

Screening of Epileptic Seizures in Children and Adolescents with Hydrocephalus and Ventriculoperitoneal Shunt

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ABSTRACT

Objectives: To assess the occurrence of epileptic seizures (ES) in children and adolescents with hydrocephalus and their relationship with ventriculoperitoneal shunt (VPS) treatment. **Methods:** Retrospective study of 45 patients from both genders, aged 0 to 18 years, with hydrocephalus and presenting with ES or not. The following variables were analyzed: gender, hydrocephalus etiology, age at diagnosis, age at initial VPS treatment, age at first ES and types of ES. **Results:** Data analysis showed the following: 20 (44.4%) presented with ES, 13 (65%) of the girls and seven (35%) of the boys. There was a predominance of ES in the girls, but with no statistically significant difference. In total, 13 (65%) patients used VPS. Of the 13 patients with VPS and ES, it was observed that the onset of ES was after VPS in 10 (76.9%) individuals, whereas it occurred before VPS in two (15.4%). **Conclusions:** The results showed no association between VPS treatment and ES ($\rho=0.832$); however, most of the patients presented with their first ES episode after VPS, suggesting a possible relationship between this treatment and the occurrence of ES. A larger sample and a prospective study might answer this question.

Key words: Hydrocephalus, seizures, epilepsy, ventriculoperitoneal shunt, children and adolescents.

RESUMO

Estudo da ocorrência de crises epilépticas em crianças e adolescentes com hidrocefalia no tratamento por derivação ventriculoperitoneal

Objetivos: Avaliar a ocorrência de crises epilépticas (CE) em crianças e adolescentes com hidrocefalia e sua relação com o tratamento por derivação ventriculoperitoneal (DVP). **Métodos:** Estudo retrospectivo de 45 crianças e adolescentes de ambos gêneros, faixa etária de 0 a 8 anos, com hidrocefalia, apresentando ou não CE. Analisaram-se as variáveis: gênero, etiologia da hidrocefalia, idade do diagnóstico de hidrocefalia, idade de colocação do shunt, tipos de CE e idade da primeira crise. **Resultados:** A análise estatística mostrou: 20 pacientes (44,4%) apresentaram CE, sendo 13 do gênero feminino (65%) e sete do masculino (35%). Houve predomínio de CE no gênero feminino sem diferença estatística significativa. Estavam em uso de DVP 13 pacientes (65%), sendo que em 10 (76,9%), o início das crises foi depois da colocação do shunt, enquanto dois (15,4%) já apresentavam CE antes da DVP. **Conclusões:** Os resultados não mostraram associação entre o tratamento com DVP e CE ($\rho=0,832$), entretanto a maior parte dos pacientes apresentou o primeiro episódio de CE depois da colocação do shunt, sugerindo uma relação entre o tratamento com DVP e a ocorrência de crises.

Unitermos: Hidrocefalia, crises epilépticas, derivação ventriculoperitoneal, crianças, adolescentes.

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INTRODUCTION

The treatment of hydrocephalus with ventricular shunts has occurred since 1896,¹ resulting in an important reduction in morbidity and mortality in patients with this disorder. However, high rates of local and systemic complications after valve insertion have been associated with this treatment, among which are mechanical problems (36%) and ventriculitis (15%).²

The literature has shown increased risk of epileptic seizures (ES) after VPS treatment, with an incidence between 20% and 50%.^{3,4} The ES in these patients may result from the hydrocephalus itself or from related malformations, as well as from complications of valve insertion. The mechanism involved in seizure onset, in this case, may be either direct damage to the nerve tissue at the moment of ventricular catheter insertion or the presence of the catheter as a foreign body.^{3,5}

The following factors associated to the increased incidence of ES in VPS patients were reported: cognitive and motor impairment⁷ and hydrocephalus etiology.⁸ Other possible related factors are: usage of antiepileptic drugs and complications such as catheter-related infection, and obstruction.^{3,5} There is no association between increased ES and the following variables: gender,⁸ poor functioning, location or age at shunt insertion⁷ and the number of VPS revisions.^{7,8}

Epilepsy seems to be an important prognostic factor in children with hydrocephalus and a predictor of poor intellectual development in shunt-treated individuals.^{10,11} However, it must be taken into consideration the possible association between cognitive impairment in these children and an underlying diffuse encephalopathy.⁷

The literature has shown controversial data, demonstrating the diversity of the variables involved in the hydrocephalus-epileptic seizure complex and how these influence the evolution of the hydrocephalus patient, showing how important it is to develop more studies related to this topic.

