Effect of early and delayed decompressive craniectomy on secondary brain damage after controlled cortical impact in mice

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The timing of decompressive craniectomy for the treatment of increased intracranial pressure (ICP) after traumatic brain injury (TBI) is a widely discussed clinical issue. Although we showed recently that early decompression is beneficial following experimental TBI, it remains unclear to what degree decompression craniectomy reduces secondary brain damage and if craniectomy is still beneficial when it is delayed by several hours as often inevitable during daily clinical practice. The aim of the current study was therefore to investigate the influence of craniectomy on secondary contusion expansion and brain edema formation and to determine the therapeutic window of craniectomy. Male C57/Bl6 mice were subjected to controlled cortical impact injury. Contusion volume, brain edema formation, and opening of the blood-brain barrier were investigated 2, 6, 12, and 24 h and 7 days after trauma. The effect of decompression craniectomy on secondary brain damage was studied in control mice (closed skull) and in animals craniotomized immediately or with a delay of 1, 3, or 8 h after trauma. Twenty-four hours after trauma, the time point of maximal lesion expansion (+60% vs. 15 min after trauma) and brain edema formation (+3.0% water content vs. sham), contusion volume in craniotomized mice did not show any secondary expansion; that is, contusion volume was similar to that observed in mice sacrificed immediately after trauma (18.3 +/- 5.3 vs. 22.2 +/- 1.4 mm(3)). Furthermore, brain edema formation was reduced by 52% in craniotomized animals. The beneficial effect of craniectomy was still present even when treatment was delayed by up to 3 h after trauma (p < 0.05). The current study clearly demonstrates that early craniectomy prevents secondary brain damage and significantly reduces brain edema formation after experimental TBI. Evaluation of early craniectomy as a therapeutic option after TBI in humans may therefore be indicated.

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