Migration of a Distal Ventriculoperitoneal Shunt Catheter Into the Internal Jugular Vein and Heart Through the External Jugular Vein
—Case Report—

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Abstract

A 6-year-old boy had undergone ventriculoperitoneal (VP) shunt for acute hydrocephalus because of a brain tumor at the age of 11 months, and presented with vomiting and somnolence after the shunt malfunctioned 6 days after VP shunt reconstruction, during which the right external jugular vein was injured during the tunneling process and the peritoneal catheter was not fixed to the peritoneum with a purse string suture. Radiography revealed an abnormal route of the peritoneal catheter, suggesting that the distal VP shunt catheter had migrated into venous vasculature through the right external jugular vein. Computed tomography revealed that the peritoneal catheter had migrated into the internal jugular vein and the right atrium. At surgery, the peritoneal catheter was exposed through a small incision on the subclavicular region, was easily extracted from the internal jugular vein and the heart as there was no coiling or adhesion of the distal catheter to the vascular tissues, and was repositioned into the internal jugular vein and the heart through the external jugular vein with weak fixing between the subcutaneous tissues of the right subclavicular region and the right abdominal rectus muscle fascia as a temporary emergency measure. Peritoneal shunt migration into the internal jugular vein and the heart through the external jugular vein can be lethal because of pulmonary infarction or arrhythmia, and must be detected as soon as possible. Periodic follow-up radiography should be scheduled after VP shunt placement, even in the absence of symptoms.

Key words: ventriculoperitoneal shunt, shunt migration, internal jugular vein, heart, pediatric surgery

Introduction

Ventriculoperitoneal (VP) shunting is the most common and effective surgical treatment for hydrocephalus. However, unusual complications can result, including migration of the peritoneal end of the shunt catheter into various sites outside the peritoneal cavity. Migration of the VP shunt catheter into the heart and pulmonary artery is rare, with only 11 cases previously reported. Here, we report a case of migration of the peritoneal shunt catheter into the internal jugular vein (IJV) and the heart through the external jugular vein (EJV), and discuss the potential mechanisms of migration.

Case Report

A 6-year-old boy who had received a VP shunt for acute hydrocephalus because of a brain tumor at the age of 11
months was admitted to our hospital for VP shunt reconstruction involving peritoneal catheter revision and lengthening. The reconstruction of the VP shunt was performed under general anesthesia on August 6, 2006. At surgery, with extension and rotation of the neck to the left in the supine position, the right EJV could be clearly identified because of congestion with blood (Fig. 1). Although the right EJV was injured during the subcutaneous tunneling procedure over the right EJV, bleeding was easily stopped by compression of the right EJV. The peritoneal catheter was not fixed to the peritoneum with a purse string suture. Postoperative chest and abdominal radiography confirmed the correct peritoneal catheter position.

On August 15, 2006 (6 days after the surgery), the patient suffered severe vomiting at midnight and somnolence early in the morning. Computed tomography (CT) revealed dilation of the ventricles. The diagnosis was acute hydrocephalus. The patient's consciousness disturbance quickly disappeared after acute drainage of cerebrospinal fluid from the reservoir. Radiography revealed that the path of the peritoneal catheter was abnormal (Fig. 2) and that the end of the tip of the peritoneal catheter was located out of the peritoneum and in the upper right quadrant of the abdomen, suggesting that the distal VP shunt catheter had migrated into the venous vasculature through the right EJV. CT revealed that the peritoneal catheter had migrated into the IJV and the heart (Fig. 3).

Emergency surgery was performed on the same day to reposition the peritoneal catheter. At surgery, the peritoneal catheter was gently and slowly extracted from the IJV and the heart through a small incision on the right subclavicular region, which was easily achieved without resistance. The peritoneal catheter was repositioned into the peritoneum and weakly fixed to the subcutaneous tissues of the right subclavicular region and the right abdominal rectus muscle fascia as a temporary emergency measure. Postoperative chest and abdominal radiography confirmed correct catheter position. No migration of the shunt has occurred over 3 years follow up.

