

Progressive hemorrhagic injury

Progressive hemorrhagic injury (PHI) greatly affects the [traumatic brain injury outcome](#) (TBI).

Intracranial hemorrhage (ICH) after traumatic brain injury (TBI) commonly increases in size and coagulopathy has been implicated in such progression.

A meta-analysis to assess their relationship. Cochrane library, PubMed, and EMBASE were searched for literatures. Pooled effect sizes and 95% confidential intervals (CIs) were calculated using random-effects model. We included six studies, involving 1700 participants with 540 progressive hemorrhagic injuries (PHIs). Our findings indicate that PT, D-dimer level, and INR value are positively associated with the risk of PHI. Higher level of PLT and Fg seemed to suggest a lower risk of PHI. Among these parameters, higher D-dimer level and INR value would possess more powerful strength in predicting PHI.¹⁾.

D-dimer/fibrinogen ratio (D/F ratio) may be a potential predictor for [venous thromboembolism](#). A study of Xu et al. sought to describe and evaluate any relationship between D/F ratio and PHI after TBI.

This retrospective study included a cohort of 192 TBI patients. Plasma D-dimer and fibrinogen were measured, and subsequently, D/F ratio was calculated. Multivariate logistic regression analysis was applied to identify predictors of PHI. The receiver operating characteristic (ROC) curve was configured to analyze predictive capability for PHI.

A total of 43 patients (22.4%) experienced PHI. Both [Glasgow coma scale](#) (GCS) score (odds ratio [OR], 0.565; 95% CI, 0.464-0.689) and D/F ratio (OR, 4.026; 95% CI, 2.219-7.305) were the two independent predictor for PHI. Area under ROC curve (AUC) of D/F ratio was similar to that of GCS score (AUC, 0.816; 95% CI, 0.754-0.868 vs. AUC, 0.834; 95% CI, 0.773-0.883; P=0.699). Moreover, D/F ratio significantly improved AUC of GCS score to 0.928 (95% CI, 0.881-0.960; P<0.001).

D/F ratio was strongly predictive of PHI in the studied cohort and, thereby should be considered in the clinical management of TBI patients²⁾.

Unclassified

2: Esnault P, Mathais Q, D'Aranda E, Montcriol A, Cardinale M, Cungi PJ, Goutorbe P, Joubert C, Dagain A, Meaudre E. Ability of Fibrin Monomers to Predict Progressive Hemorrhagic Injury in Patients with Severe Traumatic Brain Injury. *Neurocrit Care*. 2019 Dec 3. doi: 10.1007/s12028-019-00882-6. [Epub ahead of print] PubMed PMID: 31797276.

3: Zhang X, Wang JJ, Guo Y, Dong S, Shi W, Wang G, Zhang H, Wang G. Sudden Aggravated Radicular Pain Caused by Hemorrhagic Spinal Angiolipomas After Back Massage. *World Neurosurg*. 2020 Feb;134:383-387. doi: 10.1016/j.wneu.2019.11.005. Epub 2019 Nov 13. PubMed PMID: 31733392.

4: Wan X, Gan C, You C, Fan T, Zhang S, Zhang H, Wang S, Shu K, Wang X, Lei T. Association of APOE ε4 with progressive hemorrhagic injury in patients with traumatic intracerebral hemorrhage. *J*

Neurosurg. 2019 Jul 19:1-8. doi: 10.3171/2019.4.JNS183472. [Epub ahead of print] PubMed PMID: 31323634.

5: Peng Q, Zhao J, Wang P, Huang C, Chen B, Song J, Xu G. Expressions of plasma cystatin C, D-dimer and hypersensitive C-reactive protein in patients with intracranial progressive hemorrhagic injury after craniocerebral injury, and their clinical significance. Arq Neuropsiquiatr. 2019 Jul 15;77(6):381-386. doi: 10.1590/0004-282×20190057. PubMed PMID: 31314839.

