Developing a Method of Slowing Brain Tissue Degradation through Temperature, Sodium Bicarbonate and Antibiotics for Traumatic Brain Injury Testing

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Injuries to the brain come in many different forms, from traumatic brain injuries such as concussions and contusions to acquired brain injuries such as anoxia and hypoxia. In order to study these injuries, human cadavers have been used to simulate an *in vivo* subject condition. However, at the instant of death, the brain begins its tissue decomposition process. This quick deterioration of brain tissue does not allow for a long time window to test the cadaver where material properties are similar to *in vivo* conditions. The objective of this study was to determine a method to delay brain tissue degradation in postmortem subjects using storage temperature control, antibiotics, and sodium bicarbonate. Studies have been conducted using temperature and antibiotics to slow down this degradation process for human tissue and organs [Peters1997, Csonge 1995, Potier 2010]. Csonge used antibiotics to preserve human skin and identified a combination of Amphotericin, Ampicillin, and Ceftazidime that minimized breakdown of tissue over time. For anoxia and hypoxia, sodium bicarbonate has been used clinically to maintain an alkaline environment, inhibiting the pH decrease that triggers the degradation process. The use of antibiotics has not been applied to human brain tissue to observe if there are similar effects, and sodium bicarbonate has not been used for post mortem preservation for any tissue. In the current study, the proposed brain preservation methods were tested using a Post Mortem Human Surrogate (PMHS) less than 36 hours postmortem. Four artificial cerebral spinal fluid (aCSF) storage solutions were used: aCSF by itself, with sodium bicarbonate, with Csonge's antibiotic combination, and with both sodium bicarbonate and the antibiotic solution. Twenty-eight cylindrical samples were taken from the frontal (n=12), parietal (n=9) and occipital (n=7) lobes of the brain. Four frontal lobe samples were stored at room temperature for 24 hours, each in a different solution. The other twenty-four samples were immediately tested. Compression tests were conducted by dropping a 20g weight on the samples. Peak pressure, stiffness, and deformation of samples was measured. At the time of harvest, the average stiffness values for frontal, parietal and occipital lobes were 1.12±0.13N/mm, 0.87±0.27N/mm, and 0.95±0.45N/mm, respectively. After 24 hours of storage, frontal lobe stiffness values were found to be 2.09N/mm for sodium bicarbonate solution, 1.52N/mm for antibiotic solution, 0.94N/mm for antibiotic-sodium bicarbonate solution, and 0.68N/mm for aCSF. Each sample was photographed before and after storage. Based on this initial testing, antibiotic-sodium bicarbonate solution was superior at slowing brain tissue degradation of the isolated samples due to the measured stiffness being most similar to the baseline samples and demonstrating the least visible change in photographs. This slowing of degradation suggests that the antibiotic-sodium bicarbonate solution has promise for extending the usable testing time for postmortem traumatic brain injury testing. Future work prior to the symposium will include testing of additional PMHS, allowing comparison of change in tissue stiffness for different lobes of the brain after storage in different solutions and at different storage temperatures.

REFERENCES:

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