

Introduction

Mannitol, is commonly used to treat raised intracranial pressure (ICP) bridging the gap between recognition and definitive treatment in the setting of intracranial emergency. Anecdotaly its use seems prone to medical error especially during inter-hospital transfer. Therefore, we investigated mannitol dosing error during evacuation to tertiary care facilities for intracranial emergencies. We also investigated the appropriateness of mannitol use based on existing guidelines such as those by the Brian Trauma Foundation (BTF) for inhospital management of severe traumatic brain injury. They recommend mannitol be administered using weight-based dosing of 0.25 - 1.0 g/kg prior to ICP monitoring only in patients with progressive neurological deterioration and/or signs of transtentorial herniation.

Methods

We conducted a retrospective review of the Shock Trauma Air Rescue Society (STARS) electronic patient database of helicopter medical evacuations in Alberta, Canada between 2004-2012 limited to patients receiving mannitol before transfer. We extracted data on mannitol administration; patient characteristics including diagnosis, mechanism, GCS, weight, age and pupils.

Results

120 patients received a mannitol infusion initiated at a peripheral hospital for intracranial emergency (median GCS 6; range 3 – 13). There was a 23% error rate, including an underdosing rate (<0.25 g/kg) of 8.3% (10/120), an overdosing rate (>1.5g/kg) of 7.5% (9/120), and a non-bolus administration rate (> 1 hour) of 6.7% (8/120). 72% of patients had a clear indication to receive mannitol as defined by meeting at least one of the following criterion based on 2007 BTF guidelines: neurological deterioration (11%), severe traumatic brain injury (69%) or pupillary abnormality (25%).

| Table 1: Patient Characteristics | |
|------------------------------------|------------------|
| <i>Characteristic</i> | <i>No. (%)</i> |
| <i>Total patients</i> | 120 |
| <i>Gender</i> | |
| Male | 59 (49.2%) |
| Female | 61 (50.8%) |
| <i>Mean age (years)</i> | 49.0 |
| <i>Median GCS</i> | 6 (range 3 - 13) |
| <i>Pupillary status documented</i> | 51 (43%) |
| <i>CT Head prior to transfer</i> | 5 (4%) |
| <i>Primary diagnosis</i> | |
| Traumatic Brain Injury | 98 (81%) |
| Spontaneous ICH | 13 (11%) |
| Other | 9 (7.5%) |

| Mannitol Dosing Errors | | |
|--------------------------|---------------|-------------------|
| Error Type | No. (%) | Mean |
| Underdosed (< 0.25 g/kg) | 10/120 (8.3%) | 0.07 g/kg |
| Overdosed (>1.5 g/kg) | 9/120 (7.5%) | 1.78 g/kg |
| Non-Bolus (> 60 min) | 8/120 (6.7%) | 90 min (60 – 180) |
| Total | 27/120 (23%) | |

Discussion

Rates of medication error amongst inpatients is approximately 1 - 2% (Dean et al., 2002). Mannitol dosing error in patients evacuated for intracranial emergency is considerably higher at 23%. Underdosing, the most potentially harmful type of error, occurred in 8% of cases with the average dose within this group being 0.07 g/kg (vastly lower than the lowest recommended dose of 0.25 g/kg). Recent work has demonstrated that the effect of mannitol on ICP is dose-dependent, with higher doses (~1g/kg) providing more rapid and sustained control of raised ICP (Sorani et al., 2008).

The majority (72%) of our study population met at least one criterion for mannitol administration with the frequency of underdosing or non-bolus administration amongst patients judged as not appropriate for mannitol therapy being only 9% (3/34).

Discussion

Although some of the underdosing errors were clearly unit errors (eg. 100 mg instead of 100 g) in other circumstances it was not entirely clear why a sub-therapeutic dose was ordered. One potential reason for giving lower doses of mannitol may be out fear of inducing hypotension in the setting of trauma. This was not substantiated in our data as we did not observe any records of post-mannitol infusion hypotension nor were any infusions stopped prior to completion.

Conclusion

Mannitol administration during inter-facility transfer is much more prone to dosing error than baseline risk of medical error amongst inpatients. A pre-transport checklist and/or standardized ordering protocols for mannitol during medical evacuation might help to mitigate this risk.

References

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