

# Coagulation management in trauma-related massive bleeding

## Recommendations of the working group on Perioperative Coagulation of the ÖGARI

Valid until: end of 2010

### Abstract

Trauma-induced coagulopathy (TIC) occurring with massive blood loss primarily results from loss of coagulation factors and platelets and is aggravated by hemodilution and localized consumption of clotting factors and platelets. In addition, hyperfibrinolysis, hypothermia, acidosis and hypocalcemia also contribute to the development of severe hemostatic derangement. Even nowadays and at specialized centers the leading cause of death is exsanguination besides brain injury. Thus, immediate and effective coagulation management is of great importance. Over the past few years new insights into the pathophysiology of TIC and the widespread use of viscoelastic coagulation monitoring provoked the development of alternative treatment concepts. Just as for traditional therapy using fresh frozen plasma and platelet concentrates, there are still no data from large randomized studies to support alternative strategies, although there is growing evidence in favor of using coagulation factor concentrates under the guidance of viscoelastic measurements.

**Strongly recommended:** Strongly recommended for most patients without exception.

**Recommended:** Recommended because it appears obvious, but this recommendation can change if better data become available.

**Optional:** Recommended as an option; depending on the particular patient's condition, a different therapy could be better.

Table 1: *Task Force Recommendations, strong to optional, modified and adapted for simple clinical implementation.*

#### Summary on volume replacement therapy:

A combination of crystalloids (Ringer's lactate, balanced electrolyte solutions) and colloidal volume replacement agents is indicated in order to achieve adequate volume expansion.

Task Force Recommendation: "Recommended"

For colloid volume replacement agents, no definitive recommendation can be made. It must be remembered that there is no limit on daily dosage for gelatin solutions, while for HES 130/0.4 the limit is 50 ml/kg/d.

A single dose of hyperosmolar solutions (4 mL/kg) appears to have less effect on clot formation than does conventional colloid treatment for hypovolemia.

#### Summary on hyperfibrinolysis and antifibrinolytics:

Presently, only inconclusive data are available on the frequency of hyperfibrinolysis in the framework of massive blood loss. If hyperfibrinolysis is detected with ROTEM®/TEG®, in severe traumatized patients, antifibrinolytic therapy is indicated.

Task Force Recommendation: „Strongly recommended“

If ROTEM®/TEG® monitoring is not possible for detection of hyperfibrinolysis in a trauma patient with a tendency to microvascular bleeding and fibrinogen counts <100mg/dl, hyperfibrinolysis must be acutely suspected, and the empirical administration of an antifibrinolytic agent is justified. Task Force Recommendation: „Recommended“

At this time tranexamic acid is available in Austria only for clinical use. The recommended dosage is 15-20 mg/kg; repeat administration can be considered, if needed.

#### Summary on hypothermia and how to correct it:

Therapy for hypothermia-induced coagulopathy consists of preventing further cooling and of rewarming the patient by early administration of physical warming systems. Temperature monitoring is compulsory and infusion solutions must be administered only when pre-warmed.

Task Force Recommendation: „Strongly recommended“

#### Summary on acidosis and how to correct it:

If a patient suffering from massive bleeding undergoes procoagulatory substitution therapy, a pH value of >7.2 should be aimed for to ensure its effectiveness. Buffer therapy may also be necessary.  
Task Force Recommendation: „Strongly recommended“

Summary on calcium substitution:

At calcium values below 0.8-0.9 mmol/l the administration of calcium gluconate (10-20ml) or calcium chloride (5ml) is recommended.

Task Force Recommendation: „Recommended“

Summary on how to correct anemia:

During massive transfusion with persistent, active bleeding low transfusion triggers should be avoided and a hemoglobin value of 8-10 g/dl should be aimed for.

Task Force Recommendation: „Recommended“

Summary on platelet concentrates:

The scientific literature gives no clear transfusion triggers for thrombocytes. In the authors' opinion thrombocyte concentrates are indicated in patients with massive bleeding at values between 50.000/ $\mu$ l and 100.000/ $\mu$ l. In addition to thrombocyte count, a possible disturbance in thrombocyte function must also be given consideration.

