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Case Report

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Case Report of a Post-Traumatic Hydrocephalus Patient: Ventriculo-Vesicle Shunt With a Review of the Literature

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ABSTRACT

Post-traumatic hydrocephalus (PTH) is treated through cerebrospinal fluid (CSF) diversion, typically through ventriculoperitoneal shunt (VPS) or other bypass techniques. As these shunts are associated with significant complications and high revision rates in certain populations, it is important to tailor a patient's shunt procedure according to their medical history and complications. Herein, we report the case of a 30-year-old man with PTH following a traffic accident on a motorcycle. VPS was chosen as the method of treatment but required multiple revisions and replacements due to persistent complications such as post-operative infection, shunt obstruction and abdominal problem. As the patient's heart failure and pleural effusion rendered both ventriculopleural and ventriculoatrial shunt not feasible, it was decided to move the shunt to the bladder (ventriculo-vesicle shunt [VVS]) in cooperation with a urologist. Follow-up examinations after about 3 months showed a decrease in ventricle size, improved hydrocephalus, and no complications such as urinary infection or bladder stone formation. In cases where the patient's underlying conditions, such as heart failure and pleural effusion, make it unsuitable to choose the pleural cavity or atrium as non-peritoneal spaces, VVS can be a suitable option for continuous CSF drainage when complications have occurred with the previous VPS.

Keywords: Post-traumatic hydrocephalus; Ventriculoperitoneal shunt

INTRODUCTION

Hydrocephalus, which occurs for various reasons, is treated through cerebrospinal fluid (CSF) diversion. Ventriculoperitoneal shunt (VPS) is the most common procedure, and there are other CSF bypass techniques including ventriculoatrial, ventriculopleural, and rarely, ventriculo-gallbladder and ventriculo-fallopian shunts. These conventional shunts can exhibit significant complication rates and high revision rates in certain patient groups.[9] Therefore, it is necessary to perform a shunt based on the patient's medical history and complications.

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Conflict of Interest
The authors have no financial conflict of interest.

CSF diversion into the genitourinary system was first performed by Helie in 1925.[6] This study reports a case in which ventriculo-vesicle shunt (VVS) was implemented for the management of complicated conventional shunt.

CASE REPORT

The patient was a 31-year-old male with no significant medical history who was involved in a traffic accident while driving a motorcycle. A computed tomography (CT) scan of the brain revealed an acute subdural hematoma and multiple hemorrhagic contusions in the right frontotemporoparietal area, also Glasgow Coma Scale (GCS) is 8, so decompressive craniectomy was performed on the patient. Following improvements in his condition, the patient received a subsequent cranioplasty and was hospitalized for rehabilitation. The follow-up CT scan of the brain revealed a worsening of hydrocephalus, and a VPS was inserted (**FIGURE 1**). A shunt catheter infection was observed while continuing rehabilitation without any specific complications, and shunt removal was performed. CSF analysis and laboratory findings did not indicate any signs of infection, so shunt re-insertion was performed. Subsequently, conservative treatment was maintained, and the patient's progress was regularly monitored through brain CT scans and abdominal X-rays. Approximately 1 month later, a follow-up brain CT scan showed an increase in ventricle size and abdominal X-ray showed immobilization of the distal shunt catheter tip. An abdominopelvic CT scan was performed, which revealed adhesion of the distal catheter tip (**FIGURE 2**). Consequently, a laparoscopic shunt replacement was performed in cooperation with a general surgeon. Operative findings revealed that the distal catheter tip adhered to the left lower abdominal wall with fibrotic tissue and pseudocyst. CSF drain was confirmed after adhesiolysis and removal of fibrotic tissue and pseudocyst. Two subsequent laparoscopic adhesiolysis and pseudocyst removal procedures were performed to address recurrent adhesions and pseudocysts. Due to persistent complications, it was decided to remove the shunt and plan for a bypass in a location beside the peritoneum. The patient in this case experienced complications including cardiomegaly and cardiac dysfunction due to a long-term bedridden

