The Current State of Beta-Blocker Use to Improve Outcome After Traumatic Brain Injury

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Introduction

- In traumatic brain injury (TBI), a catecholamine surge in the acute setting post-injury has been observed and carries an increased risk of mortality.¹²
- Several studies have assessed the role of beta-blockers in dampening the effects of this post-TBI hyperadrenergic state.²
- We conducted a review of the current literature to provide perspective on the use of beta-blockers to improve outcome in patients following TBI.
Methods

- We conducted a systematic review beginning with a literature search on PubMed and Web of Science for peer-reviewed articles published under the search terms “traumatic brain injury” and “beta-blocker” between the years 1979 and 2019.

- 143 articles were available for screening after 50 duplicates were removed.

- These articles were screened using PRISMA criteria and Covidence systematic review software (Veritas Health Innovation, Melbourne, Australia) to ensure they met our inclusion criteria, including: (i) was a retrospective, prospective, or randomized controlled study examining the effect of beta-blockers in the acute phase after TBI in humans, (ii) reported either mortality or functional outcome, and (iii) was available in English.

- This resulted in 16 studies that were ultimately included in our systematic review (Fig 1).
Methods

Figure 1. PRISMA study flow diagram demonstrating the number of articles retained at each stage of data acquisition.

PubMed (n = 87)
Web of Science (n = 106)
Records screened after 50 duplicates were removed (n = 143)

Inclusion Criteria:
(1) The study must be a retrospective, prospective, or randomized controlled trial analyzing the use of beta-blockers after acute traumatic brain injuries.
(2) The study must report either mortality or functional outcomes.
(3) The study must be in English and include only human subjects.

Studies included in review (n= 16)
Results

- Sixteen studies were included in our review. The majority (81.3%) of these were retrospective in design.

- Fifteen manuscripts (93.8%) reported on the effect of beta-blockers on mortality, while one study assessed the effect on functional outcome.
Two recent retrospective studies observed a reduction in mortality among TBI patients who received beta-blockers in the acute phase post-injury, compared to those who did not (9.3% vs. 15.9%, p = 0.003 and 3% vs. 15%, p = 0.002).\(^1,4\)

The effect was most pronounced when propranolol, which is able to cross the blood-brain barrier, was the beta-blocker used.

Overall, in the reviewed studies there was an average mortality rate of approximately 14% among patients that received any beta-blocker during the acute phase post-TBI versus a mortality rate of approximately 20% in those who did not.
Discussion

- Review of available studies suggests that beta-blocker use in the acute phase post-TBI, particularly non-selective beta-blockers (e.g. propranolol), may have a beneficial effect on mortality and functional outcome.\(^1,3,4\)

- These results are intriguing and routine administration of beta-blockers may hold promise as a potential therapeutic intervention following TBI.

- However, significant questions remain, including timing, dose, and safety (e.g. prevention of hypotension, decreased cardiac output) of routine beta-blocker administration after TBI, warranting future high-quality studies to further investigate these compelling findings.
A significant catecholamine surge can manifest after TBI, potentially leading to secondary injury and worse outcomes.

Beta blockers, specifically non-selective agents such as propranolol, show promise in dampening this TBI-induced hyperadrenergic state and may improve functional outcomes and reduce mortality.

Additional investigation is warranted to examine optimal timing, dose, duration, and safety parameters for routine use of beta-blockers after TBI.

Ultimately, a large, multicenter, randomized trial would be useful to determine if routine propranolol administration after acute TBI is safe and effective in improving outcomes.
References