The aim of present study was to screen the occurrence of ES in children and adolescents with hydrocephalus and determine its relationship with VPS treatment.

METHODS

A retrospective chart review of 45 cases of patients from both genders, aged 0 to 18 years, and diagnosed with hydrocephalus, was conducted between 2003 and 2005 at the Pediatric Neurology out-patient clinics of the Federal University of Rio Grande do Norte (UFRN). The selection criteria were: Inclusion – I) patients diagnosed with hydrocephalus, presenting with ES or not; II) complete medical chart data; Exclusion – I) patients with incomplete medical chart data; II) lack of description of ES. The data

were collected according to standard protocol, and the following variables were analyzed: gender, age, age at hydrocephalus diagnosis, age at shunt insertion, number of VPS revisions, hydrocephalus etiology, age at first seizure and types of ES. The degree of association between ES and VPS treatment and the relationship with gender and the predominant etiology of hydrocephalus were determined.

Descriptive statistical analysis was carried out and relative frequencies in absolute and percentage values were determined. Significant statistical differences were assessed by the chi-square test and by comparison of proportions using STATISTICA 6.0 software at a significance level for $\alpha = 5\%$.

RESULTS

The clinical and sociodemographic characteristics of the sample, composed of 27 girls and 18 boys between 0 and 18 years of age (mean = 5.73 years/SD = 4.19) is showed in Table 1.

Table 1. Clinical and sociodemographic data of 45 children and adolescents with hydrocephalus with or without ventriculoperitoneal shunt (VPS) associated with epileptic seizures or not.

Characteristic	Número	Percentagem
GENDER		
Male	18	40%
Female	27	60%
ORIGIN		
Natal	18	40%
Hinterland	24	53.3%
DIAGNOSIS OF HYDROCEPHALUS		
Prenatal	7	15.6%
At birth	11	24.4%
First day of life	9	20%
Post-natal delay (>1 month)	9	20%
Undetermined	9	20%
PATIENTS TREATED WITH VPS		
Yes	30	66.7%
No	15	33.3%
NUMBER OF VPS REVISIONS		
None	16	35.6%
One revision or more	3	6.7%
Undetermined	26	57.7%
EPILEPTIC SEIZURES		
Yes	20	44.4%
No	25	55.5%

VPS=ventriculoperitoneal shunt.

In 39 (86.7%) patients the likely cause of hydrocephalus was congenital. Of these, 21 (41.7%) exhibited meningomyelocele and in three patients (6.6%) of sample the cause was acquired (Table 2). Of the 45 patients, 30 (66.7%) underwent VPS treatment and 15 (33.3%) were not treated. The age at shunt insertion varied between

2 days and 17 months (mean = 3.26 months/SD 4.54). Only three patients (10%) underwent shunt revision.

Table 2. Aetiological factors of 45 patients with hydrocephalus associated with epileptic seizures or not.

Causes	Total sample (n=45)		Patients with epileptic seizures (n=20)	
	N	%	N	%
<i>Congenital</i>				
Meningomyelocele	21	46.7	4	20
Multiple – CNS malformations	2	4.4	0	0
Benign cysts	4	8.9	4	20
Hydranencephaly	1	2.2	1	5
Dandy-Walker – malformation	2	4.4	2	10
Holoprosencephaly	1	2.2	1	5
Agenesis of the pellucid septum	1	2.2	0	
Prematurity	5	11.1	3	15
TORCH	2	4.4	1	5
Total	39	86.7	16	80
<i>Acquired</i>				
Prematurity-related intracranial hemorrhage	3	6.7	1	5
Total	3	6.7	1	5
<i>Undetermined</i>				
Total	3	6.7	3	15
Total	45	100	20	100

CNS – Central Nervous System; TORCH – toxoplasmosis, rubella, cytomegalovirus, herpes simplex.

