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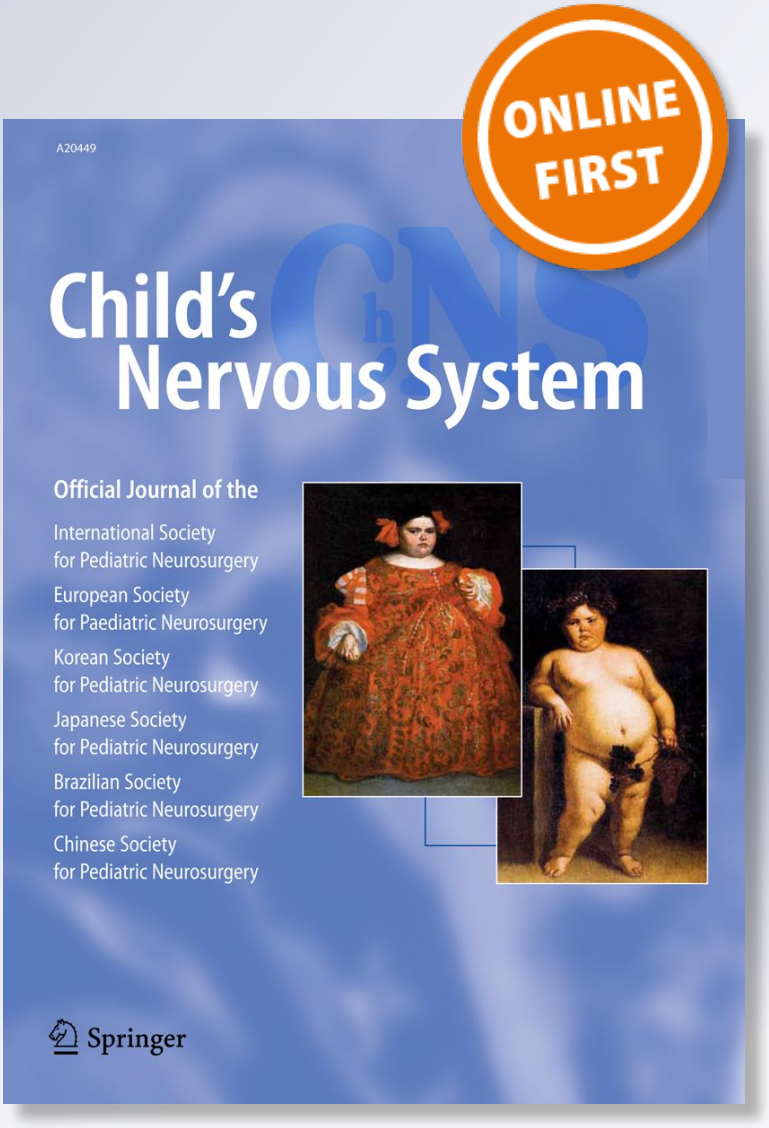

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ORIGINAL PAPER

Third ventriculostomy in infants younger than 1 year old

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Abstract
Introduction Endoscopic third ventriculostomy (ETV) gains more attention each day in the treatment of hydrocephalus. Some authors have questioned the effectiveness of the procedure for the treatment of infants younger than 1 year. More recent studies revealed that the effectiveness of the procedure is more related to the etiology of the disease than to the age of the patient.
Materials and methods We studied retrospectively the effectiveness of third ventriculostomy in our service: 75 endoscopic procedures, from which 48 were ETVs. Among the ETVs, 30 were used to treat aqueductal stenosis, three for Dandy–Walker, eight for Chiari type II.
Results When the patients were stratified by the etiology of the hydrocephalus, there was a statistically significant difference among the groups studied with higher success among patients with aqueductal stenosis the (90 %) and lower for the treatment of Chiari II-related hydrocephalus (50 % of success). With the patients stratified by age groups, there was no significant difference in terms of the success of the treatment.
Conclusion Our results have shown that the effectiveness of ETV is not actually age-related, but etiology-related.

Keywords Third ventriculostomy · Infants · Failure Hydrocephalus · Neuroendoscopy

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Introduction

Endoscopic third ventriculostomy (ETV) gains more attention each day in the treatment of hydrocephalus in the past two decades. The first neuroendoscopic procedure was performed by the urologist L'Espinasse [12] in 1910, when he used a cystoscope to attempt endoscopic coagulation of the choroid plexus. In 1914, Dandy and Blackfan [3] published the first scientific study that handled in details the etiopathogeny of hydrocephalus, when he made the difference between communicating and non-communicating hydrocephalus. Nine years later, Mixter [14] published the first successful neuroendoscopic third ventriculostomy.

