Case report

Nuclear Medicine to Evaluate Complications of Cerebral Shunts: Two Cases and Review of Literature

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Abstract

We present two cases of cerebral shunts - a ventriculopleural shunt and a ventriculoperitoneal shunt, with their associated complications. We also hope to provide a comprehensive literature review on various imaging modalities, including nuclear medicine studies in evaluating cerebral shunt complications.

Keywords: Abdominal cerebrospinal fluid oma, computed tomography in cerebrospinal fluid collection, cerebrospinal fluid pseudocyst, mass, nuclear medicine in cerebrospinal fluid pseudocyst, pleural effusion in ventriculopleural shunt, ultrasound in cerebrospinal fluid pseudocyst, ventriculoperitoneal shunt complications, ventriculopleural shunt

Introduction

Cerebral shunts are used for a variety of indications, including non communicating hydrocephalus, communicating hydrocephalus, spontaneous intracerebral hemorrhages and spontaneous subarachnoid hemorrhages. Different cerebral shunts are used, including ventriculoperitoneal, ventriculopleural, ventriculoatrial and ventriculourinary shunts. One of the main limiting factors in use of these shunts is the complications arising from them. The complications may be mechanical or functional.

Case Reports

Case 1

Mr. A is a 16-year-old boy with congenital hydrocephalus who presented with left sided chest pain of 2 months duration. The chest pain was insidious in onset, progressive, and pressure-like. Initially, he had a ventriculoperitoneal (VP) shunt placed which drained into his peritoneal cavity. This shunt ruptured and was replaced with a ventriculopleural shunt that drained into his left pleural cavity [Figure 1a and 1b]. The patient got a chest X-ray done, which showed a left-sided pleural effusion and left basilar atelectasis [Figure 2]. An ultrasound of his chest showed a large left pleural effusion without evidence of loculations [Figure 3]. Computed tomography (CT) scan of the chest confirmed the shunt in the left lower posterior pleural space with the pleural effusion [Figure 4a-4c]. A nuclear medicine scan was performed with technetium 99m MAA, which showed radiotracer uptake in the reservoir of the shunt and the left pleural space [Figure 5]. The patient was treated surgically with thoracentesis and continued to do well.

Case 2

Mr. B is 29-year-old male with a history of obstructive hydrocephalus, and a ventriculoperitonal shunt placement [Figure 6] came in with complaints of abdominal pain of 6 days duration with a 3 day history of nausea and vomiting. He had an abdominal X-ray which was inconclusive [Figure 7]. An ultrasound of his abdomen showed a large loculated, hypoechoic fluid collection extending from his xiphoid process to just below the umbilicus with a portion of the VP shunt inside [Figure 8a and 8b]. He had a CT scan of his abdomen and pelvis which showed a large fluid collection containing a portion of the VP shunt inside [Figure 9a and 9b]. He got a nuclear medicine

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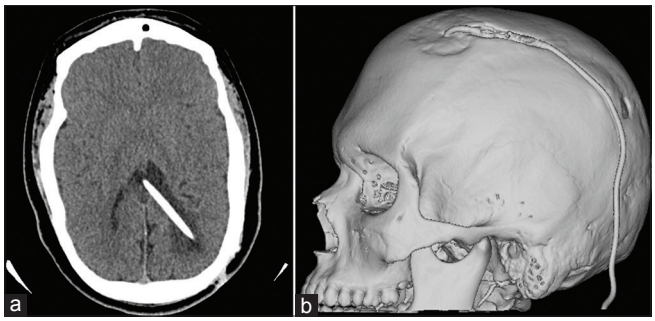

Figure 1: (a) Axial image of computed tomography scan of brain without contrast with dysmorphic lateral ventricles are noted with a shunt catheter in place in patient A. (b) Three-dimensional rendering from computed tomography images of the head of the cerebral shunt in patient A

