed. This relieves the intraventricular pressure and decreases the pressure on the brain. The ventriculoperitoneal shunt is known to be associated with complications. One of the rare complications of ventriculoperitoneal shunt is shunt migration. Shunt migration into a hernial sac is one of these complications but shunt migration is very rare and migration to unusual sites were also reported [1-13].These include shunt migration causing bowel perforation [14,-16], migration of ventriculoperitoneal shunt per anus [16-22], urethral migration of a ventriculoperitoneal shunt [23-25], transvaginal shunt migration [26,27], intracardiac migration of the shunt [28,29], shunt migration into the pulmonary vasculature [30-32], shunt migration into rectus femoris muscle [33], shunt migration to the breast [34,35], migration of the shunt into the chest [36,37] and pseudocyst formation [38,39].

This report describes an infant who presented with irreducible right inguinal hernia and was discovered to have a ventriculoperitoneal shunt that has migrated into a hernial sac. The Ventriculoperitoneal shunt complications are also discussed.

3. Case Report

A 7-month-old male infant presented to the emergency room with an irreducible right inguinal swelling. He was also complaining of left inguinal swelling for 2 months. According to the parents both swellings were reducible before, but they noticed that the right one became irreducible 5 hours prior to presentation. He is a known case of hydrocephalus and had ventriculoperitoneal shunt placed at the age of one month.

Clinically, he was found to have left inguino-scrotal swelling and a small reducible umbilical hernia. The left inguino-scrotal swelling was a communicating hydrocele. He was also found to have right irreducible inguinal hernia. The hernial sac contained a firm structure, most likely part of the ventriculoperitoneal shunt. He was operated on and underwent left inguinal herniotomy to close the patent processus vagninalis. On the right side, the hernial sac was found to contain part of the ventriculoperitoneal shunt (Figures 1 and 2). This was manipulated and reduced back into the peritoneal cavity. On both sides, the hernial sacs were dissected till the deep inguinal ring and closed with non-absorbable sutures to avoid recurrence because of increased intraabdominal pressure. Postoperatively, he did well and was discharged home on the second postoperative day.

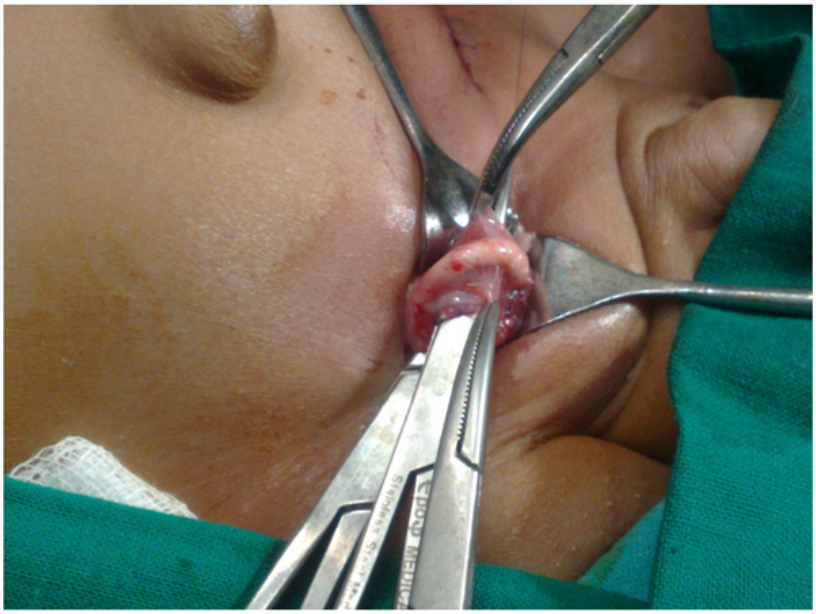

Figure 1: Intraoperative photograph showing the ventriculoperitoneal shunt within the hernial sac. Note the already repaired and closed patent processus vaginalis on the left side.