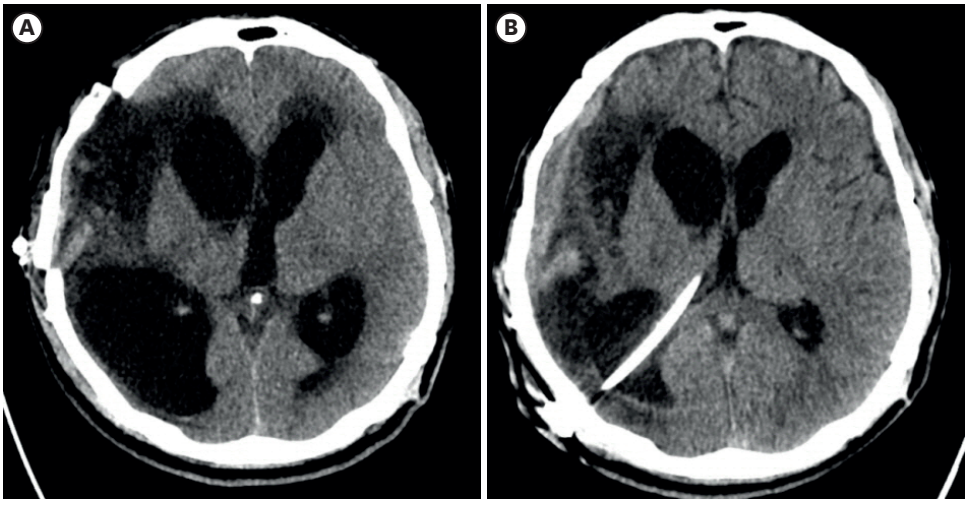

FIGURE 1. Follow-up CT scans before and after ventriculo-peritoneal shunt. (A) Follow up CT scan after cranioplasty about 3 month, (B) 3 days follow up CT scan after ventriculoperitoneal shunt show improved ventriculomegaly.
CT: computed tomography.

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FIGURE 2. Formed pseudocyst adhesion on the distal catheter tip (arrow tip).

condition, and a consequent fluid imbalance led to pleural effusion. Catheter insertion and fluid restriction were implemented for effusion drainage. Choosing the atrium or the pulmonary pleurae as a re-positioning site was deemed unfavorable considering the potential negative impact on CSF absorption and the risk of exacerbating fluid collection. As a result, it was decided to replace the shunt distal tip inside the bladder, and a VVS was performed in cooperation with a urologist (**FIGURE 3**). Subsequently, follow-up examinations including urine analysis and brain CT scans were conducted. The CT scans showed a decrease in ventricle size, hydrocephalus was improved, and no complications such as urinary infection or stone formation were observed in laboratory findings or images (**FIGURE 4**). Currently, the patient has been in rehabilitation without any complications for about 3 months.

DISCUSSION

Post-traumatic hydrocephalus (PTH) is a specific type of hydrocephalus that occurs after traumatic brain injury (TBI). The typical clinical symptoms of hydrocephalus in patients with PTH are often obscured and difficult to distinguish from the sequelae of TBI.[2,8] Thus, the incidence of PTH has been reported to vary widely, ranging from 0.7%–45%.[2]

In a normal pathological state, CSF is produced in the ventricular system of the brain and then reabsorbed into the dural venous sinus. In this case, CSF maintains a balance between its production and reabsorption within the ventricular system. However, this mechanism can become imbalanced after brain injury.[2] In traditional understanding, the cause of acute hydrocephalus is often attributed to the mass effect of a blood clot in the ventricles, which acts to prevent the CSF from flowing out of the brain cavity. In chronic hydrocephalus, inflammation can lead to increased adhesions within the ventricular system, hindering the reabsorption of CSF. Both mechanisms are associated with the development of PTH in patients with TBI.[2,7]

The gold standard for hydrocephalus treatment is shunt insertion to redirect the flow of CSF. Permanent surgical interventions for hydrocephalus include methods that create an opening alleviate obstruction such as endoscopic third ventriculostomy, and shunt insertion, which

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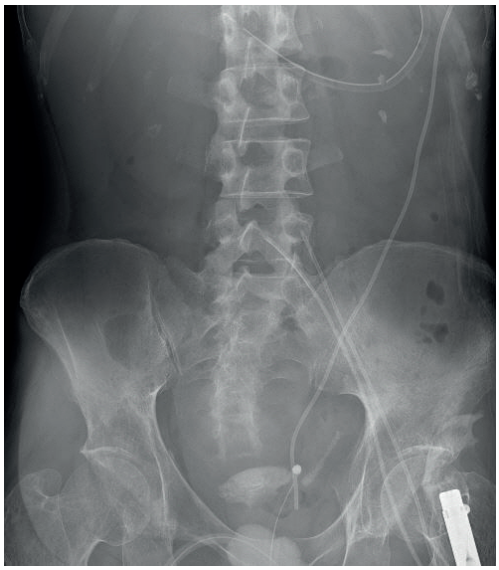

FIGURE 3. Post-operative KUB AP immediately after ventriculo-vesicle shunt.

