Behav Brain Res

2016 Feb 1;298(Pt B):158-66.
doi: 10.1016/j.bbr.2015.11.003. Epub 2015 Nov 7.

Cerebral mast cells contribute to postoperative cognitive dysfunction by promoting blood brain barrier disruption

Susu Zhang [1], Hongquan Dong [1], Xiang Zhang [1], Nana Li [1], Jie Sun [2], Yanning Qian [3]
Affiliations

- PMID: **26554724**
- DOI: 10.1016/j.bbr.2015.11.003

Abstract

Trauma induced neuroinflammation plays a key role in the development of postoperative cognitive dysfunction (POCD). The blood-brain barrier (BBB), a highly specialized endothelial layer, is exquisitely sensitive to inflammatory insults, which can result in numerous neurocognitive syndromes. While brain mast cells are the "first responder" in the injury, the functional interactions between mast cells and the BBB remain poorly understood. Our results demonstrate that tibial fracture surgery can induce cognitive impairment relating to an inflammatory response and destabilization of the BBB. Disodium cromoglycate (cromolyn)--which acts as a mast cell stabilizer--inhibited this effect. Specifically, cromolyn resulted in ameliorated cognitive ability, decrease of inflammatory cytokines and increase of BBB stability. Taken together, these results suggest that activated mast cells contributed to central nervous system inflammation and cognitive dysfunction by promoting BBB disruption, and interactions between mast cells and the BBB could constitute a new and unique therapeutic target for POCD.

Keywords: Blood-brain barrier; Cognitive; Mast cell; Neuroinflammation; Postoperative cognitive dysfunction.

Similar articles

- IL-17A contributes to perioperative neurocognitive disorders through blood-brain barrier disruption in aged mice. Ni P, Dong H, Wang Y, Zhou Q, Xu M, Qian Y, Sun J. J Neuroinflammation. 2018 Nov 30;15(1):332. doi: 10.1186/s12974-018-1374-3. PMID: 30501622 Free PMC article.

- Activated brain mast cells contribute to postoperative cognitive dysfunction by evoking microglia activation and neuronal apoptosis. Zhang X, Dong H, Li N, Zhang S, Sun J, Zhang S, Qian Y. J Neuroinflammation. 2016 May 31;13(1):127. doi: 10.1186/

s12974-016-0592-9. PMID: 27245661 Free PMC article.

- Cerebral Mast Cells Participate In Postoperative Cognitive Dysfunction by Promoting Astrocyte Activation. Zhang X, Yao H, Qian Q, Li N, Jin W, Qian Y. Cell Physiol Biochem. 2016;40(1-2):104-116. doi: 10.1159/000452528. Epub 2016 Nov 18. PMID: 27855371

- Bidirectional relationship of mast cells-neurovascular unit communication in neuroinflammation and its involvement in POCD. Li N, Zhang X, Dong H, Hu Y, Qian Y. Behav Brain Res. 2017 Mar 30;322(Pt A):60-69. doi: 10.1016/j.bbr.2017.01.006. Epub 2017 Jan 9. PMID: 28082194 Review.

- Cerebral protection: inflammation, endothelial dysfunction, and postoperative cognitive dysfunction. Riedel B, Browne K, Silbert B. Curr Opin Anaesthesiol. 2014 Feb;27(1): 89-97. doi: 10.1097/ACO.0000000000000032. PMID: 24300462 Review.

See all similar articles

Cited by *21 articles*

- Acute Traumatic Brain Injury-Induced Neuroinflammatory Response and Neurovascular Disorders in the Brain. Kempuraj D, Ahmed ME, Selvakumar GP, Thangavel R, Raikwar SP, Zaheer SA, Iyer SS, Govindarajan R, Nattanmai Chandrasekaran P, Burton C, James D, Zaheer A. Neurotox Res. 2020 Sep 21:1-10. doi: 10.1007/s12640-020-00288-9. Online ahead of print. PMID: 32955722 Free PMC article.

- Pathomechanisms of Non-Traumatic Acute Brain Injury in Critically Ill Patients. Dabrowski W, Siwicka-Gieroba D, Gasinska-Blotniak M, Zaid S, Jezierska M, Pakulski C, Williams Roberson S, Wesley Ely E, Kotfis K. Medicina (Kaunas). 2020 Sep 13;56(9): 469. doi: 10.3390/medicina56090469. PMID: 32933176 Free PMC article. Review.

- Mast Cell Deficiency Protects Mice from Surgery-Induced Neuroinflammation. Zhang X, Dong H, Wang F, Zhang J. Mediators Inflamm. 2020 Aug 1;2020:1921826. doi: 10.1155/2020/1921826. eCollection 2020. PMID: 32801993 Free PMC article.

- Potential Biochemical Mechanisms of Brain Injury in Diabetes Mellitus. Ma WX, Tang J, Lei ZW, Li CY, Zhao LQ, Lin C, Sun T, Li ZY, Jiang YH, Jia JT, Liang CZ, Liu JH, Yan LJ. Aging Dis. 2020 Jul 23;11(4):978-987. doi: 10.14336/AD.2019.0910. eCollection 2020 Jul. PMID: 32765958 Free PMC article. Review.

- Mast cell-mediated neuroinflammation may have a role in attention deficit hyperactivity disorder (Review). Song Y, Lu M, Yuan H, Chen T, Han X. Exp Ther Med. 2020 Aug; 20(2):714-726. doi: 10.3892/etm.2020.8789. Epub 2020 May 25. PMID: 32742317 Free PMC article. Review.

