Cerebral Fat Emboli and Cognitive Impairment Following Reamed Intramedullary Nailing

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Purpose: The purpose of this study was to determine the incidence of cerebral fat emboli in patients with traumatic femoral shaft fracture undergoing a reamed intramedullary nail (IMN) procedure. A secondary objective was to examine the association between cerebral fat emboli and cognitive deficits at 6 weeks following hospital discharge. The hypotheses were that 25% of patients would experience cerebral fat emboli and that the presence of intraoperative cerebral fat emboli would be associated with cognitive impairment in patients with femoral shaft fractures.

Methods: This study prospectively enrolled 24 patients, 19 to 65 years of age, admitted to a Level I trauma center for surgical treatment of a femoral shaft fracture with a reamed IMN. Participants were enrolled prior to surgery. Transcranial Doppler (TCD) sonography was used to identify intraoperative cerebral embolic particles. An intake assessment during the hospital stay collected information on demographics, health habits, and preinjury function and general health as measured by the Katz Activities of Daily Living Scale, Functional Activities Questionnaire, and Short Form-12 (SF-12). Preexisting cognitive impairment was assessed with the Informant Questionnaire of Cognitive Decline in the Elderly, short form. Clinical characteristics were abstracted from the medical record. A follow-up assessment 6 weeks after hospitalization measured cognitive impairment using a battery of standardized executive functioning tests (Trails B, Verbal Fluency Test, and Delis-Kaplan Tower Test). Depressive and posttraumatic stress disorder (PTSD) symptoms were also measured at 6-week follow-up with the Patient Health Questionnniare-9 (PHQ-9) and PTSD Checklist–Civilian Version (PCL-C), respectively. Cognitive test scores were converted to T-scores and adjusted for age, education, and gender. Cognitive impairment was defined as having 2 cognitive test scores 1.5 SD below the normative population mean or 1 test score 2 SD below the mean. Differences in demographic, psychosocial, and clinical characteristics between those with and without cognitive impairment were examined with Wilcoxon rank-sum and Fisher exact tests. Association between emboli and presence of cognitive impairment was analyzed using logistic regression analysis. The level of significance was set at $\alpha = 0.05$.

Results: 20 patients completed a 6-week follow-up assessment (83%). Of these, 9 (45%) were admitted to the ICU. One patient in the ICU displayed symptoms of delirium over 5 days. None of the patients received mechanical ventilation. Three participants (15%) had at least two blood transfusions. The average ISS was 15.1 (SD 5.7) and patients stayed an average of 4.6 days in the hospital (SD 2.5). Cerebral fat emboli occurred in 30% of participants both prereaming and postreaming. Ten participants (50%) demonstrated cerebral fat emboli at either prereaming or postreaming. The average number of prereaming and postreaming emboli was 19.3 (SD 46.7) and 7.5 (SD 15.7), respectively. A total of 7 patients (35%) demonstrated cognitive impairment, with 6 having scores below the seventh per-

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centile (T-score <35) on 2 of the 3 tests. None of the patients had preexisting cognitive impairment. The mean scores on the PHQ-9 and PCL-C at 6-week follow-up were 5.2 (SD 4) and 40 (SD 17.8), respectively. 15% reported clinically significant depressive symptoms (PHQ-9 ≥10) and 40% reported clinically significant PTSD symptoms (PCL-C ≥45). No statistically significant association was found between total number of cerebral fat emboli and cognitive impairment ($P = 0.41$).

Conclusion: Cerebral emboli are found in a significant percentage of patients with a femur fracture stabilized with an IMN. A large percentage (35%) exhibit cognitive deficits at 6 weeks postoperatively. 15% reported depressive symptoms and 40% reported PTSD symptoms. Cerebral emboli were not associated with these negative outcomes.