Rev Bras Anestesiol. 2018;68(3):238–243

Sociedade Brasileira de Anestesiologia

REVISTA BRASILEIRA DE ANESTESIOLOGIA

Publicação Oficial da Sociedade Brasileira de Anestesiologia
www.sba.com.br

SCIENTIFIC ARTICLE

Factor XIII-guided treatment algorithm reduces blood transfusion in burn surgery

João Miguel Gonçalves Valadares de Morais Carneiro[a,*], Joana Alves[b], Patrícia Conde[b], Fátima Xambre[b], Emanuel Almeida[b], Céline Marques[b], Mariana Luís[b], Ana Maria Mano Garção Godinho[c], Fernando Fernandez-Llimos[d]

[a] *Centro Hospitalar de Lisboa Norte, Hospital de Santa Maria, Serviço de Anestesiologia, Lisboa, Portugal*
[b] *Centro Hospitalar de Lisboa Norte, Hospital de Santa Maria, Departamento de Anestesiologia, Lisboa, Portugal*
[c] *Centro Hospitalar de Lisboa Norte, Hospital de Santa Maria, Departamento de Imuno-Hemoterapia, Lisboa, Portugal*
[d] *Universidade de Lisboa, Faculdade de Farmácia, Departamento de Farmacologia Social, Lisboa, Portugal*

Received 27 July 2016; accepted 20 November 2017
Available online 23 March 2018

KEYWORDS
Intensive care;
Burned;
Surgery;
Coagulation and hemostasis;
Factor XIII

Abstract
Background and objectives: Major burn surgery causes large hemorrhage and coagulation dysfunction. Treatment algorithms guided by ROTEM® and factor VIIa reduce the need for blood products, but there is no evidence regarding factor XIII. Factor XIII deficiency changes clot stability and decreases wound healing. This study evaluates the efficacy and safety of factor XIII correction and its repercussion on transfusion requirements in burn surgery.
Methods: Randomized retrospective study with 40 patients undergoing surgery at the Burn Unit, allocated into Group A those with factor XIII assessment ($n = 20$), and Group B, those without assessment ($n = 20$). Erythrocyte transfusion was guided by a hemoglobin trigger of 10 $g.dL^{-1}$ and the other blood products by routine coagulation and ROTEM® tests. Analysis of blood product consumption included units of erythrocytes, fresh frozen plasma, platelets, and fibrinogen. The coagulation biomarker analysis compared the pre- and post-operative values.
Results and conclusions: Group A (with factor XIII study) and Group B had identical total body surface area burned. All patients in Group A had a preoperative factor XIII deficiency, whose correction significantly reduced units of erythrocyte concentrate transfusion (1.95 vs. 4.05, $p = 0.001$). Pre- and post-operative coagulation biomarkers were similar between groups, revealing that routine coagulation tests did not identify factor XIII deficiency. There were no recorded thromboembolic events. Correction of factor XIII deficiency in burn surgery proved to be safe and effective for reducing perioperative transfusion of erythrocyte units.

* Corresponding author.
E-mail: joaoc17@hotmail.com (J.M. Carneiro).

https://doi.org/10.1016/j.bjane.2017.11.004

PALAVRAS-CHAVE
Cuidados intensivos;
Queimados;
Cirurgia;
Coagulação e hemostase;
Fator XIII

Algoritmo de tratamento guiado pelo fator XIII reduz a transfusão sanguínea na cirurgia de queimados

Resumo
Justificativa e objetivos: A cirurgia no grande queimado causa hemorragia de grande porte e disfunção da coagulação. Os algoritmos de tratamento guiados por ROTEM® e fator VIIa reduzem as necessidades de hemoderivados, mas falta evidência em relação ao fator XIII. A deficiência do fator XIII altera a estabilidade do coágulo e diminui a cicatrização. Este estudo avalia a eficácia e a segurança da correção do fator XIII e sua repercussão nas necessidades transfusionais na cirurgia do queimado.
Métodos: Estudo retrospectivo randomizado de 40 doentes submetidos à cirurgia na Unidade de Queimados alocados em grupo A com estudo do fator XIII ($n = 20$) e grupo B sem estudo ($n = 20$). A transfusão eritrocitária foi guiada por gatilho de hemoglobina de 10 $g.dL^{-1}$ e os outros hemoderivados por testes de coagulação de rotina e ROTEM®. A análise do consumo de hemoderivados incluiu unidades de eritrócitos, plasma fresco congelado, plaquetas e fibrinogênio. A análise dos biomarcadores da coagulação comparou os valores pré e pós-operatórios.
Resultados e conclusões: O grupo A (com estudo de fator XIII) e o grupo B apresentaram área de superfície corporal total queimada idêntica. Todos os doentes do grupo A revelaram déficit pré-operatório de fator XIII, cuja correção reduziu significativamente a transfusão de unidades de concentrado eritrocitário (1,95 vs. 4,05, $p = 0,001$). Os biomarcadores de coagulação pré e pós-operatórios foram semelhantes entre os grupos, revelaram que os testes de coagulação de rotina não identificam o déficit de fator XIII. Sem eventos tromboembólicos registrados. A correção do fator XIII na cirurgia do queimado revelou-se segura e eficaz na redução da transfusão perioperatória de unidades de eritrócitos.

Introduction

Early excision and wound closure due to burn have allowed a reduction in mortality, lower rate of sepsis associated with burn, hypercatabolic response attenuation, blood loss reduction, as well as shorter hospital stay and associated costs. However, surgical treatment may also produce substantial intraoperative hemorrhage, both in debrided areas and donor sites, resulting in a significant increase in transfusion requirements. Furthermore, the loss and consumption of coagulation factors, associated with severe trauma and major surgery in the severely burned patient, together with hemodilution secondary to volume replacement contribute to reduce the plasma fraction of coagulation factors.[1]

The surgical technique improvement over the last years has allowed the reduction of intraoperative blood loss, but not significantly. Recent studies have shown that adequate and targeted correction of trauma-induced coagulopathy using specific blood products has reduced transfusion requirements and increased survival.[2,3] However, this therapeutic strategy has not yet been evaluated in burned patients.

It is in this context that factor XIII (FXIII), with a known and proven role in hemostasis and wound healing, has gained great interest. However, it is not detected by routine coagulation tests, such as prothrombin time and activated partial thromboplastin time, nor by patient bedside monitoring systems, which show results in real time, its dosage is determined in specialized laboratories.

In this study, our primary objective was to evaluate the need for perioperative transfusion after correcting the FXIII deficit in major burns and the secondary objectives were to evaluate the presence of FXIII deficiency and the efficacy and safety of its correction, particularly regarding the occurrence of thrombotic events.

Methods

Retrospective comparative study performed at the Burn Unit of our hospital between January 1, 2014, and December 31, 2015. It was submitted and accepted as a research project ''*Estudo retrospectivo comparativo sobre a eficácia na correção pré-operatória do déficit de FXIII no grande queimado*'' with reference number 94/16. All patients admitted to the Burn Unit during this period who had undergone at least one surgical intervention for surgical debridement with grafting under general anesthesia were considered eligible. We chose to perform a retrospective cohort analysis comprised of an intervention cohort, which included all patients with preoperative assessment and correction of FXIII (Group A) and a control cohort, in which a number of patients equal to that of Group A were randomly selected among all eligible patients (Group B).

Group A ($n = 20$) included patients with preoperative assessment and correction of FXIII and Group B ($n = 20$) included patients without FXIII assessment. Population characteristics were obtained by collecting data on age, sex, percent total body surface area (%TBSA) involvement,