

## Ventriculoperitoneal shunt obstructions in the absence of radiological abnormalities: retrospective analysis of a pediatric cohort

*Radyolojik anormalliklerin yokluğunda ventriküloperitoneal şant obstrüksiyonları: pediatrik bir kohortun retrospektif analizi*

Reyhan Kasab, Mevlüt Özgür Taşkapılıoğlu

Posted date:13.02.2023

Acceptance date:10.04.2023

### Abstract

**Purpose:** Ventriculoperitoneal shunts are still the mainstay treatment for pediatric hydrocephalus. They have a high complication and failure rate, requiring multiple revisions. In this study, we aim to investigate patients who required shunt replacement without any radiological findings.

**Material and method:** The files of patients under the age of 18, who underwent shunt revision between December 2015 and December 2020 in Bursa Uludag University Medical Faculty Neurosurgery Clinic were reviewed retrospectively. All the radiological studies, laboratory results and clinical conditions of the patients were examined.

**Results:** We identified 127 patients who required a revision of ventriculoperitoneal shunt for suspected mechanical obstruction. 6 patients (5%) had symptoms of raised intracranial pressure, but showed no radiographic evidence of progressive ventricular dilatation.

**Conclusion:** Dysfunction of a ventriculoperitoneal shunt does not always lead to associated radiological alterations. In a patient with signs of intracranial hypertension, revision of the system should be considered even in the absence of progressive ventricular dilatation in radiological studies.

**Key words:** Ventriculoperitoneal shunts, hydrocephalus, obstruction, computed tomography.

Kasab R, Taskapilioglu MO. Ventriculoperitoneal shunt obstructions in the absence of radiological abnormalities: retrospective analysis of a pediatric cohort. Pam Med J 2023;16:430-433.

### Öz

**Amaç:** Ventriküloperitoneal şant uygulanması pediatrik hidrosefali hastaları için halen temel tedavi yöntemidir. Yüksek komplikasyon ve başarısızlık oranına sahiptirler ve çoklu revizyon gerektirirler. Bu çalışmada radyolojik bulgu olmaksızın şant replasmanı gerektiren hastaların araştırılması amaçlanmıştır.

**Gereç ve yöntem:** Bursa Uludağ Üniversitesi Tıp Fakültesi Nöroşirürji Kliniği'nde Aralık 2015-Aralık 2020 tarihleri arasında şant revizyonu yapılan 18 yaş altı hastaların dosyaları retrospektif olarak incelendi. Hastaların tüm radyolojik çalışmaları, laboratuvar sonuçları ve klinik durumları incelendi.

**Bulgular:** Mekanik obstrüksiyon şüphesi nedeniyle ventriküloperitoneal şant revizyonu gerektiren 127 hasta tespit edildi. 6 hastada (%5) artmış intrakraniyal basınç semptomları vardı, ancak progresif ventrikül dilatasyonuna ait radyografik bulgu görülmedi.

**Sonuç:** Ventriküloperitoneal şantın disfonksiyonu her zaman ilişkili radyolojik değişikliklere yol açmaz. İntrakraniyal hipertansiyon bulguları olan bir hastada, radyolojik çalışmalarda ilerleyici ventriküler dilatasyon olmasa bile sistemin revizyonu düşünülmelidir.

**Anahtar kelimeler:** Ventriküloperitoneal şantlar, hidrosefali, obstrüksiyon, bilgisayarlı tomografi.

Kasab R, Taşkapılıoğlu MÖ. Radyolojik anormalliklerin yokluğunda ventriküloperitoneal şant obstrüksiyonları: pediatrik bir kohortun retrospektif analizi. Pam Tıp Derg 2023;16:430-433.

Reyhan Kasab, M.D. Bursa Uludag University, School of Medicine, Department of Neurosurgery, Bursa, Türkiye, e-mail: [sinirederim@hotmail.com](mailto:sinirederim@hotmail.com) (<https://orcid.org/0000-0001-7620-2571>)

Mevlüt Özgür Taşkapılıoğlu, M.D. Prof. Bursa Uludag University, School of Medicine, Department of Neurosurgery, Bursa, Türkiye, e-mail: [ozgurt@uludag.edu.tr](mailto:ozgurt@uludag.edu.tr) (<https://orcid.org/0000-0001-5472-9065>) (Corresponding Author)

## Introduction

Hydrocephalus is a common condition in pediatric patients and characterized by ventricular enlargement caused by increased cerebrospinal fluid (CSF), thinning of the cerebral parenchyma, and increased intracranial pressure. Ventriculoperitoneal shunt is the preferred method of hydrocephalus treatment in the pediatric population. This method reduces morbidity and mortality of hydrocephalus patients, but this is not a curative solution, and does not fix the pathophysiology. The shunts treat hydrocephalus by shunting CSF from ventricle to another place that can be absorbed physiologically.