6: Zhang ZY, Li J, Ye Q, Dong Y, Bao GM, Shen YK, Weng JF, Luo LF, Cen M. Usefulness of serum interleukin-33 as a prognostic marker of severe traumatic brain injury. Clin Chim Acta. 2019 Oct;497:6-12. doi: 10.1016/j.cca.2019.07.008. Epub 2019 Jul 4. PubMed PMID: 31279693.

7: Rehman L, Afzal A, Aziz HF, Akbar S, Abbas A, Rizvi R. Radiological Parameters to Predict Hemorrhagic Progression of Traumatic Contusional Brain Injury. J Neurosci Rural Pract. 2019 Apr-Jun;10(2):212-217. doi: 10.4103/jnrp.jnrp_335_18. PubMed PMID: 31001007; PubMed Central PMCID: PMC6454978.

8: Aghaebrahim A, Agnoletto GJ, Aguilar-Salinas P, Granja MF, Monteiro A, Siddiqui AH, Levy EI, Shallwani H, Kim SJ, Haussen DC, Nogueira RG, Lopes D, Saied A, Jovin TG, Jadhav AP, Limaye K, Turk AS, Spiotta AM, Chaudry MI, Turner RD, Brasiliense LBC, Dumont TM, Cherian J, Kan P, Sauvageau E, Hanel RA. Endovascular Recanalization of Symptomatic Intracranial Arterial Stenosis Despite Aggressive Medical Management. World Neurosurg. 2019 Mar;123:e693-e699. doi: 10.1016/j.wneu.2018.12.008. Epub 2018 Dec 18. PubMed PMID: 30576811.

9: Di G, Zhang Y, Liu H, Jiang X, Liu Y, Yang K, Chen J, Liu H. Postoperative complications influencing the long-term outcome of head-injured patients after decompressive craniectomy. Brain Behav. 2019 Jan;9(1):e01179. doi: 10.1002/brb3.1179. Epub 2018 Dec 4. PubMed PMID: 30511376; PubMed Central PMCID: PMC6346640.

10: Luo LF, Weng JF, Cen M, Dong XQ, Yu WH, Du Q, Yang DB, Zheng YK, Hu W, Yu L, Luo SD. Prognostic significance of serum translocator protein in patients with traumatic brain injury. Clin Chim Acta. 2019 Jan;488:25-30. doi: 10.1016/j.cca.2018.10.035. Epub 2018 Oct 30. PubMed PMID: 30385279.

11: Du Q, Weng JF, Luo LF, Cen M, Yu WH, Zheng YK, Hu W, Pan JW, Dong XQ. Serum ST2 as a potential prognostic biomarker for traumatic brain injury. Clin Chim Acta. 2018 Dec;487:145-152. doi: 10.1016/j.cca.2018.09.035. Epub 2018 Sep 25. PubMed PMID: 30266513.

12: Zhang J, He M, Song Y, Xu J. Prognostic role of D-dimer level upon admission in patients with traumatic brain injury. Medicine (Baltimore). 2018 Aug;97(31):e11774. doi: 10.1097/MD.0000000000011774. Review. PubMed PMID: 30075606; PubMed Central PMCID: PMC6081171.

13: Margolick J, Dandurand C, Duncan K, Chen W, Evans DC, Sekhon MS, Garraway N, Griesdale DEG, Gooderham P, Hameed SM. A Systematic Review of the Risks and Benefits of Venous Thromboembolism Prophylaxis in Traumatic Brain Injury. Can J Neurol Sci. 2018 Jul;45(4):432-444. doi: 10.1017/cjn.2017.275. Epub 2018 Jun 13. PubMed PMID: 29895339.

14: Lindblad C, Thelin EP, Nekludov M, Frostell A, Nelson DW, Svensson M, Bellander BM. Assessment of Platelet Function in Traumatic Brain Injury-A Retrospective Observational Study in the Neuro-Critical Care Setting. Front Neurol. 2018 Jan 26;9:15. doi: 10.3389/fneur.2018.00015. eCollection 2018. PubMed PMID: 29434566; PubMed Central PMCID: PMC5790800.

