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ADVANCES IN ANESTHESIA

Practical Understanding of Hemostasis and Approach to the Bleeding Patient in the Operating Room

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Keywords

• