Current Recommendations of Use of Blood, Its Products and Control of Hemorrhage in Trauma Victims

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Trauma is a major cause of massive haemorrhage, which accounts for six out of ten trauma-related early deaths. Maintenance of circulation in a massive bleeding as a result of injury is a big challenge. This includes not only the control of on-going blood loss but the coagulopathy, that may result from transfusion, and hypothermia. On-going research on the subject has improved our understanding about the pathophysiology that has resulted in development of new guidelines and treatment protocols for crystalloid and massive blood transfusion, a restricted and goal directed resuscitative approach.[1]

Massive or continuous bleeding causes the volume depletion. This disturbs the physiological coagulation mechanism. Initial hypo-coagulability results in fibrinolysis leading to the uncontrolled bleeding and a shock state. This is followed by a hyper-coagulation state with excessive clot formation that leads to thromboembolism and multi-organ failure.[1] Factors like the pre-existing co-morbid conditions, duration of bleeding, hypothermia, hypo-perfusion, acidosis, hemodilution as a result of crystalloid infusion, the resultant inflammatory cascade all play their role in worsening the condition. The coagulopathy, hypothermia, acidosis and hypocalcemia make the 'lethal diamond of bleeding.[2] This highlights the importance of frequent clinical and laboratory evaluations in the management of these patients.

Viscoelastic testing (TEG or ROTEM) is recommended early in the evaluation of clotting kinetic assay. However, it is not available in trauma settings. The standard coagulation assays are usually requested though not very reliable in trauma setting. This includes estimation of hemoglobin, platelet, fibrinogen, PT, APTT, and INR.[3] For an accurate diagnosis, a whole point of care testing is required, which includes platelet function, arterial blood gases, and serum calcium levels.

In the trauma patient with moderate to severe bleeding, the coagulopathy starts early. To avoid the "lethal diamond" the body temperature of the patient should be kept near to the normal, pH of more than 7.2 or preferably normal to avoid acidosis and ionized calcium level of = 9mmol/L.[4] Tranexamic acid (TXA) as an antifibrinolytic medication. In order to be effective in controlling bleeding it is administered within three 3 hours of trauma.[5] It is recommended to transfuse as a balanced resuscitation with red blood cells, plasma, and platelets in ratios of 1:1:1 to 2:1:1 until bleeding is no longer life-threatening.[6] However, this ratio-driven approach may result in unnecessary transfusion of blood components which are not required or may be harmful.

If compatible blood is not available in an emergency, generally type specific uncross-matched (preferably) or "O" PRBCs and type AB plasma are indicated. Large volumes and inappropriate transfusion of blood or blood product may increase the morbidity and mortality. This may cause acute lung injury, circulatory overload, or immune modulation.[7]

Not all the clotting factors are equally depleted in hemorrhage and the non-targeted therapy is not effective. A "goal-directed approach", consisting of hemostatic resuscitation with blood components guided by viscoelastic haemostatic assays or the standard laboratory tests is advocated.[4]

- RBCs are only to be a substituted for hemoglobin below the 7-8 mg/ dl.
- The plasma should only be transfused when the INR is above 1.5 or 1.6.

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- Platelets transfusion is only indicated if the count drops below $50x10^9$L or is defective in function or when bleeding is continued and excessive.

- Fibrinogen is the first factor to deplete in the setting of massive bleeding and a level <1.5–2 g/L is an indication of substitution. The use of plasma and cryoprecipitate transfusion is no longer recommended for the replacement of fibrinogen. The current recommendation of European guideline is the transfusion of fibrinogen concentrate, 25–50 mg/kg BW.[1]

- Prothrombin complex concentrate (PCC) containing factors II, VII, IX, and X (4-factor PCC) or II, IX, and X (3-factor PCC) is effective if used with plasma. An initial bolus of 25 IU/kg BW appears to be effective and for those patients with an increased risk for thromboembolism an initial half-dose bolus of 12.5 IU/kg BW followed by a second dose if microvascular bleeding persists.

- Recombinant activated factor VII is indicated when traditional options for treating excessive bleeding due to coagulopathy have been exhausted.

- In USA there is growing evidence in support of the use of low titer type “O” whole blood (LTOWB) as universal donor compared to component therapy in massive transfusion. It has been found to have many advantages with few limitations.[8]

“Stop The Bleed” initiative by the American College of Surgeon's Committee on Trauma and the Hartford Consensus aims the community-based educational training for lay people to control external bleeding by proper compression techniques well before reaching the health facility.[9] Control of bleeding needs the correct identification of the bleeding patient. Compressive (external bleeding) bleeding control varies from simple pressure at the wound site, hemostatic techniques with the use of tourniquet, pelvic binders or hemostatic dressing. However, non-compressive (torso) haemorrhage may need surgical or radiological (angio-embolization) intervention. The resuscitative Endovascular occlusion of the aorta (REBOA) is a technology recently used to control haemorrhage. Expandable polyurethane foam injection into the peritoneal cavity can create a temporary tamponade effect to stop or slow bleeding.

Control of hemorrhage and transfusion of blood and blood products are the subject of ongoing research. Hemorrhage is a major challenge for the trauma surgeons and is still a major cause of morbidity and mortality. An evidence based approach helps in addressing this challenge. Surgeons must keep them updated about the current recommendations of transfusion practices. They should also contribute to the scientific literature about the utility of the current practices and potential challenges so that any change, if required, may be incorporated into future practices.

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