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Mannitol dosing errors made during transport of patients to tertiary hospitals

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Researchers in Alberta, Canada, investigated the use of the drug mannitol before and during transportation of patients with intracranial emergencies from peripheral hospitals to tertiary facilities that house neurosurgery departments. The focus was on the appropriate use of the drug and the extent to which dosing errors may have occurred. The authors found a 22% dosing error rate, with slightly more patients receiving a dose smaller, rather than larger, than the dose range recommended by the Brain Trauma Foundation. Findings of this study are reported and discussed in "Mannitol dosing error during interfacility transfer for intracranial emergencies," by Cameron A. Elliot, MD, Mark MacKenzie, MD, and Cian O'Kelly, MD, MSc,published today online, ahead of print, the *Journal of Neurosurgery*.

Elevated intracranial pressure (ICP) can be caused by increased cerebrospinal fluid surrounding the brain and spinal cord, expanding hematoma or by a rise in pressure within the brain itself. Elevated ICP often accompanies intracranial emergencies (such as traumatic brain injury or spontaneous intracranial bleeding), and if sufficiently high, elevated ICP can, in itself, constitute an intracranial emergency that may lead to poor patient outcomes, even death, if left untreated. Mannitol is frequently used to reduce elevated ICP, and as the authors inform us, the drug can be used to bridge the gap between suspicion of ICP at a peripheral hospital and specialized treatment of ICP at a tertiary hospital.

The authors examined data on mannitol doses and durations of mannitol

infusions given to patients with intracranial injuries before and during helicopter medical evacuations to tertiary hospitals in Alberta, Canada, between 2004 and 2012. These data are housed in the Shock Trauma Air Rescue Society (STARS) patient database. The authors examined the data in light of the Brain Trauma Foundation's Guidelines for the Management of Severe Traumatic Brain Injury. The guidelines recommend that mannitol should be given to patients who present with severe traumatic brain injury (determined by a Glasgow Coma Scale score of 8 or less), clearly exhibit progressive neurological deterioration, or have unilateral or bilateral fixed and/or dilated pupils. The guidelines also recommend that mannitol be administered to these patients before ICP monitoring at a dose of 0.25 to 1 gram per kilogram body weight. For the purposes of the study, the authors deemed less than 0.25 gram per kilogram to be underdosing and more than 1.5 grams per kilograms to be overdosing. They defined a nonbolus infusion as any infusion lasting more than 60 minutes. Because the effect of mannitol is dose dependent, "with higher doses (1 g/kg) providing more sustained control of ICP," the authors point out that a bolus infusion is far more effective in lowering ICP than continuous administration.

The STARS database contains information on 120 patients who received mannitol infusions during the study period. The authors tell us that according to the study criteria, 86 patients (72%) had appropriate indications for mannitol bolus infusions. In 27 patients mannitol was administered incorrectly. Ten patients (8.3%) received underdoses and nine (7.5%) received overdoses. Nonbolus administration occurred in eight patients (6.7%).

Due to privacy issues involving data collection and analysis, the authors could not follow up individual cases to report patient outcomes. However, they do inform us that given the dose-dependent effect of mannitol, the more worrisome potential error in mannitol dosing is underdosing, which occurred in 8.3% of cases. The authors point out

that the mean dose in patients who received low doses was 0.07 grams per kilogram—far below the recommended amount. They also state that the 7% rate of nonbolus administration is of concern because continuous infusion, as opposed to bolus infusion, does not effect a rapid decrease in ICP.

Based on their findings, the authors plan to develop, with the STARS staff, a preflight checklist of mannitol dosing as well as medication error awareness sessions to lower the risk of mannitol infusion errors. The authors hope that their findings will increase awareness of the frequency of dosing error in mannitol administration. Physicians and other health care providers involved in interfacility transport may develop additional strategies to mitigate this issue. The authors plan to engage their local transport stakeholders on this issue and will assess the effectiveness of their interventions two years after engagement and implementation of strategies.

More information: Elliott CA, MacKenzie M, O'Kelly C. Mannitol dosing error during interfacility transfer for intracranial emergencies. *Journal of Neurosurgery*, published online, ahead of print, June 16, 2015; DOI: 10.3171/2014.11.JNS141596