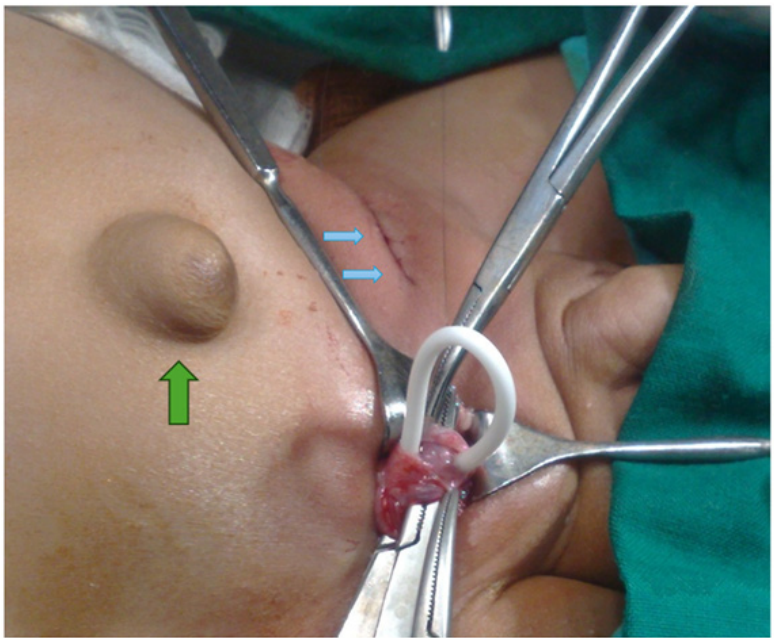

Figure 2: Intraoperative photograph showing the ventriculoperitoneal shunt protruding from the already opened hernial sac. Note the already repaired and closed patent processus vaginalis on the left side. Note also the associated umbilical hernia.

4. Discussion

The term hydrocephalus is derived from the Greek words "hydro" meaning water and "cephalus" meaning head. Hydrocephalus is a clinical condition which develops because of over-accumulation of cerebrospinal fluid within the cerebral ventricular system. The etiologies of hydrocephalus are variable, and the clinical presentation include headache, drowsiness, confusion, disorientation, irritability, decreased appetite, nausea, vomiting and vision changes. The aim of treatment is to divert the accumulated cerebrospinal fluid to another location via a shunt to reduce the intraventricular pressure. There are several types of shunts which include the ventriculoperitoneal shunt, ventriculopleural shunt, and ventriculoatrial shunt [40,41]. Cerebrospinal fluid shunt operation was first performed in 1908 by Kausch [42] and since then ventriculoperitoneal shunts (VP) have remained the method of choice to treat hydrocephalus. In a VP shunt, the proximal catheter drains excess cerebrospinal fluid (CSF) from the ventricles of the brain, while the distal catheter is tunnelled subcutaneously through the anterior or anterolateral chest wall and into the subcutaneous tissues of the abdomen to enter the peritoneal cavity. It typically enters the peritoneal cavity in the right or left lower quadrant of the abdomen, where the CSF is absorbed by the body. Ventriculoperitoneal shunts are one of the most common surgical procedures performed in neurosurgery and are easy to perform but they are not without complications.

Hydrocephalus is a condition associated with excessive accumulation of cerebrospinal fluid (CSF) in the brain, and this can develop because of several causes. Diversion of the excess CSF

is the treatment of choice. This is done via a shunt which can be a ventriculoperitoneal, theco-peritoneal, ventriculoatrial, or ventriculopleural shunts [40,41]. The ventriculoperitoneal shunt is a commonly performed operation to treat hydrocephalus. The distal end of the shunt is placed in the peritoneal cavity because the peritoneal epithelium has a high potential for fluid absorption and thus makes it an ideal place for CSF shunting. The ventriculopleural shunt, and ventriculoatrial shunt are less commonly used. Although the pleura is a good absorbative surface, significant hydrothorax may develop and, in more serious cases, this can result in cardiopulmonary compromise. Ventriculoatrial shunt is not a preferred procedure due to the potential for bloodstream infection and thrombosis. The ventriculoperitoneal shunts are known to have complications. Most of these complications occur within the first year of placement and up to 80% of patients require at least one shunt revision over the course of their lifetime (40, 41). The reported complications associated with ventriculoperitoneal shunts include infection, obstruction, breakage, pseudocyst formation, intestinal obstruction, intestinal perforation, incisional hernia, and catheter migration [1-7,40,41].

Ventriculoperitoneal shunt complications are not rare. It has been reported that up to 40% of VP shunts fail within a year of placement, requiring correction. Ventriculoperitoneal shunt complications occur more often in patients within the first year of placement and are seen in approximately 17-33% of VP shunts [42,43]. A 24-47% complication rate was reported, and shunt obstruction is by far the most common cause of shunt malfunction. Infection is the second most common cause of shunt malfunction, with a reported rate of approximately 8–15% among patients who undergo VP shunt placement [44-46].

The risk of abdominal complications associated with ventriculoperitoneal shunt is about 25%, and incidence of bowel perforation with protrusion of ventriculoperitoneal shunt per anus is about 0.1–0.7% [47,48]. Bowel perforation is a rare but serious complication of ventriculoperitoneal shunt. It has high mortality rate of around 15% [49,50], and this serious complication carries a risk of ascending infection to the brain causing meningitis, encephalitis, or brain abscess [14,15,49,50].

Ventriculoperitoneal shunt is one of the common procedures used in infants, children and adults to treat hydrocephalous. The shunt is known to be associated with many complications like obstruction, infection, migration, and separation from the connected site. In one study of 64 paediatric patients followed over 15 years, only 15.5% of patients did not require a revision during the follow up period, and 17.3% of patients required 3 or more revisions [51].

