



Prevalence of post-traumatic hydrocephalus in moderate to severe head injury

Paolo Missori¹ · Sergio Paolini² · Antonio Currà³

Received: 27 September 2022 / Accepted: 29 September 2022 / Published online: 7 October 2022
© The Author(s), under exclusive licence to Springer-Verlag GmbH Austria, part of Springer Nature 2022

Dear Editor,

We read with great interest the recent article by Heinonen et al. concerning the retrospective analysis of patients undergoing surgery for post-traumatic hydrocephalus (PTH) in a 2-year period, in Pirkanmaa region, Finland [3]. Out of 1941 adult patients with head injury who underwent acute head CT, only 3 (0.15%) met the clinical and radiological diagnosis of PTH and were reported to benefit from ventriculoperitoneal shunt.

This very low epidemiological figure is in line with some other reports based on CT scan evaluation in patients with severe brain injury [1, 2, 4, 6]. However, after some decades and many published studies, we can say with certainty that PTH complicates very frequently the clinical course of patients with moderate to severe head injury (up to 20% of these patients), that is apparently in contrast with the Heinonen's last results. Therefore, the reported low prevalence of PTH should be explained and some points and questions addressed.

In their cohort, Heinonen et al. report an overall median age of 59 years, a ground-level fall (GLF) rate of 52%, and presence of antithrombotic medication in more than a quarter of patients (26%). Conversely analysis of the pertinent literature returns a list of studies that report a younger mean age in patients with PTH, mainly from road traffic accident

(Table 1). These data suggests that the Heinonen et al. study includes a large proportion of aged patients affected by cerebrovascular disease. Consequently, head injury secondary to cerebrovascular events may be over-represented, thus biasing the prevalence result.

Currently, the attitude in the care of brain injury patients is changing. Increased hospitalization of elderly patients coupled with ease of neuroimaging influences the prevalence of PTH diagnosis in the overall population. The high frequency of GLF and/or antithrombotic medication and at least 4 cases of normal pressure hydrocephalus reported in Heinonen et al. series support this view. The authors even excluded treatment in 2 acute hydrocephalus secondary to severe TBI, due to pessimistic prognosis.

In patients under respiratory assistance, the diagnosis of PTH is based almost exclusively on neuroimaging. Ventricular enlargement that takes place after moderate to severe brain injury is consistent with the diagnosis of early hydrocephalus. The authors do not explicate the radiological criterion that neurosurgeons and neuroradiologists adopt for diagnosing hydrocephalus. The Evans' index is a paramount landmark in the PTH diagnosis, and temporal horn enlargement detects hydrocephalus earlier and faster than Evans index changes [5]. Whenever these points of reference are neglected, a radiological diagnosis of the "brain atrophy" is favoured, and recognition of PTH is delayed, resulting in irreversible brain damage and poor outcome. Pre-existing ventriculomegaly could not require surgical treatment if the radiological (and clinical) picture does not worsen with respect to preoperative clinical conditions.

To describe the symptoms of PTH, the authors refer to literature on normal pressure hydrocephalus (e.g., headache, nausea, cognitive dysfunction, ataxia, obtundation, a tetrad of psychomotor retardation, memory loss, gait trouble, and urinary incontinence). It must be noted that awake not treated PTH patients usually may not exhibit these symptoms. Instead, they can manifest a variety of non-specific symptoms (i.e. arrested clinical improvement, increased

This article is part of the Topical Collection on *Brain trauma*

✉ Paolo Missori
missorp@yahoo.com

¹ Department of Human Neurosciences, Neurosurgery, Policlinico Umberto I, "Sapienza" University of Rome, Viale del Policlinico, 155, 00161 Rome, Italy

² IRCCS Neuromed-Pozzilli, "Sapienza" University of Rome, Rome, Italy

³ Academic Neurology Unit, Department of Medical-Surgical Sciences and Biotechnologies, Ospedale A. Fiorini, Terracina, LT, "Sapienza" University of Rome, Polo Pontino, Italy

Table 1 Analysis of the literature shows that the mean age in patients with PTH is almost completely limited to the third and fourth decades

Author	Year	Mean age (years)
Paoletti	1983	38
Cardoso	1985	39
Phuenpathom	1999	30
Tribl	2000	36
Licata	2001	39
Mazzini	2003	41
Jiao	2007	45
Choi	2008	54
De Bonis	2010	35
Bauer	2011	41
Denes	2011	32
Honeybul	2012	31
Low	2013	35
Kammersgaard	2013	49
Xin	2014	47
Fotakopoulos	2015	33
Weintraub	2017	25
Sun	2019	45
Goldschmidt	2020	35
Svedung Wettervik	2022	55

spasticity, recurrent epileptic seizures, and aggressiveness). In such cases, diagnosis of PTH is likely overlooked, and surgical cerebrospinal fluid diversion should be considered mandatory and urgent.

In conclusion, inclusion in the Heinonen's study of many elderly patients with brain injury may have deceptively reduced the prevalence of PTH, which on the contrary is a very frequent complication in patients with moderate to severe traumatic brain injury. Because prompt diagnosis and treatment of PTH prevents irreversible brain damage, reduces severe disability, and avoids poor outcome,

neuroradiologists and neurosurgeons should avoid backing a past culture of brain “atrophy” or “ventriculomegaly” following traumatic brain injury.

Declarations

Ethics approval The manuscript does not contain clinical studies or patient data.

Conflict of interest The authors declare no competing interests.

References

1. Chen KH, Lee CP, Yang YH, Yang YH, Chen CM, Lu ML, Lee YC, Chen VC (2019) Incidence of hydrocephalus in traumatic brain injury: a nationwide population-based cohort study. *Medicine (Baltimore)* 98:e17568. <https://doi.org/10.1097/MD.00000000000017568>
2. Cardoso ER, Galbraith S (1985) Posttraumatic hydrocephalus—a retrospective review. *Surg Neurol* 23:261–264. [https://doi.org/10.1016/0090-3019\(85\)90092-8](https://doi.org/10.1016/0090-3019(85)90092-8)
3. Heinonen A, Rauhala M, Isokuortti H, Kataja A, Nikula M, Öhman J, Iverson GL, Luoto T (2022) Incidence of surgically treated post-traumatic hydrocephalus 6 months following head injury in patients undergoing acute head computed tomography. *Acta Neurochir (Wien)* 164:2357–2365. <https://doi.org/10.1007/s00701-022-05299-3>
4. Koo AH, LaRoque RL (1977) Evaluation of head trauma by computed tomography. *Radiology* 123:345–350. <https://doi.org/10.1148/123.2.345>
5. Missori P, Paolini S, Peschillo S, Mancarella C, Scafa AK, Rastelli E, Martini S, Fattapposta F, Currà A (2022) Temporal horn enlargements predict secondary hydrocephalus diagnosis earlier than Evans' index. *Tomography* 8:1429–1436. <https://doi.org/10.3390/tomography8030115>
6. Phuenpathom N, Ratanalert S, Saeheng S, Sripairojkul B (1999) Post-traumatic hydrocephalus: experience in 17 consecutive cases. *J Med Assoc Thai* 82:46–53

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.