

# Physiopathology of subdural hygroma following endoscopic third-ventriculostomy - a review

João Miguel de Almeida Silva<sup>1</sup>, José Carlos Esteves Veiga<sup>1,2</sup>, Guilherme Brasileiro de Aguiar<sup>1</sup>

1 Department of Surgery, Division of Neurosurgery, Faculdade de Medicina da Santa Casa de Misericórdia de São Paulo, São Paulo, Brazil.

2 Chief of the Division of Neurosurgery, Faculdade de Medicina da Santa Casa de Misericórdia de São Paulo, São Paulo, Brazil.

*Rev. Chil. Neurocirugía 39: 157 - 159, 2013*

## Resumen

La tercer ventriculostomía endoscópica (TVE) es actualmente una opción terapéutica ampliamente aceptada para el tratamiento de la hidrocefalia obstructiva. El reciente desarrollo tecnológico en este campo ha dado lugar a una renovación del interés en la TVE, considerado un procedimiento neuroquirúrgico seguro y bien establecida. A pesar de la relativa seguridad y eficacia de la TVE, innumerables informes han descrito complicaciones implicadas en el procedimiento. Como complicación postoperatoria de derivaciones ventriculares, el higroma subdural es un evento conocido, sin embargo, rara vez reportado en asociación con la TVE. A la luz del aumento en la utilización de técnicas endoscópicas, en especial la TVE, existe simultáneamente un incremento en la aparición de complicaciones relacionadas con el método. Esto nos motiva a realizar un estudio más detallado de sus mecanismos fisiopatológicos, y nos llevó a hacer una revisión de la aparición y de la fisiopatología del higroma subdural después de la TVE.

**Palabras clave:** Hidrocefalia, tercer ventriculostomía endoscópica, complicación postoperatoria, higroma subdural, fisiopatología.

## Abstract

The endoscopic thirdventriculostomy (ETV) is currently a widely accepted therapeutic option for the management of obstructive hydrocephalus. The recent technological development in the field has triggered a renewal in the interest in ETV, considered a safe and well-established neurosurgical procedure. Despite the relative safety and efficacy of the ETV, innumerable reports have described complications involved in the procedure. As a postoperative complication of ventricular derivations, the subdural hygroma is a commonly known event, however it is rarely reported in association with the ETV. In light of the increase in the utilization of endoscopic techniques, especially the ETV, there is simultaneously an increase in the occurrence of complications related to the method. This motivates us to perform a more detailed study of its physiopathological mechanisms, and brings us to make a review of the occurrence of the post-ETV subdural hygroma physiopathology.

**Key words:** Hydrocephalus, endoscopic thirdventriculostomy, postoperative complication, subdural hygroma; physiopathology.

## Introduction

The endoscopic thirdventriculostomy (ETV) is currently a widely accepted therapeutic option for the management of obstructive hydrocephalus<sup>1</sup>. The recent technological development in the field has triggered a renewal in the interest in ETV, considered a safe and well-established

neurosurgical procedure<sup>2,3</sup>.

Its use in obstructive hydrocephalus caused by expansive lesions in the posterior fossa has been recommended in the last few years, as there is evidence which favors the ETV over other types of derivations in this context<sup>4</sup>.

Despite the relative safety and efficacy of the ETV, innumerable reports have

described complications involved in the procedure. Even being considered rare, the complications linked with the ETV are in general graver. During an intervention, syndromes such as cerebral herniations, cardiac arrhythmias, subarachnoid hemorrhage and ischemic events, in addition to the possible lesions to adjacent structures on the third ventricle floor, including the

pituitary stalk and cranial nerves, can occur<sup>5,6,7,8</sup>. The possible postoperative complications of infections, diabetes insipidus, cognitive impairment and psychiatric sequelae must also be cited<sup>8,9</sup>. As a postoperative complication of ventricular derivations, the subdural hygroma is a commonly known event, however it is rarely reported in association with the ETV. As proposed by Wiewrodt, more attention must be paid to the subdural hygroma following the ETV, as he believes that this complication is more frequent than what appears in publications<sup>10</sup>. In light of the increase in the utilization of endoscopic techniques, especially the ETV, there is simultaneously an increase in the occurrence of complications related to the method. This motivates us to perform a more detailed study of its physiopathological mechanisms, and brings us to make a review of the occurrence of the post-ETV subdural hygroma physiopathology.

