Intracranial pressure monitoring for spontaneous intracerebral hemorrhage

The utility of Intracranial pressure monitoring and its benefit with respect to spontaneous intracerebral hemorrhage outcome is unknown.

The aim of a study of Chen et al., was to compare spontaneous intracerebral hemorrhage outcomes in patients who underwent intracranial pressure monitoring to those who were managed by care-guided imaging and/or clinical examination alone.

This was a retrospective analysis of data from the Ethnic/Racial variations of Intracerebral Hemorrhage (ERICH) study between 2010 and 2015. ICH patients who underwent ICP monitoring were propensity-score matched, in a 1:1 ratio, to those who did not undergo ICP monitoring. The primary outcome was 90-day mortality. Secondary outcomes were in-hospital mortality, hyperosmolar therapy use, ICH evacuation, length of hospital stay, and 90-day modified Rankin Scale (mRS) score, excellent outcome (mRS score 0-1), good outcome (mRS score 0-2), Barthel Index, and health-related quality of life (HRQoL; measured by EQ-5D and EQ-5D visual analog scale [VAS] scores). A secondary analysis for patients without intraventricular hemorrhage was performed.

The ICP and no ICP monitoring cohorts comprised 566 and 2434 patients, respectively. The matched cohorts comprised 420 patients each. The 90-day and in-hospital mortality rates were similar between the matched cohorts. Shift analysis of 90-day mRS favored no ICP monitoring ($p < 0.001$). The rates of excellent ($p < 0.001$) and good ($p < 0.001$) outcome, Barthel Index ($p < 0.001$), EQ-5D score ($p = 0.026$), and EQ-5D VAS score ($p = 0.004$) at 90 days were lower in the matched ICP monitoring cohort. Rates of mannitol use ($p < 0.001$), hypertonic saline use ($p < 0.001$), ICH evacuation ($p < 0.001$), and infection ($p = 0.001$) were higher, and length of hospital stay ($p < 0.001$) was longer in the matched ICP monitoring cohort. In the secondary analysis, the matched cohorts comprised 111 patients each. ICP monitoring had a lower rate of 90-day mortality ($p = 0.041$). Shift analysis of 90-day mRS, Barthel Index, and HRQoL metrics were comparable between the matched cohorts.

The findings of this study do not support the routine utilization of ICP monitoring in patients with ICH [1].

Unclassified

Chen CJ, Ding D, Ironside N, Buell TJ, Southerland AM, Woo D, Worrall BB; ERICH Investigators. Predictors of Surgical Intervention in Patients with Spontaneous Intracerebral Hemorrhage. World Neurosurg. 2019 Mar;123:e700-e708. doi: 10.1016/j.wneu.2018.11.260. Epub 2019 Feb 8. PubMed PMID: 30743036; PubMed Central PMCID: PMC6401311.

3: Wang F, Yang T, Niu C. The Effect of Transtemperal Approach and Placement of Intracranial Pressure Sensor Into Temporal Horn of Lateral Ventricle in Management of Spontaneous Supratentorial Intracerebral Hemorrhage Broken Into Ventricles. J Craniofac Surg. 2018 Sep;29(6):1604-1606. doi: 10.1097/SCS.0000000000004600. PubMed PMID: 29771830.

4: Lilja-Cyron A, Kelsen J, Andresen M, Fugleholm K, Juhler M. Feasibility of Telemetric Intracranial Pressure Monitoring in the Neuro Intensive Care Unit. J Neurotrauma. 2018 Jul 15;35(14):1578-1586.

doi: 10.1089/neu.2017.5589. Epub 2018 May 3. PubMed PMID: 29648985.

5: Lai HY, Lee CH, Lee CY. The Intracranial Volume Pressure Response in Increased Intracranial Pressure Patients: Clinical Significance of the Volume Pressure Indicator. PLoS One. 2016 Oct 10;11(10):e0164263. doi: 10.1371/journal.pone.0164263. eCollection 2016. PubMed PMID: 27723794; PubMed Central PMCID: PMC5056694.

6: Stone JL, Bailes JE, Hassan AN, Sindelar B, Patel V, Fino J. Brainstem Monitoring in the Neurocritical Care Unit: A Rationale for Real-Time, Automated Neurophysiological Monitoring. Neurocrit Care. 2017 Feb;26(1):143-156. doi: 10.1007/s12028-016-0298-y. Review. PubMed PMID: 27484878.

7: Connolly M, Vespa P, Hu X. Characterization of Cerebral Vascular Response to EEG Bursts Using ICP Pulse Waveform Template Matching. Acta Neurochir Suppl. 2016;122:291-4. doi: 10.1007/978-3-319-22533-3_58. PubMed PMID: 27165924.