- 15: Feng MJ, Ning WB, Wang W, Lv ZH, Liu XB, Zhu Y, Gao W, Jin HZ, Gao SS. Serum S100A12 as a prognostic biomarker of severe traumatic brain injury. *Clin Chim Acta.* 2018 May;480:84-91. doi: 10.1016/j.cca.2018.01.044. Epub 2018 Jan 31. PubMed PMID: 29408171.
- 16: Di G, Liu H, Jiang X, Dai Y, Chen S, Wang Z, Liu H. Clinical Predictors of Progressive Hemorrhagic Injury in Children with Mild Traumatic Brain Injury. *Front Neurol.* 2017 Nov 13;8:560. doi: 10.3389/fneur.2017.00560. eCollection 2017. PubMed PMID: 29250024; PubMed Central PMCID: PMC5718156.
- 17: Karri J, Cardenas JC, Matijevic N, Wang YW, Choi S, Zhu L, Cotton BA, Kitagawa R, Holcomb JB, Wade CE. Early Fibrinolysis Associated with Hemorrhagic Progression Following Traumatic Brain Injury. *Shock.* 2017 Dec;48(6):644-650. doi: 10.1097/SHK.0000000000000912. PubMed PMID: 28614144.
- 18: Yang DB, Yu WH, Dong XQ, Zhang ZY, Du Q, Zhu Q, Che ZH, Wang H, Shen YF, Jiang L. Serum macrophage migration inhibitory factor concentrations correlate with prognosis of traumatic brain injury. *Clin Chim Acta.* 2017 Jun;469:99-104. doi: 10.1016/j.cca.2017.03.030. Epub 2017 Mar 30. PubMed PMID: 28366792.
- 19: Dong XQ, Yu WH, Zhang ZY, Yang DB, Du Q, Wang H, Shen YF, Jiang L, Che ZH, Zhu Q. Serum thioredoxin and in-hospital major adverse events after traumatic brain injury. *Clin Chim Acta.* 2017 Jun;469:75-80. doi: 10.1016/j.cca.2017.03.024. Epub 2017 Mar 24. PubMed PMID: 28347674.
- 20: Hu GW, Lang HL, Guo H, Wu L, Zhang P, Kuang W, Zhu XG. A risk score based on admission characteristics to predict progressive hemorrhagic injury from traumatic brain injury in children. *Eur J Pediatr.* 2017 Jun;176(6):689-696. doi: 10.1007/s00431-017-2897-9. Epub 2017 Mar 25. PubMed PMID: 28343321.
- 21: Chen Q, Feng Z, Tan Q, Guo J, Tang J, Tan L, Feng H, Chen Z. Post-hemorrhagic hydrocephalus: Recent advances and new therapeutic insights. *J Neurol Sci.* 2017 Apr 15;375:220-230. doi: 10.1016/j.jns.2017.01.072. Epub 2017 Feb 1. Review. PubMed PMID: 28320134.
- 22: Wan X, Fan T, Wang S, Zhang S, Liu S, Yang H, Shu K, Lei T. Progressive hemorrhagic injury in patients with traumatic intracerebral hemorrhage: characteristics, risk factors and impact on management. *Acta Neurochir (Wien).* 2017 Feb;159(2):227-235. doi: 10.1007/s00701-016-3043-6. Epub 2016 Dec 9. PubMed PMID: 27943076.
- 23: Vedantam A, Yamal JM, Rubin ML, Robertson CS, Gopinath SP. Progressive hemorrhagic injury after severe traumatic brain injury: effect of hemoglobin transfusion thresholds. *J Neurosurg.* 2016 Nov;125(5):1229-1234. Epub 2016 Mar 4. PubMed PMID: 26943843; PubMed Central PMCID: PMC5065393.
- 24: Liu J, Tian HL. Relationship between trauma-induced coagulopathy and progressive hemorrhagic injury in patients with traumatic brain injury. *Chin J Traumatol.* 2016 Jun 1;19(3):172-5. Review. PubMed PMID: 27321300; PubMed Central PMCID: PMC4908229.
- 25: Wu GQ, Chou XM, Ji WJ, Yang XG, Lan LX, Sheng YJ, Shen YF, Li JR, Huang GZ, Yu WH, Dong XQ, Du Q, Yang DB, Zhang ZY, Wang H, Shen YF, Jiang L. The prognostic value of plasma nesfatin-1 concentrations in patients with traumatic brain injury. *Clin Chim Acta.* 2016 Jul 1;458:124-8. doi: 10.1016/j.cca.2016.05.001. Epub 2016 May 4. PubMed PMID: 27155585.
- 26: Shen YF, Yu WH, Dong XQ, Du Q, Yang DB, Wu GQ, Zhang ZY, Wang H, Jiang L. The change of plasma galectin-3 concentrations after traumatic brain injury. *Clin Chim Acta.* 2016 May 1;456:75-80.

