

COMMENTARY

The Shock Index: is it ready for primetime?

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See related research by Mutschler et al., <http://ccforum.com/content/17/4/R172>

Abstract

The rapid and accurate prediction of the need for massive transfusion in bleeding trauma patients remains a challenge. Various models have been proposed to anticipate massive transfusion with variable success. The current study by Mutschler and colleagues proposes four classes of shock as defined by the Shock Index and examines its ability to predict the need for massive transfusion. This model demonstrates promise as a practical tool in acute decision-making for transfusion after injury.

Predicting the need for blood component transfusion after injury remains a significant challenge. Contemporary evidence supports the early activation of transfusion protocols and replacement with a balanced ratio of red blood cells, plasma, and platelets for patients requiring massive transfusion [1,2]. Current evidence also suggests the potential for harm when trauma patients are transfused unnecessarily [3,4]. Despite this, there is little evidence to identify which patients will ultimately require a massive transfusion and therefore benefit from the activation of such protocols.

Many groups have sought to reliably predict which patients will benefit from transfusion after trauma. A wide variety of techniques have been tried; from simple to complex, from practical to intricate. Mutschler and colleagues have proposed the utility of the Shock Index (SI) in the previous issue of this journal [5].

Individual vital signs such as heart rate and blood pressure have proven unreliable in predicting transfusion requirements. This unreliability is likely due to confounding by factors such as pain, prehospital resuscitation, and medications [6]. Individual laboratory values such as hemog-

lobin, platelets, pH, and lactate also appear to have limited use in identifying the need for transfusion [6]. Recent data from Mutschler and colleagues suggest that base deficit may be a rapid and effective marker for injury severity and extent of hemorrhage in institutions with point-of-care testing capabilities [7]. The practicality of using laboratory values is limited by the time required to obtain these results.

Thromboelastography can be used to examine the characteristics of clot formation and has been shown to predict coagulopathy and hemorrhage-related death [8]. This technique is actively being studied in trauma and may be an effective tool for guiding transfusion [9,10]. Although this technology shows promise, it still requires time and skill to obtain results.

Several scoring systems have been developed in an attempt to create a quick and simple tool for predicting the need for massive transfusion. One of the most robust is the Assessment of Blood Consumption score, which utilizes the following criteria: mechanism of injury, blood pressure, heart rate, and focused assessment by sonography in trauma result [11]. Unfortunately this score, as well as the more complicated scoring systems, demonstrate a significant degree of variability in their ability to predict the need for massive transfusion.

In their present work, Mutschler and colleagues have described the application of the SI to the German Trauma Society Registry [5]. The SI (defined as heart rate divided by systolic blood pressure) has previously shown promise in identifying the severity of hemorrhagic shock as well as other forms of shock [12,13]. Their current study examines the ability of the index to predict the need for transfusion. Four classes of shock were analyzed based on the SI. Increasing SI was seen to correlate with progressive increases in the severity of injury, the clinical and metabolic markers of shock severity, and worsening outcomes. Total and individual blood product transfusion also rose with increasing class of SI, especially for class III and class IV shock. This study demonstrates that, although individual vital signs do not predict bleeding severity, the combination of heart rate and systolic blood

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pressure into a simple index seems to provide a clinically useful tool for predicting shock in trauma patients, equivalent to the use of base deficit. The SI provides several advantages. The index is very simple to calculate, a must in the chaotic trauma bay. The heart rate and blood pressure are also available immediately upon patient arrival at the emergency department and even in the field. Thus, with little effort, the trauma team can calculate this score and apply it to the injured patient.

There are multiple confounding factors and data abstraction inaccuracies inherent to any retrospective, registry-based study of acute transfusion needs in the critically ill trauma patient; all of which probably apply to this study. However, because of the simplicity of this tool, and these promising results, further prospective study to validate the applicability of the SI is warranted.

Conclusion

The decision to initiate a massive transfusion protocol in the trauma patient is a risk-versus-benefit choice often made under duress. The ability to quickly and accurately identify patients who will benefit and exclude patients at risk of harm is critical. The present study demonstrates a potentially helpful decision aid in the SI. Further prospective study and refinement of this tool is warranted.

Abbreviations

SI: Shock index.

Competing interests

The authors declare that they have no competing interests.

