Is Shunt Location a Risk Factor for the Development of De Novo Post-shunt Seizures?

Hanieh Bazrafshan1, MD; Mohamad Sadegh Masoudi2, MD; Mehdi Bazrafshan1, MD; Ali Akbar Asadi-Pooya1, MD; 2

1Epilepsy Research Center, Shiraz University of Medical Sciences, Shiraz, Iran;
2Jefferson Comprehensive Epilepsy Center, Department of Neurology, Thomas Jefferson University, Philadelphia, Pennsylvania, PA, USA

Correspondence:
Ali Akbar Asadi-Pooya, MD;
Epilepsy Research Center, Shiraz University of Medical Sciences, Zand Blvd., Postal Code: 71437-34719, Shiraz, Iran
Tel: +98 9352274990
Fax: +98 71 36125062
Email: aliasadipooya@yahoo.com
Received: 21 October 2020
Revised: 19 November 2020
Accepted: 13 March 2021

Abstract

Background: While ventriculo-extracranial shunting procedures have been the standard treatment option for hydrocephalus for a long time, their long-term morbidity, including the development of post-shunt de novo seizures, should be taken into account. This study aimed to investigate the rate and risk factors of the occurrence of de novo post-shunt seizures in patients with hydrocephalus.

Methods: In this retrospective longitudinal study, all patients with hydrocephalus who had ventriculo-peritoneal shunt insertion from 2014 to 2017 at Namazi Hospital, (Shiraz, Iran) were studied. Phone calls were made to all patients to obtain their postoperative seizure outcome and other data (e.g., sex, age at surgery, shunt insertion location, history of seizures before surgery, history of seizures after surgery, any other type of brain surgery, and the etiology of their hydrocephalus). The Pearson Chi Square was used for the analysis of binary variable (e.g., sex) differences, and the t test for the analysis of differences in the means of numerical variables (e.g., age). Bonferroni correction tests were also utilized. P values less than 0.05 were considered significant.

Results: A total of 114 patients were included in the study. Overall, 68 (60%) patients had a frontal location of shunt insertion and 46 (40%) had a parietal site. Twenty-four (21%) patients reported experiencing de novo post-shunt seizures, 15 of which had a frontal location and nine a parietal location for shunt insertion ($P=0.824$).

Conclusion: De novo post-shunt seizures are common occurrences. However, shunt location is not a significant risk factor for the development of de novo post-shunt seizures.


Keywords • Brain • Epilepsy • Seizures • Neurosurgery

What’s Known

• The comorbidity of epilepsy and hydrocephalus (HC) is mainly due to the underlying etiology; however, the treatment (i.e., shunting procedure) has also been implicated in the development of epilepsy in some patients.

What’s New

• De novo post-shunt seizures are common occurrences. However, shunt location is not a significant risk factor for the development of de novo post-shunt seizures.

Introduction

Hydrocephalus (HC) is a cerebrospinal fluid (CSF) physiology disorder that causes abnormal enlargement of the cerebral ventricles. This disorder has various etiologies.1 Congenital hydrocephalus, which frequently involves aqueduct stenosis, has a genetic etiology. Hydrocephalus can also be acquired, mainly as a result of pathological events affecting ventricular outflow, subarachnoid space function, or cerebral venous compliance. Treatment strategies may include shunt and endoscopic approaches.1 Epilepsy is a major comorbidity in patients with HC and may have a serious impact on their outcomes.2
comorbidity of epilepsy and HC is mainly due to the underlying etiology. However, the treatment (i.e., shunting procedure) has also been implicated in the development of epilepsy in some patients.\textsuperscript{2,5} Despite the reproducibility of the observation of post-shunt \textit{de novo} seizure occurrences in multiple studies,\textsuperscript{2,6} the risk factors associated with such sequelae are contradictory in previous studies. For example, one study suggested that shunt location is very important.\textsuperscript{3} This observation was not reproduced in any other study.\textsuperscript{4} While ventriculo-extracranial shunting procedures have been the standard treatment option for HC for a long time,\textsuperscript{1, 2} their long-term morbidity, including the development of post-shunt \textit{de novo} seizures, should be taken into account.

The current study aimed to investigate the rate and risk factors of the occurrence of \textit{de novo} post-shunt seizures in patients with HC. In specific, we hypothesized that shunt location is a significant risk factor for the development of \textit{de novo} post-shunt seizures in patients with HC. The answer to this question could have significant practical implications.

**Patients and Methods**

The study was approved by the Review Board and the Ethics committee of Shiraz University of Medical Sciences (code: IR.SUMS.REC.1398.1287). In the current retrospective longitudinal study, all patients with HC who had ventriculo-peritoneal shunt insertion between 2014 and 2017 at Namazi Hospital, (Shiraz, Iran) were studied. There were no exclusion criteria at this stage. In the initial phase, we reviewed their medical records to obtain detailed clinical information such as sex, age at surgery, shunt insertion location, history of seizures before surgery, history of seizures after surgery, any other type of brain surgery, and the etiology of their HC. The shunt insertion location criteria were not known in this retrospective study (it was based on the decision of treating neurosurgeons).