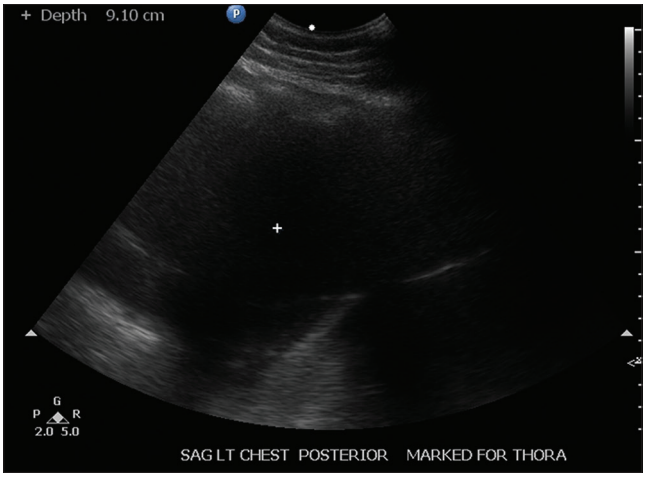

Figure 3: Ultrasound image of the thorax depicting the left sided pleural effusion

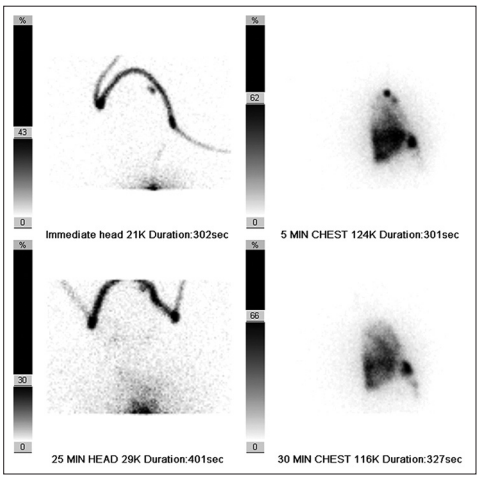

Figure 5: Nuclear medicine images with technetium 99m MAA. Planar images of the head and chest immediately after injection and delayed planar images. Radiotracer was seen throughout the left pleural space

scan with technetium diethylene-triamine-pentaacetate which showed ventriculomegaly and free spill of contrast into the peritoneal cavity [Figure 10]. The patient was

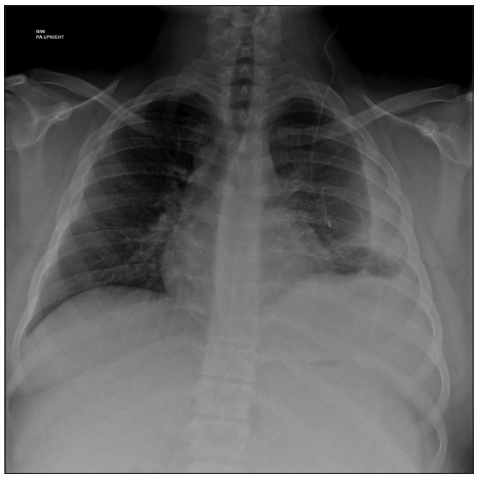

Figure 2: Anteroposterior plain radiograph of the chest depicting a ventriculopleural shunt, left pleural effusion and left basilar atelectasis

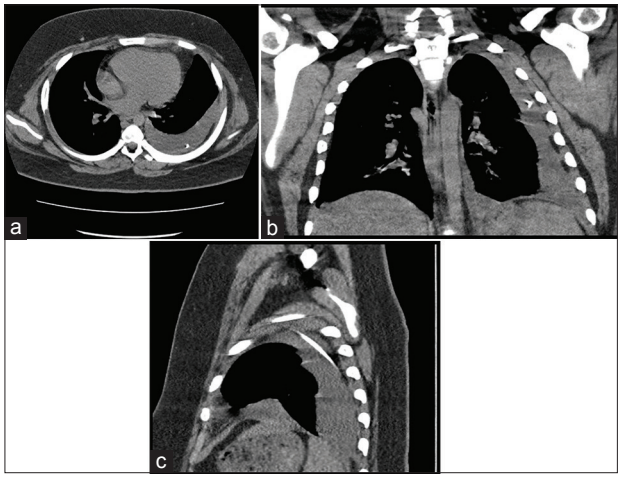

Figure 4: Computed tomography without contrast of the chest showing a left sided pleural effusion with the ventriculopleural shunt catheter entering the pleural cavity at the anterior apex of the lung and its tip in the left lower posterior pleural space. (a) Axial view. (b) Coronal view. (c) Sagittal view

treated surgically and got his VP shunt replaced with a ventriculoatrial shunt.