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References

- Holcomb JB, Del Junco DJ, Fox EE, Wade CE, Cohen MJ, Schreiber MA, Alarcon LH, Bai Y, Brasel KJ, Bulger EM, Cotton BA, Matijevic N, Muskat P, Myers JG, Phelan HA, White CE, Zhang J, Rahbar MH, for the PROMMTT Study Group: **The prospective, observational, multicenter, major trauma transfusion (PROMMTT) study: comparative effectiveness of a time-varying treatment with competing risks.** *Arch Surg* 2012, Epub ahead of print.
- Sambasivan CN, Kunio NR, Nair PV, Zink KA, Michalek JE, Holcomb JB, Schreiber MA, Trauma Outcomes Group, Wade CE, Brasel KJ, Vercruyse G, MacLeod J, Dutton RP, Hess JR, Duchesne JC, McSwain NE, Muskat P, Johannigam J, Cryer HM, Tillou A, Cohen MJ, Pittet JF, Knudson P, De Moya MA, Tieu B, Brundage S, Napolitano LM, Brunsvold M, Sihler KC, Beilman G, *et al*: **High ratios of plasma and platelets to packed red blood cells do not affect mortality in nonmassively transfused patients.** *J Trauma* 2011, **71**:S329–S336.
- Inaba K, Branco BC, Rhee P, Blackburne LH, Holcomb JB, Teixeira PG, Shulman I, Nelson J, Demetriades D: **Impact of plasma transfusion in trauma patients who do not require massive transfusion.** *J Am Coll Surg* 2010, **210**:957–965.
- Sihler KC, Napolitano LM: **Complications of massive transfusion.** *Chest* 2010, **137**:209–220.
- Mutschler M, Ulrike N, Münzberg M, Wölfl C, Schöchel H, Paffrath T, Bouillon B, Mägele M: **The Shock Index revisited – a fast guide to transfusion requirement? A retrospective analysis on 21,853 patients derived from the TraumaRegister DGU®.** *Crit Care* 2013, **17**:R172.
- Barbosa RR, Rowell SE, Diggs BS, Schreiber MA, Trauma Outcomes Group, Holcomb JB, Wade CE, Brasel KJ, Vercruyse G, MacLeod J, Dutton RP, Hess JR, Duchesne JC, McSwain NE, Muskat P, Johannigam J, Cryer HM, Tillou A, Cohen MJ, Pittet JF, Knudson P, De Moya MA, Schreiber MA, Tieu B, Brundage S, Napolitano LM, Brunsvold M, Sihler KC, Beilman G, Peitzman AB, *et al*: **Profoundly abnormal initial physiologic and biochemical data cannot be used to determine futility in massively transfused trauma patients.** *J Trauma* 2011, **71**:S364–S369.
- Mutschler M, Nienaber U, Brockamp T, Wafaisade A, Fabian T, Paffrath T, Bouillon B, Mägele M, TraumaRegister DGU®: **Renaissance of base deficit for the initial assessment of trauma patients: a base deficit-based classification for hypovolemic shock developed on data from 16,305 patients derived from the TraumaRegister DGU®.** *Crit Care* 2013, **17**:R42.
- da Luz LT, Nascimento B, Rizoli S: **Thrombelastography (TEG®): practical considerations on its clinical use in trauma resuscitation.** *Scand J Trauma Resusc Emerg Med* 2013, **21**:29.
- Johansson PI, Sorensen AM, Larsen CF, Windelov NA, Stensballe J, Perner A, Rasmussen LS, Ostrowski SR: **Low hemorrhage-related mortality in trauma patients in a Level I trauma center employing transfusion packages and early thromboelastography-directed hemostatic resuscitation with plasma and platelets.** *Transfusion* 2013. [Epub ahead of print].
- Leemann H, Lustenberger T, Talving P, Kobayashi L, Bukur M, Brenni M, Bruesch M, Spahn DR, Keel MJ: **The role of rotation thromboelastometry in early prediction of massive transfusion.** *J Trauma* 2010, **69**:1403–1408. discussion 1408–1409.
- Nunez TC, Voskresensky IV, Dossett LA, Shinall R, Dutton WD, Cotton BA: **Early prediction of massive transfusion in trauma: simple as ABC (assessment of blood consumption)?** *J Trauma* 2009, **66**:346–352.
- Demuro JP, Simmons S, Jax J, Gianelli SM: **Application of the shock index to the prediction of need for hemostasis intervention.** *Am J Emerg Med* 2013, **31**:1260–1263.
- McNab A, Burns B, Bhullar I, Chesire D, Kerwin A: **An analysis of shock index as a correlate for outcomes in trauma by age group.** *Surgery* 2013, **154**:384–387.

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