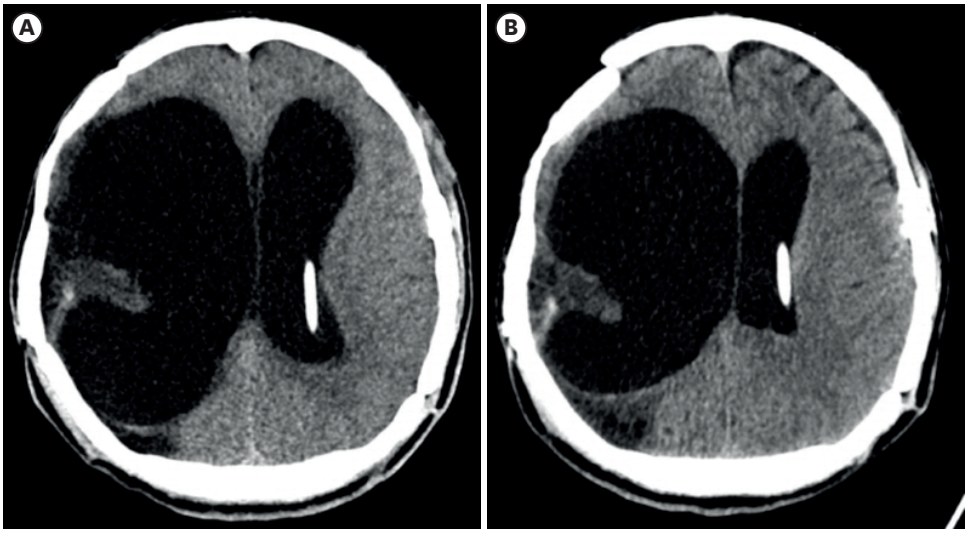

FIGURE 4. Follow-up CT scans before and after ventriculo-vesicle shunt. (A) Pre-operative CT scan, (B) 3 days follow up CT scan after ventriculo-vesicle shunt.
CT: computed tomography.

redirects the flow of CSF from the ventricles to be absorbed in another body cavity. Shunts are typically inserted into the peritoneal, atrial, or pleural cavity.[5]

VPS is the most performed shunt worldwide, but the rate of complications remains quite high.[1,9] Shunt obstruction and infection are the most common complications seen with VPS, often requiring revisions and replacements. Other complications such as bowel perforation, pseudocyst formation, and over-draining, which can lead to subdural hematoma formation, may also occur.[9]

In the reported case, complications including infection and abdominal pseudocyst occurred and revisions were performed.

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Shunt infection is the second most common cause of shunt malfunction, reported in approximately 8%–15% of patients who undergo VPS. The treatment of shunt infection involves the removal of the infected shunt followed by intravenous administration of antibiotics. External ventricular drain (EVD) insertion to remove the source of infection may be considered.[9,11,12]

The treatment plan of EVD is to keep it until the signs of ventricular infections are cleared so shunt replacement can be performed safely.

Abdominal pseudocyst is a rare complication of VPS and occurs in approximately 1%–4.5% of patients who undergo VPS.[3,10]

Dabdoub et al.[3] and Paff et al.[9] reported that the recurrence rate of pseudocysts was 19.8% in pediatric patients and 24.2% in adult patients and that repositioning the distal catheter to a non-peritoneal space reduces the recurrence rate effectively.

Shunt replacement can be a treatment option for complications with shunt insertion. Surgical treatment options include repositioning of the distal catheter to a non-peritoneal space such as the pleural cavity, atrium, vesicle, and urethra.[4]

In the reported case, the patient had heart enlargement and heart failure, and the chest X-ray showed severe pleural effusion. Due to these conditions, the bladder was selected as the non-peritoneal space for CSF drainage, and VVS was performed.