## Objective

The objective of the present study is to make a review of the literature on the occurrence of the subdural hygroma following endoscopic third ventriculostomy, as to its incidence, occurrence mechanisms and management.

## Methods

A review of the literature was made based on articles from the databases of MEDLINE and SCIELO, using the following keywords: Endoscopic third ventriculostomy; Hygroma; Hydrocephalus. References of the same were tracked once the articles were found. Some other articles related to the topic were also included in the study.

The result of the research was analyzed and shown in this paper. A discussion of the topic was made, having the aim of answering the initial doubts that motivated the review.

## Discussion

The subdural hygroma is an already known complication of extracranial derivations, rarely being reported as associated with ETV. This is because in the derivations there is a cerebrospinal fluid (CSF) diversion to another compartment, making

the occurrence of hyperdrainage possible. In the ETV, there is no CSF diversion to outside of the subarachnoid space, which conveys the idea that hyperdrainage would not occur and consequently the formation of a subdural hygroma would be very unlikely<sup>8,11</sup>.

The ETV has been established as an amply employed method in the treatment of non-communicating hydrocephalus, as it presents advantages over extracranial derivations, avoiding mechanical complications in the valves, reducing infection rates and reactions to foreign bodies. The ETV is also able to avoid complications related to hyperdrainage, as it does not divert the CSF to an extracranial compartment. Nevertheless, subdural effusions, in the form of hygroma or hematoma, have been reported following this procedure<sup>10,12,13</sup>.

The frequency of hygroma following the ETV is yet a target for questioning. Some authors of clinical series with a representative sample number do not report said complications in their publications. The descriptions of this complication as a result of the ETV have been exposed in the form of reports on isolated cases, with the presentation of subdural hygromas or hematomas. The incidence varies between 1% and 12.5% in most of the publications<sup>1,11,12,13,14,15</sup>. Wiewrodt, in a publication on individuals under 1 year of age, observed an incidence rate of 26%, a number notably higher than the average reported frequency, a possible justification for this finding being the follow up adopted with serial transfontanelle ultrasonography performed for a period longer than one week following the procedure<sup>10</sup>.

The mechanism for the occurrence of subdural hygroma following the ETV is not yet clear. As proposed by Schroeder in a review on complications following the ETV, the abrupt loss of CSF during the procedure could lead to a collapse in the cortical mantle, causing the increase in subdural space, which would favor the collection formation<sup>13</sup>.

The craniocerebral disproportion is another predisposing factor for the formation of hygromas following the ETV. Kamel proposed, in light of the observed development of the subdural hematoma following the ETV, that the prolonged ventricular dilation leads to the compression of the thin cortical mantle, causing an alteration in the cerebral viscoelastic properties<sup>12</sup>. Thus, there would be not be adequate spacing in the cortical mantle following the ETV, therefore favoring the

collection formation in the increased subdural space. The author also proposes that in these circumstances, in addition to the hygroma, there could also occur the formation of subdural hematomas due to the ample cerebral mobility, favoring the rupture of the bridge veins. These events do not obligatorily develop as a result of the hyperdrainage phenomenon, but rather only due to the intracranial pressure normalization<sup>12</sup>.

