CRITICAL CARE

LETTER

Algorithm-based management of bleeding in patients with extracorporeal membrane oxygenation

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See related research by Repressé *et al.*, http://ccforum.com/content/17/2/R55

We read with interest the paper published by Repressé and colleagues [1]. Coagulation management is a challenge during extracorporeal membrane oxygenation (ECMO) due to complex hemostatic and inflammatory responses associated with the underlying conditions that include infection, sepsis, surgery, and/or traumatic injury [2]. Repressé and colleagues present the first algorithm-based approach to bleeding in ECMO patients. However, additional perspectives are important to consider.

First, activated partial thromboplastin time or anti-activated factor X monitoring are routinely used to monitor heparin therapy in ECMO patients, despite intra-individual and inter-individual variability [3]. Rotational thromboelastometry (ROTEM®; TEM® International GmbH, Munich, Germany) is also increasingly used in the ICU to rapidly assess the coagulation status, including clotting factors, fibrinogen levels, and whole blood clotting [4]. Moreover, this test also facilitates fibrinolytic pathway evaluation, which cannot be easily explored by routine laboratory tests. We believe ROTEM® could be used to design an algorithm-based approach to bleeding in ECMO patients and follow fibrinogen consumption associated with hyperfibrinolysis, an important cause of bleeding. For this reason, anti-fibrinolytic agents should be considered in the multimodal approach (Figure 1), an important point the authors omitted in their algorithm.

Second, adverse events including 32% venous thrombosis and a 2.5% incidence of fatal pulmonary embolism have already been reported in ECMO patients [5]. In another series, Combes and colleagues reported a 10% incidence of femoral vein and 7% incidence vena cava thrombosis [6]. Recombinant activated factor VII is associated with thromboembolic events [7] and should be used with caution until additional data help us evaluate the benefit-to-risk administration in bleeding ECMO patients.

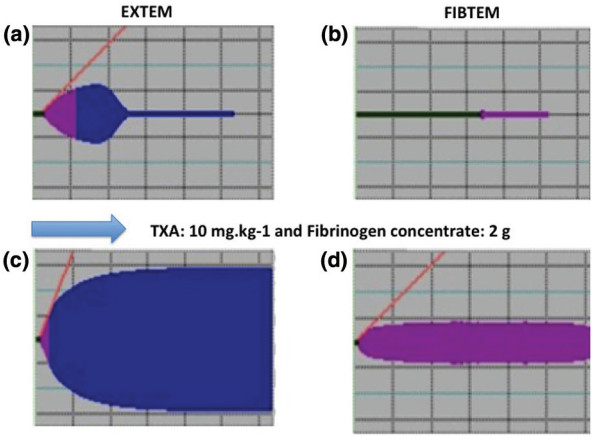

Figure 1. Hyperfibrinolysis diagnosed in a bleeding extracorporeal membrane oxygenation patient. (a) Baseline EXTEM, **(b)** baseline FIBTEM, **(c)** EXTEM and **(d)** FIBTEM thromboelastometry tests after the administration of tranexamic acid (TXA; 10 mg/kg) and fibrinogen concentrates (2 g).

Abbreviations

ECMO, extracorporeal membrane oxygenation; ROTEM, rotational thromboelastometry.

Competing interests

The authors declare that they have no competing interests.

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References

1. Repressé X, Au SM, Brechot N, Trouillet J, Leprince P, Chastre J, Combes A, Luyt CE: **Recombinant factor VIIa for uncontrollable bleeding in patients with extracorporeal membrane oxygenation: report on 15 cases and literature review.** *Crit Care* 2013, **17**:R55.

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2. Peek GJ, Firmin RK: **The inflammatory and coagulative response to prolonged extracorporeal membrane oxygenation.** *ASAIO J* 1999, **45:**250-263.
3. Dempfle CE, Elmas E, Link A, Suvajac N, Liebe V, Janes J, Borggrefe M: **Endogenous plasma activated protein C levels and the effect of enoxaparin and drotrecogin alfa (activated) on markers of coagulation activation and fibrinolysis in pulmonary embolism.** *Crit Care* 2011, **15:**R23.
4. Bischof D: **Thrombelastography in the surgical patient.** *Minerva Anestesiol* 2010, **76:**131-137.
5. Rastan AJ, Lachmann N, Walther T, Doll N, Gradistanac T, Gommert JF, Lehmann S, Wittekind C, Mohr FW: **Autopsy findings in patients on postcardiotomy extracorporeal membrane oxygenation (ECMO).** *Int J Artif Organs* 2006, **29:**1121-1131.
6. Combes A, Leprince P, Luyt CE, Bonnet N, Trouillet JL, Leger P, Pavie A, Chastre J: **Outcomes and long-term quality-of-life of patients supported by extracorporeal membrane oxygenation for refractory cardiogenic shock.** *Critl Care Med* 2008, **36:**1404-1411.
7. Levy JH, Faraoni D, Sniecinski RM: **Perioperative coagulation management in the intensive care unit.** *Curr Opin Anaesthesiol* 2013, **26:**65-70.