Discussion

Cerebral shunts are used for a variety of indications. These include noncommunicating hydrocephalus, communicating hydrocephalus, spontaneous intracerebral hemorrhages, and spontaneous subarachnoid hemorrhages.[1] Cochrane and Kestle talk about three different locations for cerebral shunt placement-namely VP shunts, ventriculopleural shunts and ventriculoatrial shunts.[2] Less commonly, ventriculourinary shunts are used. The most commonly used shunt is a VP one.[1]

Ventriculoperitoneal shunts are preferred over the other routes due to various reasons, including ease of placement

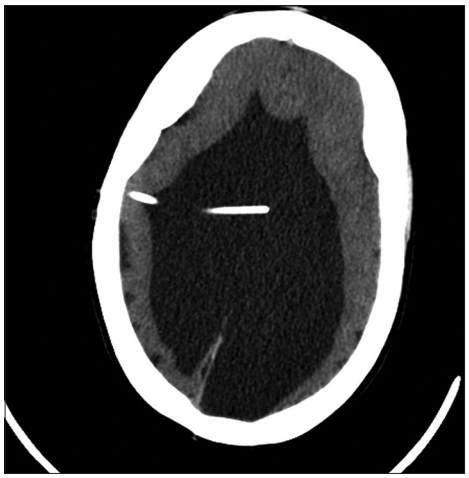

Figure 6: Computed tomography brain without contrast showing ventriculomegaly with an interventricular shunt. Also noted are callosal dysgenesis and absent septum pellucidum

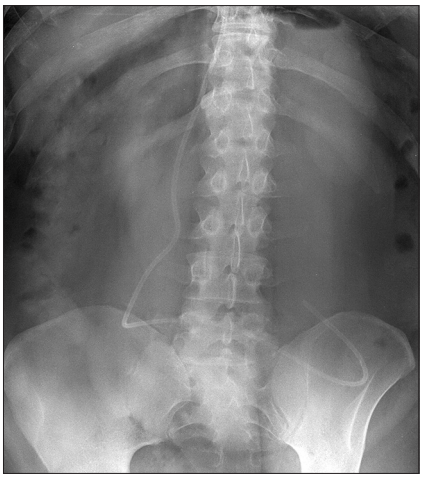

Figure 7: Plain radiograph of the abdomen depicting a nonobstructive gas pattern and the ventriculoperitoneal shunt in place

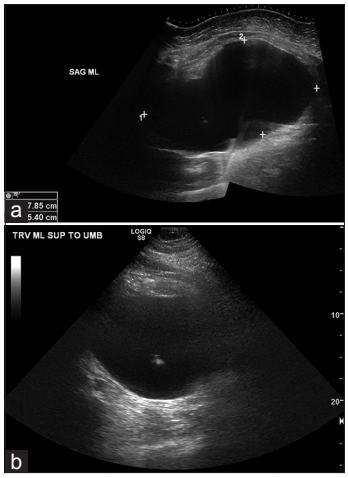

Figure 8: Ultrasound images depicting a large hypoechoic fluid collection extending from the xiphoid process to just below the umbilicus. The collection appears loculated, measuring 27.9 cm × 15.4 cm × 22.5 cm and contains a portion of the ventriculopleural shunt inside. (a) Sagittal view. (b) Transverse view

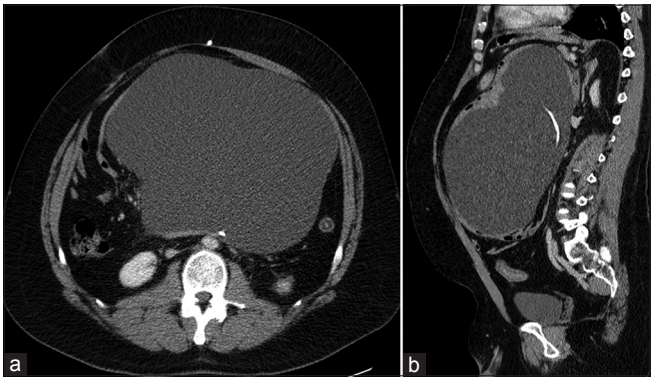

Figure 9: Computed tomography of the abdomen and pelvis with intravenous contrast depicting a fluid collection measuring 27.6 cm × 20.9 cm × 16.9 cm in the abdomen with a portion on the ventriculoperitoneal shunt inside. Also noted is the collapse of the inferior vena cava, likely secondary to the pseudocyst. (a) Axial view. (b) Coronal view

and lesser severity of potential complications.[3] The ventriculopleural shunts can be used as a temporary diversion in cases with contraindications to a VP shunt, until a definitive intracardiac shunt placement is done.[4] The contraindications may include recent abdominal infections.[5]