doi: 10.1016/j.cca.2016.02.029. Epub 2016 Mar 2. PubMed PMID: 26944570.

27: Fiaschi P, Severino M, Ravegnani GM, Piatelli G, Consales A, Accogli A, Capra V, Cama A, Pavanello M. Idiopathic Cervical Hematomyelia in an Infant: Spinal Cord Injury without Radiographic Abnormality Caused by a Trivial Trauma? Case Report and Review of the Literature. *World Neurosurg.* 2016 Jun;90:38-44. doi: 10.1016/j.wneu.2016.01.094. Epub 2016 Feb 16. Review. PubMed PMID: 26899465.

28: Yuan Q, Sun YR, Wu X, Yu J, Li ZQ, Du ZY, Wu XH, Zhou LF, Hu J. Coagulopathy in Traumatic Brain Injury and Its Correlation with Progressive Hemorrhagic Injury: A Systematic Review and Meta-Analysis. *J Neurotrauma.* 2016 Jul 15;33(14):1279-91. doi: 10.1089/neu.2015.4205. Epub 2016 Mar 22. Review. PubMed PMID: 26850305.

30: Martínez-Valverde T, Vidal-Jorge M, Martínez-Saez E, Castro L, Arikan F, Cordero E, Rădoi A, Poca MA, Simard JM, Sahuquillo J. Sulfonylurea Receptor 1 in Humans with Post-Traumatic Brain Contusions. *J Neurotrauma.* 2015 Oct 1;32(19):1478-87. doi: 10.1089/neu.2014.3706. Epub 2015 Jun 3. PubMed PMID: 26398596; PubMed Central PMCID: PMC4589328.

31: Cepeda S, Gómez PA, Castaño-Leon AM, Martínez-Pérez R, Munarriz PM, Lagares A. Traumatic Intracerebral Hemorrhage: Risk Factors Associated with Progression. *J Neurotrauma.* 2015 Aug 15;32(16):1246-53. doi: 10.1089/neu.2014.3808. Epub 2015 Apr 15. PubMed PMID: 25752340.

32: da Costa MD, Paz Dde A, Rodrigues TP, Gandolfi AC, Lamis FC, Stavale JN, Suriano IC, Cetl LD, Cavalheiro S. Hemorrhagic onset of spinal angiolioma. *J Neurosurg Spine.* 2014 Dec;21(6):913-5. doi: 10.3171/2014.9.SPINE131162. Epub 2014 Oct 10. PubMed PMID: 25303620.

33: Yuan Q, Wu X, Du ZY, Sun YR, Yu J, Li ZQ, Wu XH, Mao Y, Zhou LF, Hu J. Low-dose recombinant factor VIIa for reversing coagulopathy in patients with isolated traumatic brain injury. *J Crit Care.* 2015 Feb;30(1):116-20. doi: 10.1016/j.jcrc.2014.07.009. Epub 2014 Jul 11. PubMed PMID: 25092615.

