CORRESPONDENCE

Compliance with the massive hemorrhage protocol in trauma: a retrospective quality review

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To the Editor,

Sunnybrook Health Sciences Centre is the largest level 1 trauma centre in Canada, with 2,100 trauma activations per year. Although the trauma literature suggests that massive hemorrhage protocol (MHP) reduces mortality,¹ adherence is vital for ongoing success of the MHP. We conducted a retrospective audit of the adherence to our MHP in severely hemorrhaging trauma patients between 1 January 2017 and 31 August 2018. The objective was to determine the overall compliance with the protocol (score: 0–100) and each MHP component. The 11 quality metrics (Table) were developed by committee consensus, tailored to the need of our centre.

There were 96 MHP activations, and 90% of the activations occurred in the trauma bay. Most patients were male (75%). The median [interquartile range (IQR)] age was 41 [25–58] yr, the injury severity score was ≥ 16 in 91% of patients, and most injuries (70%) were blunt. Ten patients were excluded because the MHP was terminated within 30 min. Satisfactory compliance with the MHP (score ≥ 70) was achieved for 51% of activations. The median [IQR] scores for adequate and inadequate compliance groups were 75 [75–85]% and 55 [50–60]%, respectively. The demographics and clinical characteristics were similar between the two groups.

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Table Quality metrics to assess compliance to MHP and level of compliance in each

Metrics	Assigned score (points)	Survivors <i>n</i> = 68	Non-survivors <i>n</i> = 28	<i>P</i> value	Overall compliance <i>n</i> (%)
1) Appropriate trigger: patient received 6 or more units of RBCs within the first 24 hr, or died from hemorrhage before receiving the 6th unit within the first 24 hr	20	42 (61.8%)	26 (92.9%)	0.0025	68/96 (70.8)
2) Collection of group and screen: the confirmatory sample was sent to the lab within 30 min of MHP activation	5	59 (86.8%)	20 (71.4%)	0.0468	74/91 (81.3)
3) Complete trauma laboratory panel as baseline	5	3 (4.4%)	6 (21.4%)	0.0168	3/90 (3.3)
4) Laboratory testing was repeated after 1 hr	5	33 (48.5%)	20 (71.4%)	0.0454	41/84 (48.8)
5) TXA administration: any dose within 3 hr of injury	10	67 (98.5%)	23 (82.1%)	0.0076	81/86 (94.3)
6) First dose of TXA was given within 1 hr of injury	10	65 (95.6%)	26 (92.9%)	0.6269	79/86 (91.2)
7) Second gram of TXA was administered within the first 3 hr of injury	10	43 (63.2%)	19 (67.9%)	0.8151	50/84 (59.5)
8) Hypothermia monitoring: Temperature was measured every 30 min until protocol termination	5	7 (10.3%)	8 (28.6%)	0.0876	8/82 (9.8)
9) Maintaining normothermia: patient was normothermic (> 35°C) by ICU admission	10	51 (75.0%)	17 (60.7%)	0.3052	55/79 (69.6)
10) Transition to group specific blood within 90 min	10	45 (66.2%)	19 (67.9%)	0.3467	49/80 (61.3)
11) Fibrinogen replacement: 10 units of cryoprecipitate was administered if fibrinogen < 1.5 g·L ⁻¹	10	64 (94.1%)	23 (82.1%)	0.0374	43/48 (89.6)
Adequate compliance		33 (49.2%)	10 (55.5%)	0.7916	
Inadequate compliance		34 (50.7%)	8 (44.4%)		

ICU Intensive care unit, MHP massive hemorrhage protocol, RBCs red blood cells, TXA tranexamic acid

Compliance rates were highest for the following: tranexamic acid (TXA) administration (any dose) within three hours (94%), first gram of TXA within the first hour (91%), fibrinogen replacement (89%), and group and screen confirmation within 30 min (82%). The lowest compliance rates were for drawing a full lab panel at MHP activation (3%), monitoring temperature every 30 min (10%), and repeating blood work within one hour after MHP activation (49%).

Higher compliance with appropriate MHP activation was observed in non-survivors compared with survivors (93% vs 62%; $P = 0.003$). This was likely secondary to critical patient condition requiring immediate massive transfusion. Although compliance with TXA was high, a second dose was administered in only 60% of patients. In addition, non-survivors were less likely to receive TXA within the first three hours (82% vs 99%; $P = 0.008$).

Baseline panel is required on admission and hourly following activation, until its termination, but blood work was sent in only 3% of cases. A similar low compliance (4%) was identified by Bawazeer *et al.*² In addition, ionized calcium was commonly missed (85%), which is corroborated by other studies.^{2,3} To address this issue, we implemented a preset trauma panel in our electronic ordering system. Furthermore, sample tubes, requisition, and intravenous calcium are now provided with each

trauma pack (every four red blood cell units transfused), to prompt the team to repeat sample draws and administer calcium.

We warm fluids and blood products with an infusion device (Level 1® H-1200 Fast Flow Fluid Warmer, Smith's Medical ASD, Inc. St Paul, MN, USA), use forced air warming blankets (Mistral-Air® plus Warming Unit -Stryker MA1100-PM, Portage, MI, USA), and warm blankets. Nevertheless, on admission to the intensive care unit, 28% of patients had a body temperature < 35°C. We will be evaluating the use of chemical warming blankets (e.g., Ready-Heat™ 6-Panel Blanket, NJ, USA) as a strategy to prevent hypothermia.⁴

Limitations of our study include that it was a single-centre experience with a relatively low sample size. Our compliance tool has not been validated and the definition of compliance (score ≥ 70) was arbitrary and unvalidated. In addition, the retrospective nature with missing information may have introduced bias.

We identified several issues, which will be addressed with quality improvement initiatives to improve protocol compliance. For example, we have simplified the TXA dose regimen to 2 g on admission, a regimen currently under investigation (NCT01990768).⁵ This quality audit score may also allow other centres to measure compliance and benchmark with peer institutions.

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References

1. Cotton BA, Gunter OL, Isbell J, et al. Damage control hematology: the impact of a trauma exsanguination protocol on survival and blood product utilization. *J Trauma* 2008; 64: 1177-82; discussion 82-3.
2. Bawazeer M, Ahmed N, Izadi H, McFarlan A, Nathens A, Pavenski K. Compliance with a massive transfusion protocol (MTP) impacts patient outcome. *Injury* 2015; 46: 21-8.
3. Godier A, Bacus M, Kipnis E, et al. Compliance with evidence-based clinical management guidelines in bleeding trauma patients. *Br J Anaesth* 2016; 117: 592-600.
4. Kober A, Scheck T, Fulesdi B, et al. Effectiveness of resistive heating compared with passive warming in treating hypothermia associated with minor trauma: a randomized trial. *Mayo Clin Proc* 2001; 76: 369-75.
5. U.S. National Library of Medicine. ClinicalTrials.gov. Prehospital Tranexamic Acid Use for Traumatic Brain Injury (TXA). Available from URL: <https://ClinicalTrials.gov/show/NCT01990768> (accessed September 2020)

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