Task Force Recommendation: „Optional“

Summary on fibrinogen concentrate:

High fibrinogen counts exert a protective effect with regard to the amount of blood loss. In multiple traumatized patients priority must be given to early and effective correction of impaired fibrin polymerization by administering fibrinogen concentrate. Because of the timely delay and imprecision involved in measuring plasma count, measurement of fibrin polymerization by ROTEM®/TEG® is preferred to estimate the need for fibrinogen administration. If the maximum clot firmness (MCF) in the FIBTEM® analysis is < 10-12 mm and/or the 10-min. value is < 7 mm, administration of 50 mg/kg fibrinogen concentrate is recommended. If ROTEM®/TEG® monitoring is not possible, fibrinogen should be maintained at minimum 150 - 200 mg/dl.

If no fibrinogen concentrate is available, fresh frozen plasma (minimum 30 ml/kg) must be transfused.

Task Force Recommendation: „Strongly recommended“

Summary on PCC:

In case of adequate substitution of fibrinogen, an elevated bleeding tendency and prolonged clotting time (CT) persist, administration of PCC (20 - 30 IU/kg BW) is recommended. Alternatively, fresh frozen plasma (minimum 30 ml/kg) can be transfused.

Task Force Recommendation: „Recommended“

Multiple traumatized patients on oral anti-coagulant therapy are a special case and require PCC and vitamin K before any other steps toward coagulation management.

Task Force Recommendation: „Strongly recommended“

Summary on Factor XIII and Factor XIII concentrate:

If clot strength remains too low despite persistent and adequate administration of fibrinogen with sufficient thrombin formation, it is likely that precisely Factor XIII activity is critically reduced. In such cases the empiric administration of Factor XIII concentrate (30 IU/kg) is recommended. Alternatively, fresh frozen plasma can be transfused.

An FXIII deficiency can also be assumed when the activity of the procoagulators is < 30%, because parallel loss of FXIII is probable.

Task Force Recommendation: „Optional“

Summary on rFVIIa:

rFVIIa is used „off-label“ for the indication mentioned here. In the authors' opinion administration of rFVIIa can be considered for bleeding that can not be stopped by conventional, surgical or interventional radiological means and/or when comprehensive coagulation therapy fails (including administration of antifibrinolytics and buffer therapy). For rFVIIa therapy to be successful there must be enough substrate, particularly fibrinogen and thrombocytes, the pH value must be > 7.2 and body temperature > 34°C. The individual dose should be 90-120 µg/kg and can be repeated.

Task Force Recommendation: „Recommended“

Summary on Fresh Frozen Plasma (FFP):

FFP administration for therapy of relevant coagulopathy has historic origins. The dose of 10 - 15 ml/kg FFP recommended by other medical societies is deemed by the Task Force to be inadequate for this indication. Whether a higher dose of FFP (30 ml/kg) prevents loss and dilutional coagulopathy in the framework of massive transfusion or reduces its scope is unclear. Likewise, there is no consensus on the rationale for a set ratio of transfused FFP to erythrocyte and/or thrombocyte concentrates. For patients with a relevant clotting disorder and accompanying increased bleeding tendency, the Task Force feels that factor concentrates should be administered at least initially, because this permits quick and effective correction of relevant deficiencies.

Task Force Recommendation: „Recommended“

Multiple traumatized patients with severe congenital or acquired bleeding disorders need substitution or therapy that is interdisciplinarily planned.

Desmopressin can be administered in adults to diminish the effect of clopidogrel or acetylsalicylic acid.

Task Force Recommendation: „Optional“

Summary on hemostatic dressings:

QuickClot®, Combat-Gauze® and HemCon® appear to be superior to customary gauze compression dressings. If definitive local hemostasis can not be achieved in a surface wound (for example, in the emergency room or shock room), use of these local hemostatic agents should be considered.

Task Force Recommendation: „Recommended“