- The Mast Cell Is an Early Activator of Lipopolysaccharide-Induced Neuroinflammation and Blood-Brain Barrier Dysfunction in the Hippocampus. Wang Y, Sha H, Zhou L, Chen Y, Zhou Q, Dong H, Qian Y. Mediators Inflamm. 2020 Feb 24;2020:8098439. doi: 10.1155/2020/8098439. eCollection 2020. PMID: 32184702 Free PMC article.

- The Investigation of Hippocampus-Dependent Cognitive Decline Induced by Anesthesia/Surgery in Mice Through Integrated Behavioral *Z*-Scoring. Meng B, Li X, Lu B, Liu R, Yuan H, Zhai X, Qin J, Chen Z, Zheng J, Chen J. Front Behav Neurosci. 2020 Jan 22;13:282. doi: 10.3389/fnbeh.2019.00282. eCollection 2019. PMID: 32038186 Free PMC article.

- Stabilization of Brain Mast Cells Alleviates LPS-Induced Neuroinflammation by Inhibiting Microglia Activation. Dong H, Wang Y, Zhang X, Zhang X, Qian Y, Ding H, Zhang S. Front Cell Neurosci. 2019 May 3;13:191. doi: 10.3389/fncel.2019.00191. eCollection 2019. PMID: 31130850 Free PMC article.

- Japanese encephalitis virus neuropenetrance is driven by mast cell chymase. Hsieh JT, Rathore APS, Soundarajan G, St John AL. Nat Commun. 2019 Feb 11;10(1):706. doi: 10.1038/s41467-019-08641-z. PMID: 30742008 Free PMC article.

- The Role of Neuroinflammation in Postoperative Cognitive Dysfunction: Moving From Hypothesis to Treatment. Safavynia SA, Goldstein PA. Front Psychiatry. 2019 Jan 17;9:752. doi: 10.3389/fpsyt.2018.00752. eCollection 2018. PMID: 30705643 Free PMC article. Review.

- Surgery, neuroinflammation and cognitive impairment. Alam A, Hana Z, Jin Z, Suen KC, Ma D. EBioMedicine. 2018 Nov;37:547-556. doi: 10.1016/j.ebiom.2018.10.021. Epub 2018 Oct 19. PMID: 30348620 Free PMC article. Review.

- Effect of tryptase on mouse brain microvascular endothelial cells via protease-activated receptor 2. Zhou Q, Wang YW, Ni PF, Chen YN, Dong HQ, Qian YN. J Neuroinflammation. 2018 Aug 31;15(1):248. doi: 10.1186/s12974-018-1287-1. PMID: 30170602 Free PMC article.

- Does Dexmedetomidine Ameliorate Postoperative Cognitive Dysfunction? A Brief Review of the Recent Literature. Carr ZJ, Cios TJ, Potter KF, Swick JT. Curr Neurol Neurosci Rep. 2018 Aug 6;18(10):64. doi: 10.1007/s11910-018-0873-z. PMID: 30083844 Review.

- Emerging Roles of Immune Cells in Postoperative Cognitive Dysfunction. Liu Y, Yin Y. Mediators Inflamm. 2018 Feb 18;2018:6215350. doi: 10.1155/2018/6215350. eCollection 2018. PMID: 29670465 Free PMC article. Review.

- An Inflammation-Centric View of Neurological Disease: Beyond the Neuron. Skaper SD, Facci L, Zusso M, Giusti P. Front Cell Neurosci. 2018 Mar 21;12:72. doi: 10.3389/fncel.

2018.00072. eCollection 2018. PMID: 29618972 Free PMC article. Review.

- Reciprocal Interactions of Mitochondria and the Neuroimmunoendocrine System in Neurodegenerative Disorders: An Important Role for Melatonin Regulation. Polyakova VO, Kvetnoy IM, Anderson G, Rosati J, Mazzoccoli G, Linkova NS. Front Physiol. 2018 Mar 12;9:199. doi: 10.3389/fphys.2018.00199. eCollection 2018. PMID: 29593561 Free PMC article. Review.

- Neuroimmune Axes of the Blood-Brain Barriers and Blood-Brain Interfaces: Bases for Physiological Regulation, Disease States, and Pharmacological Interventions. Erickson MA, Banks WA. Pharmacol Rev. 2018 Apr;70(2):278-314. doi: 10.1124/pr.117.014647. PMID: 29496890 Free PMC article. Review.

- The Anti-allergic Cromones: Past, Present, and Future. Sinniah A, Yazid S, Flower RJ. Front Pharmacol. 2017 Nov 14;8:827. doi: 10.3389/fphar.2017.00827. eCollection 2017. PMID: 29184504 Free PMC article. Review.

- Anesthesia and Surgery Impair Blood-Brain Barrier and Cognitive Function in Mice. Yang S, Gu C, Mandeville ET, Dong Y, Esposito E, Zhang Y, Yang G, Shen Y, Fu X, Lo EH, Xie Z. Front Immunol. 2017 Aug 9;8:902. doi: 10.3389/fimmu.2017.00902. eCollection 2017. PMID: 28848542 Free PMC article.

- Brain and Peripheral Atypical Inflammatory Mediators Potentiate Neuroinflammation and Neurodegeneration. Kempuraj D, Thangavel R, Selvakumar GP, Zaheer S, Ahmed ME, Raikwar SP, Zahoor H, Saeed D, Natteru PA, Iyer S, Zaheer A. Front Cell Neurosci. 2017 Jul 24;11:216. doi: 10.3389/fncel.2017.00216. eCollection 2017. PMID: 28790893 Free PMC article. Review.

- Remote ischemic preconditioning improves the cognitive function of elderly patients following colon surgery: A randomized clinical trial. He Z, Xu N, Qi S. Medicine (Baltimore). 2017 Apr;96(17):e6719. doi: 10.1097/MD.0000000000006719. PMID: 28445286 Free PMC article. Clinical Trial.