



# Shunt fracture as a sequela of cervical spine manipulation: a case report

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Shunt disconnection is an unreported complication of spinal mobilization and manipulation. We present the case of a young adult who underwent cystoperitoneal (CP) shunt placement for an arachnoid cyst at the age of 6 years. The shunt remained functional during a follow-up period of 11 years. The patient was admitted with headache and diplopia that started after cervical manipulation by a chiropractor. Radiography revealed fracture of the distal catheter and resultant enlargement of the temporosylvian cyst. The patient required replacement of the disconnected tubing caudal to the shunt valve. The distal catheter ruptured immediately below the outlet connector of the valve. The symptoms and signs resolved completely after insertion of a new distal tube into the peritoneum. This case report demonstrates that chiropractic manipulation of the neck may be a cause of tubing breakage in patients with CP shunts.

**Keywords:** Arachnoid cysts; Chiropractic; Complications

## Introduction

Spinal manipulation is widely used as an alternative therapy for neck and back pain. This procedure is a passive forced mobilization that can move joint elements beyond their range of motion. Patients typically consider this complementary therapy safe and effective. However, numerous adverse events have been associated with spinal chiropractic treatments, although their reported incidence is low [1].

Cystoperitoneal (CP) shunting is a viable intervention for symptomatic cerebral arachnoid cysts (ACs) owing to its simplicity and rapid achievement of radiological resolution [2]. Nonetheless, fractures or disconnections are common causes of mechanical dysfunction in shunted patients [3]. Shunt failure associated with chi-

ropractic trauma to the hardware has not been documented previously. This study aimed to illustrate the rare occurrence of a shunt fracture after cervical manipulation in a young adult with a CP shunt for Sylvian AC.

## Case

**Ethical statements:** This study was reviewed and approved by the Institutional Review Board (IRB) of Keimyung University Dongsan Hospital (IRB No: 2023-02-023). Written informed consent was obtained from the patient to participate in the study.