8: Ferrete-Araujo AM, Egea-Guerrero JJ, Vilches-Arenas Á, Godoy DA, Murillo-Cabezas F. Predictors of mortality and poor functional outcome in severe spontaneous intracerebral hemorrhage: a prospective observational study. Med Intensiva. 2015 Oct;39(7):422-32. doi: 10.1016/j.medin.2014.10.008. Epub 2014 Dec 11. English, Spanish. PubMed PMID: 25499725.

9: Horie N, Sadakata E, Izumo T, Hayashi K, Morikawa M, Nagata I. De Novo Vertebral Artery Dissection after Endovascular Trapping for Ruptured Dissecting Internal Carotid Artery Aneurysm: Case Report. Neurol Med Chir (Tokyo). 2015;55(6):524-7. doi: 10.2176/nmc.cr.2013-0159. Epub 2014 Jan 10. PubMed PMID: 24418785; PubMed Central PMCID: PMC4628206.

10: Eide PK, Holm S, Sorteberg W. Simultaneous monitoring of static and dynamic intracranial pressure parameters from two separate sensors in patients with cerebral bleeds: comparison of findings. Biomed Eng Online. 2012 Sep 7;11:66. doi: 10.1186/1475-925X-11-66. PubMed PMID: 22958653; PubMed Central PMCID: PMC3506507.

11: Aguilar MI, Brott TG. Update in intracerebral hemorrhage. Neurohospitalist. 2011 Jul;1(3):148-59. doi: 10.1177/1941875211409050. PubMed PMID: 23983850; PubMed Central PMCID: PMC3726132.

12: Petrikov SS, Solodov AA, Guseĭnova KhT, Titova IuV, Dash'ian VG, Aleshchenko EI, Khamidova LT, Krylov VV. [Role of multicomponent neuromonitoring in the determination of intensive care tactics in a female patient with subarachnoidal hemorrhage due to cerebral arterial aneurysmal rupture]. Anesteziol Reanimatol. 2009 May-Jun;(3):61-3. Russian. PubMed PMID: 19663226.

13: Pati S, Kombogiorgas D, Anwar A, Price RF. Spontaneous extra-axial intracranial hemorrhage followed by thrombosis in congenital afibrinogenemia: perioperative management of this rare combination. Surg Neurol. 2009 Jun;71(6):689-92, discussion 692. doi: 10.1016/j.surneu.2007.10.034. Epub 2008 Mar 4. PubMed PMID: 18295846.

14: Wang E, Ho CL, Lee KK, Ng I, Ang BT. Changes in brain biochemistry and oxygenation in the zone surrounding primary intracerebral hemorrhage. Acta Neurochir Suppl. 2008;102:293-7. PubMed PMID: 19388332.

15: Ryttlefors M, Howells T, Nilsson P, Ronne-Engström E, Enblad P. Secondary insults in subarachnoid hemorrhage: occurrence and impact on outcome and clinical deterioration. Neurosurgery. 2007 Oct;61(4):704-14; discussion 714-5. PubMed PMID: 17986931.

16: Tseng MY, Al-Rawi PG, Czosnyka M, Hutchinson PJ, Richards H, Pickard JD, Kirkpatrick PJ.

Enhancement of cerebral blood flow using systemic hypertonic saline therapy improves outcome in patients with poor-grade spontaneous subarachnoid hemorrhage. J Neurosurg. 2007 Aug;107(2):274-82. PubMed PMID: 17695380.

17: Gross WP, Hesselmann V, Wedekind C. Development of chronic hydrocephalus and early cranial CT findings in spontaneous intracerebral/intraventricular hemorrhage. Zentralbl Neurochir. 2006 Feb;67(1):21-5. PubMed PMID: 16518747.

18: Heese O, Regelsberger J, Kehler U, Westphal M. Hollow mandrin facilitates external ventricular drainage placement. Acta Neurochir (Wien). 2005 Jul;147(7):759-62; discussion 762. Epub 2005 Mar 10. PubMed PMID: 15739037.

19: Fadrus P, Smrcka V, Svoboda T, Maca K, Nadvornik P, Neuman E. Stereotactic evacuation of spontaneous infratentorial hemorrhage with monitoring of intracerebral pressure. Bratisl Lek Listy. 2004;105(5-6):235-9. PubMed PMID: 15535116.

20: Wroński J, Juniewicz H, Mierzwa J, Zub L. The concept of cerebral circulatory-pressure index (CCPI). Neurol Neurochir Pol. 2000;34(6 Suppl):80-8. PubMed PMID: 11452860.