A ventriculoperitoneal shunt consists of 4 parts as proximal catheter, reservoir, valve, and distal catheter. The ventricular catheter is usually placed in the frontal horn of each lateral ventricle. Most modern shunt catheters drain into the peritoneal cavity. Mechanical obstruction, migration, over-drainage, infection, and fracture are the main reasons for failure.

After the shunt is applied, patients are routinely followed up at regular intervals. During follow-up, the patient's clinical condition, radiological examinations and, when necessary, blood tests are checked. The diagnosis of ventriculoperitoneal shunt failure may be obvious, but more often, the diagnosis can be confused with the symptoms of many childhood diseases like gastroenteritis, otitis, urinary tract infections, viral syndromes, and migraine. Therefore, diagnosing shunt dysfunction can be quite difficult and requires experience. If the correct and rapid diagnosis is not made, some serious results are seen in the patients, so patients with a V-P shunt should always be evaluated carefully and should be considered both radiologically and clinically.

The follow-up of all patients was performed at the outpatient clinic and craniography, posteroanterior chest radiography, and abdominal radiography were evaluated annually. The patients with clinically suspected shunt dysfunction but no disconnection could be detected on roentgenogram were evaluated with a computerized tomography (CT) to determine the presence of ventricular enlargement. Sometimes, when patients present with certain complaints (headache, altered consciousness,

vomiting) no abnormality is detected in their examinations.

When history is taken from the family, there is a suspicion that the patient's condition may be serious. In our study, we aim to investigate patients who required shunt replacement without any radiological findings.

## Materials and methods

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration.

All patients under the age of 18 who underwent shunt revision between December 2015 through December 2020 at Bursa Uludag University Medical Faculty Neurosurgery Clinic were reviewed, the patients who required shunt revision without radiological abnormality were included. The patient who had co-morbidity like congenital disease, tumor or infection were excluded. All the radiological studies, laboratory results and clinical condition of the patients were reviewed, perioperative findings were noted.

## Results

We identified 127 patients who required a revision of ventriculoperitoneal shunt for suspected mechanical obstruction. The patients whose shunts were revised due to skin problems were excluded. The radiological examinations of 6 patients were reported as 'stable' or 'normal' with no evidence of malpositioned ventricular portion of the shunt or discontinued distal catheter. These six patients are the population of our study (Table 1). The initial age of shunting was 10 months. Male/Female ratio was 4/2. The most frequent etiology was hydrocephalus due to prematurity. 2 of the patients underwent shunt revision before. Headache and altered consciousness were the symptoms seen in our patients. In all patients the valve was filling with CSF after consecutive presses. No percutaneous tapping was executed in any of the patients because of infection risk. During the revision procedure all the patient's CSF pressure was found to be high. The cranial tip of the shunt was occluded in all the six patients. The CSF tests were obtained routinely and there was no evidence of infection.

**Table 1.** The general characteristic features of the study patients

Patient	Age	Prematurity	Gender	Etiology	Initial Shunt	Previous Revision
1	4	No	M	IVH	1 month	Yes
2	3	Yes	M	Hidro	birth	Yes
3	2	Yes	M	Mshi+hid	1day	yes
4	13	Yes	F	Hidro	8 month	Yes
5	10 m	Yes	M	Mshi+hid	1day	Yes
6	12	No	F	Hidro	7month	Yes

M: male, F: female, IVH: intraventricular haemorrhage, Hidro: primary hydrocephalus, Mshi: myelochisis

## Discussion

The misdiagnosis of shunt malfunction can be serious condition which may lead to severe neurological deterioration or even death. To avoid it, every patient with ventriculoperitoneal shunt should be evaluated carefully. Shunt malfunction diagnosis is usually set on clinical and radiological findings stated by Sivaganesan et al. [1]. Malfunction without radiological abnormality is not reported frequently but is the most challenging condition that must be carried out by the neurosurgeons. We think that this condition is a result of a poor compliance of ventricles. Iskandar et al. [2] reported 11% of the patients with shunt revision who doesn't show enlarged ventricles. This ratio in our study has been found to be 5%. In our study routine percutaneous tap or invasive intracranial pressure monitoring was not performed due to risk of infection, despite McNatt et al. [3].