VVS is a technically straightforward procedure for distal catheter replacement, and it has a low risk of obstruction. Yet, there are some disadvantages to consider. Firstly, continuous drainage of CSF through urine can lead to fluid-electrolyte depletion, Second, the presence of a foreign body in the bladder may increase the risk of urinary tract infection (UTI) and bladder stone formation, and because the distal tip is inside the bladder, patients may feel discomfort.[6]

UTI can be treated by administering appropriate antibiotics, but for UTI that do not improve even with continued administration of appropriate antibiotics, shunt replacement may be considered. The incidence of complications due to fluid electrolyte depletion can be reduced by providing fluids and adequate nutrition. Bladder stones can be removed and treated through urological procedures such as cystolithotomy.[6]

In the present case, there were no specific complications related to VVS observed within 3 months after the procedure. It is believed that appropriate use of intravenous antibiotics or general management can sufficiently prevent any potential issues.

CONCLUSION

In cases where the patient's underlying conditions such as heart failure and pleural effusion make it unsuitable to choose the pleural cavity or atrium as non-peritoneal spaces, VVS can be a suitable option for continuous CSF drainage when complications have occurred with the previous VPS. Nonetheless, careful patient selection is necessary since complications such as UTI and vesical stones can arise. Moreover, continuous and strict follow-up can help reduce the risk of complications.

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REFERENCES

1. Bondurant CP, Jimenez DF. Epidemiology of cerebrospinal fluid shunting. **Pediatr Neurosurg** 23:254-258, 1995
PUBMED | CROSSREF
2. Chen KH, Lee CP, Yang YH, Yang YH, Chen CM, Lu ML, et al. Incidence of hydrocephalus in traumatic brain injury: a nationwide population-based cohort study. **Medicine (Baltimore)** 98:e17568, 2019
PUBMED | CROSSREF
3. Dabdoub CB, Dabdoub CF, Chavez M, Villarroel J, Ferrufino JL, Coimbra A, et al. Abdominal cerebrospinal fluid pseudocyst: a comparative analysis between children and adults. **Childs Nerv Syst** 30:579-589, 2014
PUBMED | CROSSREF
4. Hamid R, Baba AA, Bhat NA, Mufti G, Mir YA, Sajad W. Post ventriculoperitoneal shunt abdominal pseudocyst: challenges posed in management. **Asian J Neurosurg** 12:13-16, 2017
PUBMED | CROSSREF
5. Hochstetler A, Raskin J, Blazer-Yost BL. Hydrocephalus: historical analysis and considerations for treatment. **Eur J Med Res** 27:168, 2022
PUBMED | CROSSREF
6. Ibrahim AK. Urinary bladder stone complicating ventriculovesical shunt. **Sultan Qaboos Univ Med J** 14:e142-e144, 2014
PUBMED | CROSSREF
7. Miki T, Nakajima N, Wada J, Haraoka J. Cause of post-traumatic hydrocephalus because of traumatic aqueduct obstruction in two cases. **J Trauma** 61:985-989, 2006
PUBMED | CROSSREF
8. Oberholzer M, Müri RM. Neurorehabilitation of traumatic brain injury (tbi): A clinical review. **Med Sci (Basel)** 7:47, 2019
PUBMED | CROSSREF
9. Paff M, Alexandru-Abrams D, Muhonen M, Loudon W. Ventriculoperitoneal shunt complications: a review. **Interdisciplinary Neurosurgery** 13:66-70, 2018
CROSSREF
10. Rainov N, Schobess A, Heidecke V, Burkert W. Abdominal CSF pseudocysts in patients with ventriculo-peritoneal shunts. Report of fourteen cases and review of the literature. **Acta Neurochir (Wien)** 127:73-78, 1994
PUBMED | CROSSREF
11. Reddy GK, Bollam P, Caldito G. Long-term outcomes of ventriculoperitoneal shunt surgery in patients with hydrocephalus. **World Neurosurg** 81:404-410, 2014
PUBMED | CROSSREF
12. Stone JJ, Walker CT, Jacobson M, Phillips V, Silberstein HJ. Revision rate of pediatric ventriculoperitoneal shunts after 15 years. **J Neurosurg Pediatr** 11:15-19, 2013
PUBMED | CROSSREF

https://doi.org/10.13004/kjnt.2023.19.e52