Overall shunt complications are seen in 24.6% of patients.[6] 45% of overall cerebral shunts require revision at some point of time.[7] VP shunts by themselves have been found to have a complication rate of 32% over a 5-year study period.[8]

Shunt complications can be divided as mechanical complications and functional complications. The mechanical complications include shunt obstruction, breaks, disconnections, migrations, or leakage. Functional complications can include infections, shunt over drainage, decompensated hydrocephalus, intracranial cyst formation, slit ventricle syndrome, cerebrospinal fluid (CSF) pseudocyst formation, or pleural effusions.[6,7,9]

Various diagnostic modalities can be used to evaluate cerebral shunts. Plain X-rays can evaluate shunt disconnections, kinks, breaks, or migration. CT can be used to confirm the findings and also to check for evidence of elevated intracranial pressure such as increased size of the ventricles. Magnetic resonance imaging can be used to evaluate central nervous system infections or hemorrhage. Nuclear studies can be used to evaluate shunt patency. Ultrasonography helps to evaluate the distal end of the shunt. Shunt studies with iodine injection can evaluate for leaks or confirm the site of obstruction.[9]

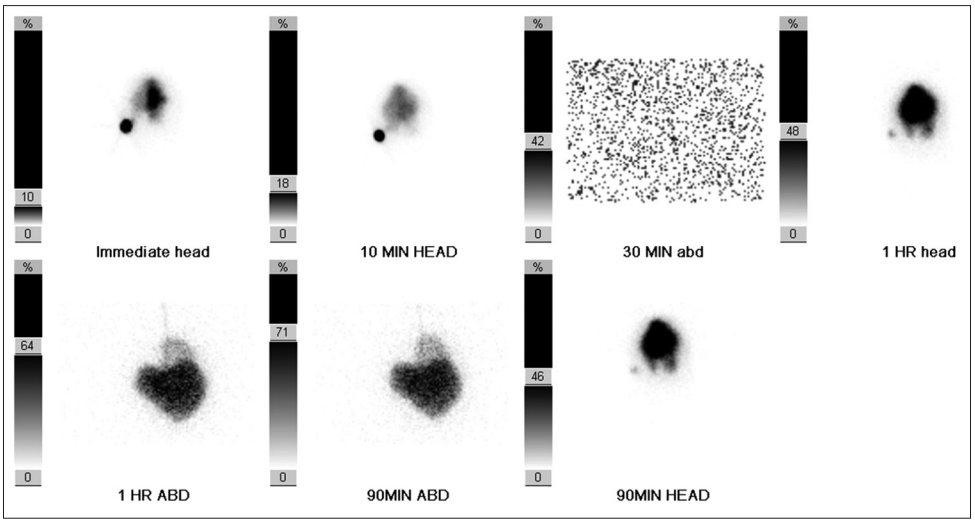

Figure 10: Nuclear medicine images with 99m technetium diethylene-triamine-pentaacetate with ventriculomegaly and free spill of contrast into the peritoneal cavity at 90 min

Overall, shunts have been found to have an infection rate of 8.6%.[2] Most cerebral shunt infections are seen in children 1–6 months of age. Two-thirds of these infections were found to be due to coagulase-negative *Staphylococcus*.[10]

Cerebrospinal fluid pseudocyst formation is one of the complications of a VP shunt. These are further complicated by bowel obstruction and infections.[9] Treatment options for abdominal pseudocyst include-treating infection if any, repositioning the catheter into the peritoneum, repositioning into pleural space, atrium or gallbladder; exploratory laparotomy with adhesion lysis and repositioning the catheter, abdominal pseudocyst aspiration, and shunt removal.[11] We describe a case of VP shunt in which an abdominal CSF pseudocyst was treated with surgical drainage and repositioning of the shunt into atria.

Ventriculopleural shunts can be complicated by minor pneumothoraces and less commonly pleural effusion.[5,12] In our case of a ventriculopleural shunt, our patient developed a pleural effusion which was drained, and the patient did well.

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