In a recent publication which evaluated the incidence of hygroma following ETV in infants, Wiewrodt<sup>10</sup> observed that the occurrence of the complication was more frequently present in those on which a larger diameter endoscope had been used. In spite of there not being a statistical significance due to the reduced sample, it was possible to observe the development of hygroma in 31% of the patients treated with a 6mm endoscope and in only 13% of those treated with a 3 mm endoscope<sup>10</sup>. Kamel, in a single case report on subdural collection following ETV, also proposed that as an 8mm endoscope had been utilized, it may have facilitated the leakage of the CSF through the orifice of the cortical puncture that had been made<sup>12</sup>.

The opening of the Lilliequist membrane during the ETV is routinely performed<sup>16</sup>. It is known that its fenestration in microsurgeries for ruptured cerebral aneurysm clipping reduces the risk of the occurrence of postoperative hydrocephalus, however it increases the formation of subdural collections<sup>17</sup>. In this manner, the opening of the Lilliequist membrane is being discussed as a procedure which in reality permits even better access to the subdural space than to the interpenduncular cistern. Cartmill and Vloeberghs attributed the occurrence of spinal subdural hematoma in a 9-year-old child to the very same mechanism<sup>18</sup>.

As for the possibility of the prevention of the occurrence of subdural collections following the ETV, the value of ventricular reexpansion with a crystalloid solution before removal of the lateral ventricle endoscope is being discussed<sup>12,14,19</sup>. Care in not permitting the excessive escape of CSF during the procedure is also a conduct to be valued during the procedure, principally in the hydrocephalus of major consequence, thus preventing the perioperative collapse of the thin cortical mantle<sup>12,20</sup>.

Kurschel et al., proposed that the obliteration of the endoscopic passage following the removal of the surgical instrument

## Revisión de Tema

with a mixture of a hemostatic agent and a fibrin adhesive would reduce the occurrence of the same in a publication on the reduction of the risk of developing subdural collection in this context. The author showed that in the pediatric population only 1 child in the 21 submitted to the procedure developed asymptomatic subdural collection as an outcome, justifying this finding with the closing of the communication between the ventricular space and the subarachnoid space<sup>19</sup>.

The subdural hygroma as a consequence of the ETV in children under one year of age in the majority of the publications was asymptomatic. The surgical solution for this complication has been considered necessary only when facing sympto-

matic clinical presentations, reportedly the possibilities of open surgical drainage, serial punctures and subdural-peritoneal derivations<sup>1,13,21,22</sup>. In general, the surgical necessity occurs in half of the patients who developed subdural collections following ETV, being the adequate outcome in the majority of the publications, both in the surgical and the non-surgical groups<sup>10</sup>.

## Conclusion

The frequency of subdural collection following the ETV still follows the varied estimated incidence among the current publications with the probable occurrence

of non-diagnosed cases. The mechanisms considered responsible for such a complication have been highlighted in the last few years, there already being well-elaborated and literature-based preventive strategies. In light of the occurrence of hygroma following the ETV, the surgical solution has been opted for only in symptomatic patients, a benign outcome being obtained in the majority of the cases, independent of the necessity for intervention.