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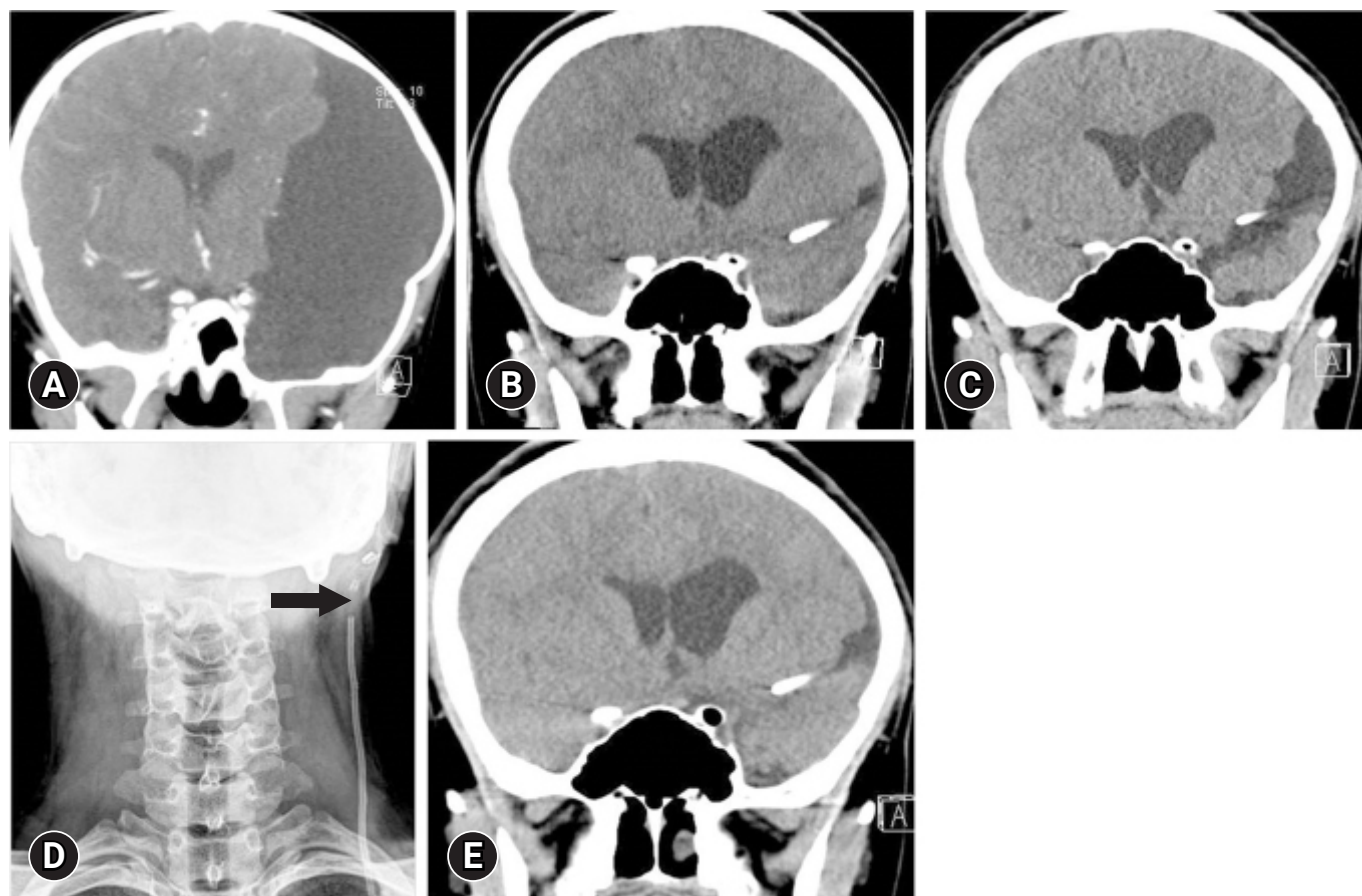
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A 17-year-old male patient complained of progressive headache and double vision with subacute onset. At 6 years of age, the patient underwent CP shunt placement for a large AC in the left Sylvian fissure (Fig. 1A). A Strata system (Medtronic, Goleta, CA, USA) with a programmable pressure valve was placed at the temporal squama. Computed tomography (CT) revealed cyst volume reduction and a return to more normal temporosylvian anatomy (Fig. 1B). The shunt had remained patent prior to the current admission. However, the patient recently visited a chiropractor to relieve cervical discomfort. Manipulation therapy was administered to the implantation site in the occiput and neck for approximately 6 weeks. The patient reported having been subjected to cervical traction and rotational head movements. The last session was performed 1 week before visiting the emergency department.

The patient had partial palsy of the left lateral rectus. A pumping test of the reservoir yielded good refilling. CT confirmed enlargement of the temporal cyst compared to previous control scans

(Fig. 1C). Segmental calcification in the shunt tubing was observed near the collarbone on the radiograph. This clearly revealed a catheter fracture immediately below the outlet connector of the valve (Fig. 1D). The opening pressure was 38 cmH<sub>2</sub>O during lumbar puncture in the lateral decubitus position. Laboratory investigations of the blood and cerebrospinal fluid failed to reveal any acute abnormalities.

The patient was immediately transferred to the operating room. The cranial end of the shunt tube was found to be broken and positioned caudal to the valve. A small amount of fluid was observed around the fibrous sheath at the disconnection. The operator identified a 14-mm gap between the two ends of the disconnected catheter. Clear fluid flowed freely from the shunt reservoir. The aged tubing was exteriorized by making short incisions perpendicular to the prior shunt tract. A shunt tunnel was created, and a new peritoneal catheter was inserted. Postoperatively, efficient operation of the shunt system was confirmed by head CT (Fig. 1E). The



**Fig. 1.** Fracture of cystoperitoneal (CP) shunt following cervical chiropractic therapy. (A) An enhanced coronal computed tomography (CT) image shows a large arachnoid cyst with remarkable mass effect. (B) Head CT taken 2 years after the CP shunt reveals disappearance of the Sylvian cyst. (C) Admission CT scan depicts a regrowing cyst and its mass effect on the cerebral cortex. (D) Neck X-ray discloses breakage of the shunt tubing at its cervical portion (arrow). (E) There is complete resolution of the cyst recurrence following the revision shunt surgery.

patient showed symptomatic improvement over the next 15 days.