34: Yang DB, Yu WH, Dong XQ, Du Q, Shen YF, Zhang ZY, Zhu Q, Che ZH, Liu QJ, Wang H, Jiang L, Du YF. Plasma copeptin level predicts acute traumatic coagulopathy and progressive hemorrhagic injury after traumatic brain injury. *Peptides.* 2014 Aug;58:26-9. doi: 10.1016/j.peptides.2014.05.015. Epub 2014 Jun 4. PubMed PMID: 24905622.

35: Li C, Pei B, Wu X, Lu X, Hu J, Zhou L. [Activity of factor VII in patients with isolated blunt traumatic brain injury: association with coagulopathy and progressive hemorrhagic injury]. *Zhonghua Yi Xue Za Zhi.* 2014 Mar 11;94(9):688-91. Chinese. PubMed PMID: 24842210.

36: Simard JM, Woo SK, Aarabi B, Gerzanich V. The Sur1-Trpm4 Channel in Spinal Cord Injury. *J Spine.* 2013 Aug 17;Suppl 4. pii: 002. PubMed PMID: 24834370; PubMed Central PMCID: PMC4019017.

37: Wu X, Du Z, Yu J, Sun Y, Pei B, Lu X, Tang Z, Yin M, Zhou L, Hu J. Activity of factor VII in patients with isolated blunt traumatic brain injury: association with coagulopathy and progressive hemorrhagic injury. *J Trauma Acute Care Surg.* 2014 Jan;76(1):114-20. doi: 10.1097/TA.0b013e3182a8fe48. PubMed PMID: 24368365.

38: Simard JM, Popovich PG, Tsymbalyuk O, Caridi J, Gullapalli RP, Kilbourne MJ, Gerzanich V. MRI evidence that glibenclamide reduces acute lesion expansion in a rat model of spinal cord injury. *Spinal Cord.* 2013 Nov;51(11):823-7. doi: 10.1038/sc.2013.99. Epub 2013 Sep 17. PubMed PMID: 24042989; PubMed Central PMCID: PMC4076111.

39: Ding J, Yuan F, Guo JY, Chen H, Tian HL. Influence of glibenclamide on outcome in patients with