Since then, many studies have been published demonstrating technical variations, possible complications and evaluation of the safety and effectiveness of the third ventriculostomy. Among the most relevant studies, special attention has been given to the efficiency of the procedure for the treatment of infants younger than 1 year, for whom the procedure has previously been considered ineffective [6, 11, 15, 18].

However, other studies showed that the failure of the procedure is not actually related to the age of the patient, but to the etiology of the disease [1, 2, 7–10, 13, 20]. The effectiveness of the third ventriculostomy is high in the treatment of hydrocephalus due to aqueductal stenosis (about 70–80 % of success), while the treatment of infection-related and post-hemorrhagic hydrocephalus achieves lower rates of success (close to 50 %). When the patients are stratified by etiology, the age does not seem to play a major role in the rates of success [20]. Yet, there are many doubts among physicians about the effectiveness of the procedure in the treatment of young infants.

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Table 1 Effectiveness of ETV stratified by age

Age	Failure	Effective	Total	RR	EF* failure	EF* effective	
<1 month	4	22	26	0.846	3.792	22.208	χ^2=1.562
1–6 months	3	12	15	0.8	2.188	12.813	p=0.458
6–12 monhs	0	7	7	1	1.021	5.979	
Total	7	41	48	0.854	7.001	41	

*Expected frequency

Table 2 Effectiveness stratified by etiology

Etyology	Failure	Effective	Total	RR	EF* failure	EF* effective	
Aqueductal stenosis	3	27	30	0.9	5.122	24.878	χ^2=7.82
Dandy–Walker	0	3	3	1	0.512	2.488	p=0.0202
Chiari II	4	4	8	0.5	1.366	6.634	
Total	7	34	41	0.829	7	34	

*Expected frequency

Table 3 Effectiveness of ETV for aqueductal stenosis stratified by age

Age	Failure	Effective	Total	RR	EF* failure	EF* Effective	
<1 month	0	14	14	1	1.4	12.6	χ^2=6.672
1–6 months	3	7	10	0.7	1	9	p=0.0357
6–12 months	0	6	6	1	0.6	5.4	
Total	3	27	30	0.9	3	27	

*Expected frequency

Patients and methods

We have proposed a study to verify the efficiency of the ETV among infants younger than 1 year. A retrospective study was conducted on patients within this age group who underwent ETV in the Biocor Instituto between 1998 and 2010. There were 75 endoscopic procedures, from which 48 were ETVs. Among the ETVs, 30 were used to treat aqueductal stenosis, three for Dandy–Walker, eight for Chiari type II. The children were stratified in age groups: younger than 1 month old, 1–6 months old, and 6–12 months old.

The failure of the procedure was defined as the worsening of the patient's symptoms leading to complications, the occurrence of death or the need of reoperation. The procedures were carried by the same surgeon with the same surgical technique and this fact reduces the biases of our study. All patients were followed up until 2011. The minimum follow-up period was 14 months, and the maximum was 13 years and the average follow-up was 108.9 months (9 years).

Results

The overall effectiveness of ETV among infants younger than 1 year in our service was 85 %. There was a correlation between the effectiveness and the age group, with a small reduction of the success rates among children younger than 6 months (Table 1).

When the patients were stratified by etiology of the hydrocephalus, there was a statistically significant difference between the groups studied (Table 2). For children treated for aqueductal stenosis the effectiveness of the procedure was 90 %, while the same method achieved only 50 % success for the treatment of Chiari II patients.

When the largest group (patients with aqueductal stenosis) was stratified by age group, we could conclude that there was no significant difference of the success of the treatment between the different age groups (Table 3).

Discussion

Neuroendoscopy is still a method in constant study, and each day it gains more attention for its applications in the treatment of multiple neurosurgical diseases. The effectiveness of ETV for the treatment of hydrocephalus in young infants has been questioned over the years. Previously, it was thought that rates of success were lower among younger children, especially those younger than 1 year. Recent studies, however, show that the success of the treatment is better related to the etiology of the hydrocephalus than to the age of the patient. Our study strongly supports this idea and may lighten the discussion of the use of ETV among younger infants.

Our results have shown that the effectiveness of ETV is not actually age-related, but etiology-related and agrees with

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previous studies [13]. For children with aqueductal stenosis, the prognosis is good with success rates close to 90 %. Among children with hydrocephalus due to Chiari type II, the rates of failure are higher — close to 50 %. Other authors have advocated similar failure rates (about 60 %) when the treatment is proposed for infections or neonatal post-hemorrhagic hydrocephalus [7, 16, 19].

We advocate that, even for the diseases that the ETV has not achieved high rates of success, it is still a method of treatment that can be suggested as the first therapeutic option, once its counterpart — the ventriculoperitoneal shunting — is related to high rates of complications and morbidity when considering the long term follow-up of the patients [4, 5, 17].

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