## Discussion

Shunt fractures result from calcification, fibrosis, and tethering within tissues, which predispose the catheter to rupture when biomechanical tension is applied [3]. A follow-up study showed that aged implants become fragile within an average of 5 years after the appearance of calcification in pediatric patients [4]. Tubing fractures occur most often in children when their height increases rapidly. During a growth spurt, the distal component is subjected to maximal traction at the connection between the shunt valve and anchoring at the peritoneal wall. In most cases of growth-related strain on the hardware, fractures of the shunt tubing are located just proximal to the clavicle in the neck [5]. Characteristically, however, the drainage tube was broken far from the common location of its disconnection, and shunt calcification was not observed at the fracture site for the current case.

Common clinical features related to underdrainage due to fractured shunts include headache, vomiting, visual impairment, drowsiness, and gait disturbance [6]. In rare cases, delayed presentation of headache may raise the possibility of shunt dependency syndrome in patients with shunted ACs without tubing fractures [7]. Patients may also present with redness, pain, or fluid over the shunt pathway at the site of the fracture or disconnection [3-5]. Infrequently, the presence of a fibrous sheath enveloping the distal passage explains why the shunt system remains functional even when it is fractured and disconnected [8]. Tubing discontinuation can be considered when there is evidence of anatomical changes in the shunt system, cerebral cysts, or the ventricular system. In addition, the broken shunt no longer functions and can potentially move upward or downward into the extraperitoneal spaces.

Patients with fractured shunts must undergo reoperation, the timing of which is mainly dictated by their neurological status [3,6]. Surgical revision is performed on an urgent schedule in patients with increased intracranial pressure, as in the present case. In particular, open or endoscopic cyst fenestration could be considered as the first-line option for selected dysfunctional CP shunts when opening the cyst to the basal cisterns is possible. This internal drainage can leave the patient shunt-independent, and it may be followed by external shunting, if indicated [9].

Cervical manipulations consist of a series of forced and repetitive adjustments involving the combined motions of flexion, extension, rotation, or lateral flexion of a definite vertebral segment [1]. Chiropractic therapy is potentially harmful to patients even when each session is administered by a qualified professional. Despite this, radiological screening of this patient's underlying comorbidities

was not performed before spinal manipulation. Sudden thrust or high-velocity, low-amplitude manipulations applied to certain areas of the neck are often considered the cause of untoward reactions to chiropractic mobilization [10]. Although rare, this approach has given rise to complications, such as cervical radiculopathy, stroke, cervical arterial dissection, spinal cord injury, intracranial hypotension, retinal hemorrhage, vertebral fracture, spinal epidural hematoma, and retinal artery occlusion [11,12].

To raise awareness, a better understanding of manipulation-induced complications is essential for both patients and practitioners. In general, a trained chiropractor tends to manipulate the cervical spine in younger patients more vigorously, thereby increasing the risk of iatrogenic injury to indwelling catheters in the head and neck [1,12]. In our patient, a more aggressive therapy was theorized to cause rotation of the extended neck, resulting in extraordinary stress at the potential tethering between the calcified shunt segment and the valve outlet connector. Biomechanically, this enhanced shearing force was a major contributor to the atypical site of rupture at the cervical portion of the distal drainage [13]. We also have found reports of breakage following the application of strain to the shunt during deformity correction with the aid of halo traction and instrumentation in preadolescents and adolescents with neuromuscular scoliosis [14,15]. It is reasonable to assume that the mechanism of fatigue fracture in these reports was the same as that in our patient, who received neck traction and rotation. Therefore, this case report emphasizes that clinicians should carefully monitor young patients with cerebrospinal fluid shunt systems when they have undergone cervical spine chiropractic therapy or realignment of scoliosis.

## Notes

### Conflicts of interest

No potential conflict of interest relevant to this article was reported.

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