In the second phase, the neurologist, the first author, made phone calls with all the patients to verify their medical information, as well as to obtain their postoperative seizure outcome (occurrence and frequency of seizures). The patients were asked if they agreed to share their information over the phone (no written consent was obtained). Patients who did not respond to our phone call, those not willing to participate, and patients who reported having seizures before their surgery were excluded. All data has been kept confidential.

Relevant clinical variables were summarized descriptively to characterize the study population.

**Statistical Analysis**

IBM-SPSS statistics (version 25, IBM Corp.-USA) was used for statistical analyses. Fisher’s Exact test was used for the analysis of binary variable (e.g., sex) differences. The \textit{t} test was used for the analysis of differences in the means of numerical variables (e.g., age), and Bonferroni correction tests were applied for statistical analyses. \( P \) values less than 0.05 were considered significant.

**Results**

A total of 114 patients [48 women (42%) and 66 men (58%)] met the inclusion criteria and entered the study. Their mean age at the time of the shunt surgery was 46±101 months (range: 0-79 years) and their postoperative follow-up period was 38±10 months (range: 2-5 years). Overall, 68 (60%) patients had a frontal location of shunt insertion, and 46 (40%) had a parietal site. Twenty-four (21%) patients reported experiencing \textit{de novo} post-shunt seizure(s).

Table 1: Factors potentially associated with the occurrence of \textit{de novo} post-shunt epileptic seizures

<table>
<thead>
<tr>
<th>Variable</th>
<th>Patients with \textit{de novo} post-shunt seizures (N=24)</th>
<th>Patients without \textit{de novo} post-shunt seizures (N=90)</th>
<th>( P ) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>3 (13%)</td>
<td>45 (50%)</td>
<td>0.001\textsuperscript{1}</td>
</tr>
<tr>
<td>Male</td>
<td>21 (87%)</td>
<td>45 (50%)</td>
<td></td>
</tr>
<tr>
<td>Age at surgery (Mean±SD) (month)</td>
<td>56±62</td>
<td>43±109</td>
<td>0.585\textsuperscript{2}</td>
</tr>
<tr>
<td>Etiology of hydrocephalus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Congenital</td>
<td>10 (42%)</td>
<td>59 (66%)</td>
<td>0.058\textsuperscript{1}</td>
</tr>
<tr>
<td>Acquired</td>
<td>14 (58%)</td>
<td>31 (34%)</td>
<td></td>
</tr>
<tr>
<td>Other brain surgery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frontal</td>
<td>6 (25%)</td>
<td>15 (17%)</td>
<td>0.379\textsuperscript{1}</td>
</tr>
<tr>
<td>Parietal</td>
<td>15 (63%)</td>
<td>53 (59%)</td>
<td>0.818\textsuperscript{1}</td>
</tr>
</tbody>
</table>

\*After Bonferroni correction, significant predictive value is 0.01. \textsuperscript{1}Fisher’s Exact test; \textsuperscript{2}t test
seizures (i.e., no seizure in the past 12 months), and 15 had uncontrolled seizures (i.e., having seizures in the past 12 months despite receiving antiepileptic drugs for 13 months or after the discontinuation of their drugs in two months).

Discussion

In this study, we observed that de novo seizures occur in 21% of patients with HC, who receive ventriculo-extracranial shunting procedures. This rate is similar to that in one previous report, while it is higher in another study. The development of de novo post-shunt seizures could be directly related to shunt implantation. De novo seizures may also happen following other types of brain surgery. This observation has significant clinical and practical implications. First, it is reasonable to consider using alternative CSF diversionary techniques, when they are clinically appropriate, or using alternative procedures, such as endoscopic third ventriculostomy (ETV), to treat HC, when anatomically possible. In newborns with HC, initial treatment with ETV is preferable to the implantation of a shunt. In adults with HC, ETV failed sooner than shunt therapy; nonetheless, ETV was more efficient. Shunt location was not a significant risk factor for the development of de novo post-shunt seizures in our study. One previous study suggested that shunt location is not a significant risk factor for the development of de novo post-shunt seizures. It seems that shunt location is not a significant risk factor for the development of de novo post-shunt seizures in patients with HC.

In conclusion, de novo post-shunt seizures are common occurrences and require serious attention. When possible, it is reasonable to consider using alternative techniques instead of ventriculo-extracranial shunting procedures. If performing ventriculo-extracranial shunting procedures is mandatory, it is important to try to prevent and minimize the risk factors for the development of de novo post-shunt seizures. It seems that shunt location is not a significant risk factor for the development of de novo post-shunt seizures in patients with HC.

Acknowledgment

This study was supported by the National Institute for Medical Research Development (Grant No. 987669). We also thank the Neuroscience Research Center affiliated with Shiraz University of Medical Sciences (Shiraz, Iran) for supporting this study.

Authors’ Contribution

H.B: Acquisition, analysis, and interpretation of data, revising it critically for important intellectual content; M.S.M: Acquisition, analysis, and interpretation of data, revising it critically for...
important intellectual content; M.B: Acquisition, analysis, and interpretation of data, revising it critically for important intellectual content; A.A.A: Study concept and design, acquisition, analysis, and interpretation of data, drafting the manuscript; All authors have read and approved the final manuscript and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Conflict of Interest: None declared.

References