21: Fernandes HM, Siddique S, Banister K, Chambers I, Wooldridge T, Gregson B, Mendelow AD. Continuous monitoring of ICP and CPP following ICH and its relationship to clinical, radiological and surgical parameters. Acta Neurochir Suppl. 2000;76:463-6. PubMed PMID: 11450068.

22: May Llanas ME, Alcover Bloch E, Cambra Lasaosa FJ, Campistol Plana J, Palomeque Rico A. [Non-traumatic cerebral hemorrhage in childhood: etiology, clinical manifestations and management]. An Esp Pediatr. 1999 Sep;51(3):257-61. Spanish. PubMed PMID: 10575748.

23: Fukuhara T, Douville CM, Eliott JP, Newell DW, Winn HR. Relationship between intracranial pressure and the development of vasospasm after aneurysmal subarachnoid hemorrhage. Neurol Med Chir (Tokyo). 1998 Nov;38(11):710-5; discussion 716-7. PubMed PMID: 9919902.

24: Holzschuh M, Woertgen C, Metz C, Brawanski A. Clinical evaluation of the InnerSpace fibreoptic intracranial pressure monitoring device. Brain Inj. 1998 Mar;12(3):191-8. PubMed PMID: 9547949.

25: Endo S, Kuwayama N, Takaku A, Nishijima M. Direct packing of the isolated sinus in patients with dural arteriovenous fistulas of the transverse-sigmoid sinus. J Neurosurg. 1998 Mar;88(3):449-56. PubMed PMID: 9488298.

26: Steinmeier R, Bauhuf C, Hübner U, Bauer RD, Fahlbusch R, Laumer R, Bondar I. Slow rhythmic oscillations of blood pressure, intracranial pressure, microcirculation, and cerebral oxygenation. Dynamic interrelation and time course in humans. Stroke. 1996 Dec;27(12):2236-43. PubMed PMID: 8969787.

27: Kitanaka C, Tanaka J, Kuwahara M, Teraoka A, Sasaki T, Takakura K, Tanaki J [corrected to Tanaka J]. Nonsurgical treatment of unruptured intracranial vertebral artery dissection with serial follow-up angiography. J Neurosurg. 1994 Apr;80(4):667-74. Review. Erratum in: J Neurosurg 1994 Jun;80(6):1132. PubMed PMID: 8151345.

28: Kaufman HH. Treatment of deep spontaneous intracerebral hematomas. A review. Stroke. 1993 Dec;24(12 Suppl):I101-6; discussion I107-8. Review. PubMed PMID: 8249004.

29: Kotwica Z, Paciorek G. [Usefulness of intracranial pressure measurement by Camino V420 system: preliminary report]. Neurol Neurochir Pol. 1992 Sep-Oct;26(5):671-6. Polish. PubMed PMID: 1291905.

30: Ohkuma A, Kawaguchi M, Sugimoto S, Yanagimoto M, Hattori T. [Epilepsy after operation for ruptured intracranial aneurysm]. No Shinkei Geka. 1990 Aug;18(8):729-34. Japanese. PubMed PMID: 2215866.

31: Takeuchi S, Koike T, Sasaki O, Kamada K, Tanaka R, Arai H. Intracranial extradural pressure monitoring after direct operation on ruptured cerebral aneurysms. Neurosurgery. 1989 Jun;24(6):878-83. PubMed PMID: 2747861.

32: Kogure Y, Fujii H, Higashi S, Hashimoto M, Yamamoto S. [Electroencephalographic changes during experimental plateau waves]. No Shinkei Geka. 1988 Dec;16(13):1439-43. Japanese. PubMed PMID: 3226494.

33: Yagüe L, Garcia-March G, Paniagua C, Sánchez-Ledesma MJ, Diaz P, Ludeña D, Maillo A, Broseta J. Stereotactic evacuation and local administration in intracerebral haematomas. A comparative study. Acta Neurochir Suppl (Wien). 1987;39:45-8. PubMed PMID: 3314386.

34: Keränen T, Tapaninaho A, Hernesniemi J, Vapalahti M. Late epilepsy after aneurysm operations. Neurosurgery. 1985 Dec;17(6):897-900. PubMed PMID: 4080121.

35: Duff TA, Ayeni S, Levin AB, Javid M. Nonsurgical management of spontaneous intracerebral hematoma. Neurosurgery. 1981 Oct;9(4):387-93. PubMed PMID: 6795526.

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Chen CJ, Ding D, Ironside N, Buell TJ, Southerland AM, Testai FD, Woo D, Worrall BB; ERICH Investigators. Intracranial pressure monitoring in patients with spontaneous intracerebral hemorrhage. J Neurosurg. 2019 May 31:1-11. doi: 10.3171/2019.3.JNS19545. [Epub ahead of print] PubMed PMID: 31151113.