Discussion

Twelve cases of distal VP shunt catheter migration into the pulmonary artery have been reported since the first case in 1994 (Table 1). Our case differs from the 11 previous cases in the upward migration of the distal VP shunt catheter against the venous flow. The distal VP shunt catheter entered the right EJV, passed through the superior vena cava to the right atrium, looped superiorly, and ascended back to the right IJV against the venous flow, then looped inferiorly again, exited, and continued to the right upper abdominal region. The windlass effect for distal VP shunt catheters caused by motion of the head and neck results in rare upward migration of the distal VP shunt catheter into the subgaleal space. Thus, in our case, the upward migration of the distal VP shunt catheter into the right IJV against the venous flow may have been caused by flexion, extension, and rotation of the neck.
Migration of a Peritoneal Catheter

Table 1 Reported cases of migration of a distal ventriculoperitoneal (VP) shunt catheter into the heart or pulmonary artery (PA)

<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Age (yrs) at shunt operation</th>
<th>Time until migration</th>
<th>Migration</th>
<th>Symptoms</th>
<th>Neck vessel</th>
<th>Operation to remove distal catheter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morell et al. (1994)</td>
<td>8 yrs</td>
<td>4 yrs</td>
<td>PA</td>
<td>headache, vomiting, hypertension</td>
<td>NR</td>
<td>RAI, IVR</td>
</tr>
<tr>
<td>Kang et al. (1996)</td>
<td>12 mos</td>
<td>2 mos</td>
<td>heart</td>
<td>headache, vomiting, hypertension</td>
<td>NR (rt EJV)</td>
<td>open thoracotomy</td>
</tr>
<tr>
<td>Frazier et al. (2002)</td>
<td>14 mos</td>
<td>1 mo</td>
<td>heart</td>
<td>hypertension</td>
<td>rt IJV</td>
<td>CI, FSG</td>
</tr>
<tr>
<td>Imamura and Nomura (2002)</td>
<td>76 yrs</td>
<td>18 days</td>
<td>heart</td>
<td>none</td>
<td>rt IJV</td>
<td>CI</td>
</tr>
<tr>
<td>Kubo et al. (2002)</td>
<td>48 yrs</td>
<td>1 mo</td>
<td>PA</td>
<td>neck pain</td>
<td>rt EJV</td>
<td>CI</td>
</tr>
<tr>
<td>Fewel and Garton (2004)</td>
<td>16 yrs</td>
<td>33 days (2 days)*</td>
<td>heart</td>
<td>seizure</td>
<td>rt EJV</td>
<td>RAI, FSG</td>
</tr>
<tr>
<td>Kim et al. (2005)</td>
<td>70 yrs</td>
<td>2 mos (21 days)**</td>
<td>heart</td>
<td>gait disturbance, urinary incontinence, abdominal pain</td>
<td>rt IJV</td>
<td>RAI</td>
</tr>
<tr>
<td>Chong et al. (2008)</td>
<td>68 yrs</td>
<td>14 days (2 days)*</td>
<td>heart</td>
<td>fever, headache</td>
<td>rt IJV</td>
<td>intravascular guided snare</td>
</tr>
<tr>
<td>Hermann et al. (2009)</td>
<td>51 yrs</td>
<td>5 mos</td>
<td>PA</td>
<td>respiratory distress</td>
<td>rt EJV</td>
<td>RAI</td>
</tr>
<tr>
<td>Rizk et al. (2009)</td>
<td>6 yrs</td>
<td>18 days</td>
<td>heart</td>
<td>“butterflies in my chest”</td>
<td>rt IJV</td>
<td>RAI</td>
</tr>
<tr>
<td>Present case</td>
<td>6 yrs</td>
<td>6 mos</td>
<td>heart, rt IJV</td>
<td>vomiting, somnolence</td>
<td>rt EJV</td>
<td>SCI</td>
</tr>
</tbody>
</table>


Such upward migration of the distal VP shunt catheter against the venous flow is unique.