- type 2 diabetes and traumatic brain injury. *Clin Neurol Neurosurg.* 2013 Oct;115(10):2166-9. doi: 10.1016/j.clineuro.2013.08.010. Epub 2013 Aug 17. PubMed PMID: 23998719.
- 40: Yuan F, Ding J, Chen H, Guo Y, Wang G, Gao WW, Chen SW, Tian HL. Predicting progressive hemorrhagic injury after traumatic brain injury: derivation and validation of a risk score based on admission characteristics. *J Neurotrauma.* 2012 Aug 10;29(12):2137-42. doi: 10.1089/neu.2011.2233. Epub 2012 Jun 25. PubMed PMID: 22568757; PubMed Central PMCID: PMC3419842.
- 41: Seddighi A, Seddighi AS, Zali AR, Baqdashti HR. Presentation of a minimally symptomatic large extradural hematoma in a patient with an arachnoid cyst: a case report and review of the literature. *J Med Case Rep.* 2011 Dec 19;5:581. doi: 10.1186/1752-1947-5-581. PubMed PMID: 22182235; PubMed Central PMCID: PMC3339374.
- 42: Simard JM, Tsymbalyuk O, Keledjian K, Ivanov A, Ivanova S, Gerzanich V. Comparative effects of glibenclamide and riluzole in a rat model of severe cervical spinal cord injury. *Exp Neurol.* 2012 Jan;233(1):566-74. doi: 10.1016/j.expneurol.2011.11.044. Epub 2011 Dec 8. PubMed PMID: 22177998; PubMed Central PMCID: PMC3272255.
- 43: Simard JM, Gerzanich V. When replication teaches more than the original experiment—the saga of the unknown unknown. *Exp Neurol.* 2012 Feb;233(2):623-4. doi: 10.1016/j.expneurol.2011.03.023. Epub 2011 Nov 10. PubMed PMID: 22078759; PubMed Central PMCID: PMC3278910.
- 44: Kurland D, Hong C, Aarabi B, Gerzanich V, Simard JM. Hemorrhagic progression of a contusion after traumatic brain injury: a review. *J Neurotrauma.* 2012 Jan 1;29(1):19-31. doi: 10.1089/neu.2011.2122. Epub 2011 Dec 5. Review. PubMed PMID: 21988198; PubMed Central PMCID: PMC3253310.
- 45: Rahme R, Weil AG, Bojanowski MW. Early rerupture of cerebral arteriovenous malformations: beware the progressive hemispheric swelling. *Med Hypotheses.* 2011 Apr;76(4):570-3. doi: 10.1016/j.mehy.2011.01.003. Epub 2011 Feb 1. PubMed PMID: 21282013.
- 46: Simard JM, Woo SK, Norenberg MD, Tosun C, Chen Z, Ivanova S, Tsymbalyuk O, Bryan J, Landsman D, Gerzanich V. Brief suppression of Abcc8 prevents autodestruction of spinal cord after trauma. *Sci Transl Med.* 2010 Apr 21;2(28):28ra29. doi: 10.1126/scitranslmed.3000522. PubMed PMID: 20410530; PubMed Central PMCID: PMC2903041.
- 47: Tian HL, Chen H, Wu BS, Cao HL, Xu T, Hu J, Wang G, Gao WW, Lin ZK, Chen SW. D-dimer as a predictor of progressive hemorrhagic injury in patients with traumatic brain injury: analysis of 194 cases. *Neurosurg Rev.* 2010 Jul;33(3):359-65; discussion 365-6. doi: 10.1007/s10143-010-0251-z. Epub 2010 Mar 27. PubMed PMID: 20349100.
- 48: Tong WS, Zheng P, Xu JF, Guo YJ, Zeng JS, Yang WJ, Li GY, He B, Yu H. Early CT signs of progressive hemorrhagic injury following acute traumatic brain injury. *Neuroradiology.* 2011 May;53(5):305-9. doi: 10.1007/s00234-010-0659-8. Epub 2010 Feb 4. PubMed PMID: 20131047.
- 49: Simard JM, Kilbourne M, Tsymbalyuk O, Tosun C, Caridi J, Ivanova S, Keledjian K, Bochicchio G, Gerzanich V. Key role of sulfonylurea receptor 1 in progressive secondary hemorrhage after brain contusion. *J Neurotrauma.* 2009 Dec;26(12):2257-67. doi: 10.1089/neu.2009.1021. PubMed PMID: 19604096; PubMed Central PMCID: PMC2824216.
- 50: Su IC, Yang CC, Wang WH, Lee JE, Tu YK, Wang KC. Acute cerebral ischemia following intraventricular hemorrhage in moyamoya disease: early perfusion computed tomography findings. *J Neurosurg.* 2008 Dec;109(6):1049-51. doi: 10.3171/JNS.2008.109.12.1049. PubMed PMID: 19035718.