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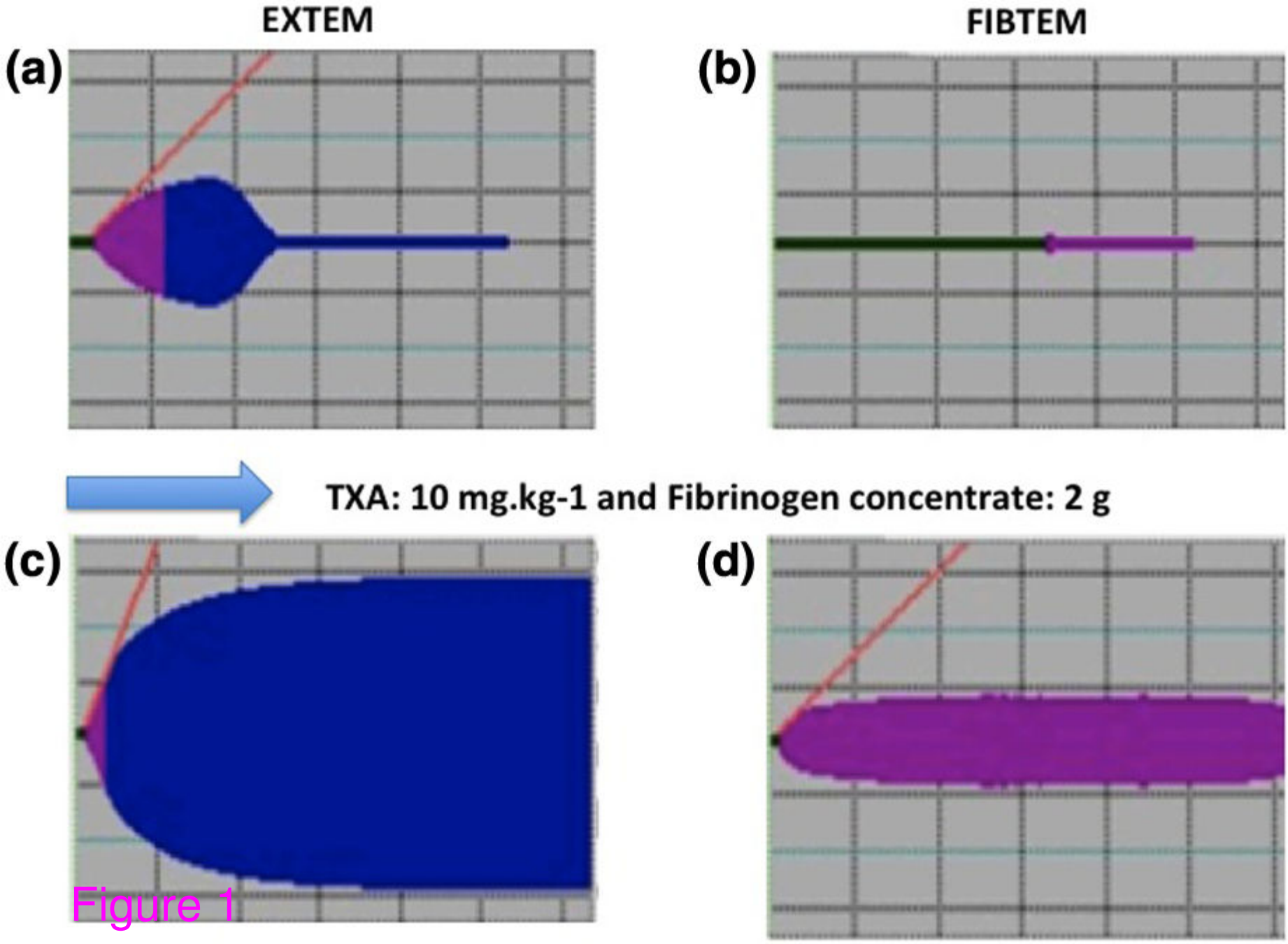
EXTEM
FIBTEM
(a)
(b)
TXA: 10 mg.kg-1 and Fibrinogen concentrate: 2 g
(c)
(d)

Figure 1