Migration of the distal VP shunt catheter into the heart or pulmonary artery is more common in children, with 7 of the 12 reported cases, including the present case, occurring in patients aged 16 years or younger. There was no obvious difference in the rates of occurrence of perforation of the catheter into the neck vessels in the EJV and the IJV. Only 4 of the 12 reported cases exhibited typical symptoms of obstructed hydrocephalus. Pulmonary failure, palpitation-like symptoms, hypertension, convulsion, or fever were observed as atypical symptoms of hydrocephalus in many of these cases. An asymptomatic case was also reported, so careful follow up is required after VP shunting.

Negative inspirational pressure and venous flow were common important factors in the previous 11 cases, but the reason for the migration of the distal VP shunt catheter into the neck veins remains unknown. It is possible that the distal VP shunt catheter continuously erodes the wall, and finally enters the jugular vein. However, venous injury during tunneling by a passer occurred in 6 of the 12 reported cases. Venous bleeding during tunneling by a passer was previously reported and occurred in the present case. The IJV may be perforated by a passer without bleeding as visualized by three-dimensional CT angiography. A kink of the distal VP shunt catheter in the neck was found 2 days after surgery, suggesting that the distal VP shunt catheter had begun to migrate into the vessels. Venous injury without bleeding by a passer might have occurred in these two cases, because the kink of the catheter occurred early after the surgery. Therefore, iatrogenic perforation of the EJV or IJV by a passer during tunneling would allow a distal catheter to migrate into the jugular veins in most cases.

In our case, the right EJV was located near the surface beneath the platysma in the neck, and crossed the route of the shunt passer. Routing of the shunt passer near the right EJV in the neck during the VP shunt procedure could not be avoided. Further, the passer used in our current case was too worn to sharply penetrate into the subcutaneous tissues. Consequently, the right EJV could be injured with much crushing of the subcutaneous tissues, and the right EJV might have been injured with crushing of the subcutaneous tissues during the VP shunt procedure. Therefore, the tunneling procedure must not be performed through using a worn passer. Another factor might be that subcutaneous re-tunneling near the right EJV caused the distal VP shunt catheter to adhere unexpectedly to the right EJV, resulting in erosion of the wall and finally penetration. Therefore, great care in the reconstruction of the VP shunt procedure on the same side is essential.

Although the perforated right EJV should be treated through a subcutaneous re-tunneling procedure at a site rostral to the perforated right EJV in the current case, the subcutaneous re-tunneling procedure could not be performed without re-injuring the right EJV by the same.
worn-out passer. Using the same worn-out passer in the subcutaneous re-tunneling procedure, much severer re-injury and obstruction of the right EJV would occur, or incorrect subcutaneous passage during a re-tunneling procedure to avoid re-injuring the right EJV would cause perforation into the thorax. At surgery, the distal catheter could be easily withdrawn through a subclavicular incision, and then was replaced into the intraperitoneal cavity with weak fixing to the subcutaneous tissue of the right subclavicular region and the rectus muscle fascia as a temporary emergency measure, without re-tunneling under the subcutaneous tissue. Without treatment of the perforated right EJV, migration of a distal catheter into the right EJV had not reoccurred during 3 years follow up. Therefore, the treatment method in the current case may not be ideal, but was better than using the same worn-out passer.

Eight of the 12 reported cases could be treated by a simple retrieval or retrieval under fluoroscopic guidance. Three of the 12 reported cases were treated by snare retrieval, as the distal catheter had coiled in, or had adhered to the heart or pulmonary arteries. Only one case was treated by open thoracotomy, but could have been treated by snare retrieval. To treat migration of a distal catheter into the heart or the pulmonary artery, early detection of migration of the distal catheter is important, before the catheter coils in or adheres to the heart or pulmonary artery. Therefore, periodic radiography during follow up should be scheduled after VP shunting, even in the absence of symptoms.

References


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