- 51: Vural M, Yarar C, Durmaz R, Atasoy MA. Spontaneous acute subdural hematoma and chronic epidural hematoma in a child with F XIII deficiency. *J Emerg Med.* 2010 Jan;38(1):25-9. doi: 10.1016/j.jemermed.2007.11.041. Epub 2008 Jun 2. PubMed PMID: 18514462.
- 52: Zhang A, Collinson RL, Hurst RW, Weigle JB. Rheolytic thrombectomy for cerebral sinus thrombosis. *Neurocrit Care.* 2008;9(1):17-26. doi: 10.1007/s12028-008-9058-y. PubMed PMID: 18250978.
- 53: Akhaddar A, Albouzidi A, Elmostarchid B, Gazzaz M, Boucetta M. Sudden onset of paraplegia caused by hemorrhagic spinal epidural angiolioma. A case report. *Eur Spine J.* 2008 Sep;17 Suppl 2:S296-8. doi: 10.1007/s00586-008-0591-3. Epub 2008 Jan 29. PubMed PMID: 18228054; PubMed Central PMCID: PMC2525899.
- 54: Mocco J, Shelton CE, Sergot P, Ducruet AF, Komotar RJ, Otten ML, Sosunov SA, Macarthur RB, Kennedy TP, Connolly ES Jr. O-desulfated heparin improves outcome after rat cerebral ischemia/reperfusion injury. *Neurosurgery.* 2007 Dec;61(6):1297-303; discussion 1303-4. PubMed PMID: 18162910.
- 55: Simard JM, Tsymbalyuk O, Ivanov A, Ivanova S, Bhatta S, Geng Z, Woo SK, Gerzanich V. Endothelial sulfonylurea receptor 1-regulated NC Ca-ATP channels mediate progressive hemorrhagic necrosis following spinal cord injury. *J Clin Invest.* 2007 Aug;117(8):2105-13. PubMed PMID: 17657312; PubMed Central PMCID: PMC1924498.
- 56: Kurokawa R, Kawase T. Spinal arachnoid cyst causing paraplegia following skull base surgery. *Neurol Med Chir (Tokyo).* 2006 Jun;46(6):309-12. PubMed PMID: 16794354.
- 57: Thomé C, Zevgaridis D. Delayed visual deterioration after pituitary surgery-a review introducing the concept of vascular compression of the optic pathways. *Acta Neurochir (Wien).* 2004 Oct;146(10):1131-5; discussion 1135-6. Review. PubMed PMID: 15744849.
- 58: Ziyal IM, Aydin S, Inci S, Sahin A, Ozgen T. Multilevel acute spinal epidural hematoma in a patient with chronic renal failure-case report. *Neurol Med Chir (Tokyo).* 2003 Aug;43(8):409-12. PubMed PMID: 12968810.
- 59: Sawauchi S, Taya K, Hashimoto T, Ishii T, Otsuka T, Morooka S, Yuhki K, Takao H, Murakami S, Abe T. [Progressive brain injury]. *No Shinkei Geka.* 2003 Jul;31(7):749-55. Japanese. PubMed PMID: 12884789.
- 60: Maraire JN, Abdulrauf SI, Berger S, Knisely J, Awad IA. De novo development of a cavernous malformation of the spinal cord following spinal axis radiation. Case report. *J Neurosurg.* 1999 Apr;90(2 Suppl):234-8. PubMed PMID: 10199254.
- 61: Kawai N, Keep RF, Betz AL. Hyperglycemia and the vascular effects of cerebral ischemia. *Acta Neurochir Suppl.* 1997;70:27-9. PubMed PMID: 9416268.
- 62: Hariri RJ, Ghajar JB, Bahramian K, Sharif S, Barie PS. Alterations in intracranial pressure and cerebral blood volume in endotoxemia. *Surg Gynecol Obstet.* 1993 Feb;176(2):155-66. PubMed PMID: 8421804.
- ¹⁾ Zhang D, Gong S, Jin H, Wang J, Sheng P, Zou W, Dong Y, Hou L. Coagulation Parameters and Risk of Progressive Hemorrhagic Injury after Traumatic Brain Injury: A Systematic Review and Meta-Analysis. *Biomed Res Int.* 2015;2015:261825. Epub 2015 Sep 17. PubMed PMID: 26457298.

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Xu DX, Du WT, Li X, Wu ZX, Yu GF. D-dimer/fibrinogen ratio for the prediction of progressive hemorrhagic injury after traumatic brain injury. *Clin Chim Acta*. 2020 Apr 22. pii: S0009-8981(20)30177-7. doi: 10.1016/j.cca.2020.04.022. [Epub ahead of print] PubMed PMID: 32333859.

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