**Recibido: 30 de octubre de 2012**  
**Aceptado: 12 de diciembre de 2012**

## Bibliografía

1. Jones RF, Stening WA, Brydon M. Endoscopic third ventriculostomy. *Neurosurgery* 1990; 26: 86-92.
2. Brockmeyer D, Abtin K, Carey L, Walker ML. Endoscopic third ventriculostomy: an outcome analysis. *Pediatr Neurosurg* 1998; 28: 236-240.
3. Buxton N, Ho KJ, Macarthur D, Vloeberghs M, Robertson I. Neuroendoscopic third ventriculostomy for hydrocephalus in adults: report of a single unit's experience with 63 cases. *Surg Neurol* 2001; 55: 74-78.
4. El-Ghandour NM. Endoscopic third ventriculostomy *versus* ventriculoperitoneal shunt in the treatment of obstructive hydrocephalus due to posterior fossa tumors in children. *Childs Nerv Syst* 2011; 27: 117-126.
5. Yusuf E, Arslan D. Complications of endoscopic third ventriculostomy. *Childs Nerv Syst* 2008; 24: 943-948.
6. Buxton N, Punt J. Cerebral infarction after neuroendoscopic third ventriculostomy: case report. *Neurosurgery* 2000; 46: 999-1002.
7. Navaro R, Gil-Parra R, Reitman AJ, Olavarria G, Grant JA, Tomita T. Endoscopic third ventriculostomy in children: early and late complications and their avoidance. *Child Nerv Syst* 2006; 22: 506-513.
8. Beems T, Grotenhuis JA. Long-term complications and definition of failure of neuroendoscopic procedures. *Child Nerv Syst* 2004; 20: 868-877.
9. Benabarre A, Ibáñez J, Boget T, Obiols J, Martínez-Aran A, Vieta E. Neuropsychological and psychiatric complications in endoscopic third ventriculostomy: A clinical case report. *J Neurol Neurosurg Psychiatry* 2001; 71: 268-271.
10. Wiewrodt D, Reinhard S, Wagner W. Hygromas after endoscopic third ventriculostomy in the first year of life: incidence, management and outcome in a series of 34 patients. *Childs Nerv Syst* 2008; 24: 57-63.
11. Kim BS, Jallo GI, Kothbauer K, Abbott IR. Chronic subdural hematoma as a complication of endoscopic third ventriculostomy. *Surg Neurol* 2004; 62: 64-68.
12. Kamel MH, Murphy M, Aquilina K, Marks C. Subdural haemorrhage following endoscopic third ventriculostomy. A rare complication. *Acta Neurochir (Wien)* 2006; 148: 591-593.
13. Schroeder HW, Niendorf WR, Gaab MR. Complications of endoscopic third ventriculostomy. *J Neurosurg* 2002; 96: 1032-1040.
14. Teo C. Complications of endoscopic third ventriculostomy. In: Cinalli G, Maixner WJ, Sainte-Rose C (eds) *Pediatric hydrocephalus*. Springer, Milan, 2004; pp 411-420.
15. Kadrian D, van Gelder J, Florida D, Jones R, Vonau M, Teo C. Long-term reliability of endoscopic third ventriculostomy. *Neurosurgery* 2005; 56: 1271-1278.
16. Buxton N, Vloeberghs M, Punt J. A neuroendoscopic approach to Lilliequist's membrane. *Clin Anat* 1998; 11: 187-190.
17. Higashi K, Hatano M, Okamura T, Yamashita T. Lilliequist's membranotomy for patients with ruptured intracranial aneurysms. *No Shinkei Geka* 1979; 7: 1109-1114.
18. Maria Cartmill, Michael Vloeberghs. The fate of the cerebrospinal fluid after neuroendoscopic third ventriculostomy. *Child's Nerv Syst* 2000; 16: 879-881.
19. Kurschel S, Ono S, Oi S. Risk reduction of subdural collections following endoscopic third ventriculostomy. *Child's Nerv Syst* 2007; 23: 521-526.
20. Mohanty A, Anandh B, Reddy MS, Sastry KV. Contralateral massive acute subdural collection after endoscopic third ventriculostomy - a case report. *Minim Invasive Neurosurg* 1997; 40: 59-61.
21. Freudenstein D, Wagner A, Ernemann U, Duffner F. Subdural hygroma as a complication of endoscopic neurosurgery - two case reports. *Neurol Med Chir (Tokyo)* 2002; 42: 554-559.
22. Murshid WR. Endoscopic third ventriculostomy: towards more indications for the treatment of non-communicating hydrocephalus. *Minim Invas Neurosurg* 2000; 43: 75-82.

## Corresponding author:

Guilherme Brasileiro de Aguiar, MD  
Department of Surgery, Division of Neurosurgery, Santa Casa Medical School. São Paulo, Brazil.  
Rua Cesário Motta Jr., 112 - Vila Buarque. 01221-900. São Paulo - SP, Brazil. Tel: 55 11 21767000  
E-mail: guilhermebraguiar@yahoo.com.br