Epileptic seizures occurred in 20 patients (44.4%), seven (35%) boys and 13 (65%) girls. There was no statistically significant difference between the genders on the comparison of proportions test ($Z_{cal} = -0.61$). In the 20 patients with seizure, 16 (80%) presented with hydrocephalus, whose etiology was likely congenital. The comparison between meningomyelocele and other malformations of the central nervous system in terms of ES occurrence (Table 3) showed a significant statistical difference for the absence of seizures in patients with meningomyelocele ($p=0.029$). As to the type of ES, nine (45%) patients suffered generalized seizures, seven (35%) presented with partial seizures and in four (20%) the ES were not classified. Of the generalized seizures, the tonic-clonic predominated in four (44.4%) patients and of the partial seizures, four (57.1%) presented with secondary generalized seizures.

Table 3. Meningomyelocele versus other central nervous system malformations and their relationship with the occurrence of epileptic seizures in 32 patients with congenital hydrocephalus treated or not with ventriculoperitoneal shunt.

Etiology	Epileptic seizures				Total	p-value
	Yes		No			
	N	%	N	%		
Myelomeningocele	4	19.04%	17	80.95%	21	0.029
Other malformations	8	66.66%	3	33.33%	11	
Total	12	44.44%	20	55.55%	32	

Of the 30 patients with VPS, 13 (43.3%) suffered seizures, and 17 (53.7%) did not (Table 4). Of the 13 patients with ES, in 10 (76.9%) of these individuals seizure onset occurred after VPS insertion and in two (15.4%) the ES took place after insertion. In the group of VPS patients, partial seizures predominated in six (46.1%) and of these, three (50%) presented with secondary generalized seizures.

Table 4. Occurrence of epileptic seizures in 45 patients with hydrocephalus treated or not with ventriculoperitoneal shunt (VPS).

VPS	Epileptic seizures				Total	p-value
	Yes		No			
	N	%	N	%		
Yes	13	43.3	17	56.7	30	0.83
No	7	46.7	8	53.3	15	
Total	20	44.4	25	55.5	45	

DISCUSSION

Statistical analysis showed no relationship between VPS and the occurrence of ES, a result that may have been influenced by the small sample and by the very limitations of a retrospective study.

However we observed that most of the patients developed ES after shunt insertion, over a span of time ranging from a few days to eight years, which leads us to believe that these ES may really occur as a local complication of the procedure. In addition to this finding is the higher percentage of partial seizures compared to generalized seizures among VPS patients. Considering the likely physiopathogeny of the occurrence of ES in patients with VPS, it is expected that partial seizures predominate in this group as a consequence of local irritation from the catheter or from the recognition of it as a foreign body.^{3,5} It was not possible to confirm statistically if there is a relationship between VPS and the type of ES, owing to the small values involved.

The study of ES epidemiology in patients with hydrocephalus shows a predominance of cases in the boys,^{2,14} with a tendency to greater compromise in girls when associated to spina bifida¹⁴ In the sample studied, despite the predominance of ES in the girls, there was no statistically significant difference between the genders.

Among the etiologies of hydrocephalus, the most frequently found were the congenital types, such as meningomyelocele, which showed an inverse relationship with the occurrence of ES. The literature has shown an important association between the occurrence of ES and the etiology of hydrocephalus,⁹⁻¹¹ and meningomyelocele in particular shows low incidences of ES.^{12,13} The cause of this relationship remains unknown.

We found a greater occurrence of ES (44.4%) than that reported in other studies,³ which showed a prevalence of around 30%. A plausible explanation for the higher number of ES found in our study, in addition to the fact that it was performed in a reference center for epilepsy care, is the high percentage of other central nervous system malformations in our sample, which in itself predisposes to the occurrence of ES.⁷

The absence of a relationship between VPS and ES has been reported in other studies,^{7,8} which suggests that this association has been overestimated in the literature and that other variables such as the etiology of the hydrocephalus and associated mental retardation are linked more closely to ES than to VPS.

Finally, the results of the analyses of the retrospective data showed the greater frequency of epileptic seizures related to VPS insertion this observation supports the argument that new prospective studies with a larger sample, associated to neuroimaging and EEG data, may contribute to accurately defining this possible relationship between ES and VPS treatment.

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