None of our patients had slit ventricle syndrome, despite of our suggestion of poor compliance. The patients with 'normal radiological findings' were more likely to suffer acute neurological deterioration, vomiting and nausea compared to rest of the study population, consistent with Engel et al. [4]. Our study showed that patients with hydrocephalus, particularly in the premature children, are more likely to present shunt malfunction without ventricular enlarging. Dahlerup et al. [5] found only headache as a symptom of shunt malfunction. Regarding to these findings we postulate that the prematurity predisposes to worsen ventricular compliance, so these patients should be evaluated very carefully at their follow ups.

Barnes et al. [6] signs, and radiographic findings accompanying presumed ventriculoperitoneal (VP) mentioned that drowsiness is the best clinical predictor of VP shunt failure while headache and vomiting were

less predictive. CT findings were very valuable especially if there is a possibility to compare with previous images, however, it should be kept in mind that not all cases of proven shunt failure presented an increase in ventricular size. Ventricular enlargement could be detected in 84% of the patients but 14% of the patients had unchanged ventricular size.

Small portion of pediatric shunt malfunction appears without radiological findings, so it's important to be aware of this entity when considering the need for surgical intervention in patient who had symptoms of raised intracranial pressure but doesn't demonstrate ventricular dilatation. According to this, the parents' opinions should be evaluated very carefully.

The physicians must not underestimate the observations of the parents and caretakers who have known the regular state of health that were generally complicated by various disabilities and especially that have had experienced shunt failure in the past. Watkins et al. [7] pointed out that families were at least as accurate as paediatricians in diagnosing shunt failure.

**Conflict of interest:** The authors declared no conflicts of interest concerning the authorship and publication of this article.

## References

1. Sivaganesan A, Krishnamurthy R, Sahni D, Viswanathan C. Neuroimaging of ventriculoperitoneal shunt complications in children. *Pediatr Radiol* 2012;42:1029-1046. <https://doi.org/10.1007/s00247-012-2410-6>
2. Iskandar BJ, McLaughlin C, Mapstone TB, Grabb PA, Oakes WJ. Pitfalls in the diagnosis of ventricular shunt dysfunction: radiology reports and ventricular size. *Pediatrics* 1998;101:1031-1036. <https://doi.org/10.1542/peds.101.6.1031>
3. McNatt SA, Kim A, Hohuan D, Krieger M, McComb JG. Pediatric shunt malfunction without ventricular dilatation. *Pediatr Neurosurg* 2008;44:128-132. <https://doi.org/10.1159/000113115>

4. Engel M, Carmel PW, Chutorian AM. Increased intraventricular pressure without ventriculomegaly in children with shunts: "normal volume" hydrocephalus. *Neurosurgery* 1979;5:549-552. <https://doi.org/10.1227/00006123-197911000-00001>
5. Dahlerup B, Gjerris F, Harmsen A, Sorensen PS. Severe headache as the only symptom of long-standing shunt dysfunction in hydrocephalic children with normal or slit ventricles revealed by computed tomography. *Child's Nerv Syst* 1985;1:49-52. <https://doi.org/10.1007/BF00706731>
6. Barnes NP, Jones SJ, Hayward RD, Harkness WJ, Thompson D. Ventriculoperitoneal shunt block: what are the best predictive clinical indicators? *Arch Dis Child* 2002;87:198-201. <https://doi.org/10.1136/adc.87.3.198>
7. Watkins L, Hayward R, Andar U, Harkness W. The diagnosis of blocked cerebrospinal fluid shunts: a prospective study of referral to a paediatric neurosurgical unit. *Child's Nerv Syst* 1994;10:87-90. <https://doi.org/10.1007/BF00302769>

**Ethics committee approval:** This study was approved by the Bursa Uludag University Faculty of Medicine, Clinical Research Ethics Committee (date: 07/01/2022 and number: 2021-KAEK-26/8).

#### **Authorship and contribution**

All authors have made substantive contributions to the study, and all authors endorse the data and conclusions. R.K., M.O.T. contributed to the preparation of the manuscript, research, literature review and analyses.