Ventriculoperitoneal shunt-related complications are broadly classified into the mechanical and nonmechanical complications [52,53]. The mechanical complications include shunt obstruction, disconnection, and migration. The nonmechanical complications include infection, pseudocyst formation, ascites, and pleural effusion. The shunt migration is estimated to occur in 1 in 1000 patients who have undergone a shunt procedure [52,53]. This is relatively uncommon when compared with the other shunt-related complications such as infection or shunt obstruction. Migration of ventriculoperitoneal shunt is also classified as total where the entire shunt migrates and partial where either the distal or proximal part of the shunt migrate. In this context the terms cranial (upward) and caudal (downward) migration would refer only to situations where there is migration of the entire shunt system. In general, caudal migration is more common than cranial migration. The incidence of caudal migration is around 10% [52,53]. Caudal migrations are usually asymptomatic, whereas cranial migrations are usually symptomatic. Shunt migrations may also be classified based on their clinical presentation into two types, symptomatic or asymptomatic.

VP shunt complications are also divided into 2 broad categories: mechanical failure and infection [52,53]. Mechanical failure includes equipment failure, breakage, obstruction, and migration of either proximal or distal catheter tip. These complications range from very minor ones to major complications and despite advancements in surgical techniques, asepsis and the use of prophylactic antibiotics, some complications still occur.

Shunt migration, though rare, is a well-described complication and accounts for 7% of all complications. The prevalence of VP shunt infection is variable, reported at 2%-38%, which may lead to abscess formation [47,48, 52,53]. Shunt migration is a relatively rare complication and usually occurs when the distal segment of the shunt migrates within the peritoneal cavity, thorax, abdominal wall, or pelvis. CSF can accumulate in these areas and form a pseudocyst [54,55]. Shunt migration frequently involves the thoracic cavity and can cause pleural effusions, hydrothorax, pneumonia, and pneumothorax. VP shunts have also been reported to migrate into breast tissue. This has been associated with complications, such as shunt dysfunction, breast CSF pseudocysts, CSF nipple discharge, breast swelling, migration into breast implant cavity for those with breast augmentation, and implant rupture [34-37].

Distal migration of ventriculoperitoneal shunt to the scrotum is an unusual complication and can be associated with serious implications [1-5]. Scrotal migration is more common in children and usually occurs within the first few months after shunt placement and most cases reported developed migration to the scrotum within the first 6 months after surgery. There are several reported factors that make paediatric patients particularly vulnerable to ventriculoperitoneal shunt migration to the scrotum. These factors include rapid physical growth and weight gain, higher physical activity, and differences in abdominal wall structure and compliance [1-7]. The presence of patent processus vaginalis, which can act as a pathway for the catheter to move from the peritoneal cavity to the scrotum, is an important anatomical factor. The processus vaginalis remains patent in up to 80–90% of infants born preterm and in approximately 20–30% of full-term infants. Many children with ventriculoperitoneal shunt and patent processus vaginalis present with hydroceles which can

be unilateral but more commonly bilateral. This is attributed to an increase in the abdominal pressure due to CSF draining from the ventricles into the peritoneal cavity through the shunt. This increase in the intraabdominal pressure may prevent the obliteration of the processus vaginalis. Add to this the chronic catheter irritation and fluid flow from the shunt. Scrotal migration of a ventriculoperitoneal shunt typically presents with a palpable mass in the scrotum. This mass may be tender and associated with pain or discomfort. In some cases, the patients may experience symptoms of increased pressure in the hydrocephalus, such as headache, vomiting, altered vision or altered mental status. These patients commonly present with scrotal swelling, scrotal pain, edema, and sometimes superadded infection. This migration may also affect the testes and compromise their vascularity.

The management of scrotal ventriculoperitoneal shunt migration depends on the clinical presentation and the extent of ventriculoperitoneal shunt migration. In patients without significant abdominal complications and minimal scrotal shunt migration, mobilizing and repositioning of the shunt back into the peritoneal cavity is the treatment of choice. This approach is simple and generally has a low complication rate. However, in cases of complete ventriculoperitoneal migration or significant obstruction, a more complex surgical procedure may be necessary, such as shunt revision or replacement. The recurrence rate of ventriculoperitoneal shunt migration is not known. To avoid recurrence, we advocate closing the processus vaginalis with non-absorbable sutures. In these patients, there is a high chance of finding a patent processus vaginalis on the contralateral side and once the affected side is closed, there is ahigh chance and because of high intraabdominal pressure, there other processus vaginalis will open. To avoid the possibility of developing a contralateral shunt migration, we advocated exploring the contralateral side and closing the processus vaginalis with non-absorbable sutures. Our patient presented with a right-side migration of the ventriculoperitoneal to the scrotum, but he also presented with a left side hydrocele because of patent processus virginals. Exploring the contralateral side and closing the patent processus vaginalis is a simple operation and this will prevent the possibility of subsequent operation which may be complicated. Currently, this can be done laparoscopically. Through the laparoscopic approach, not only can the shunt be retrieved and repositioned into the peritoneal cavity, but both processes vaginalis can be closed simultaneously [56,57,58].

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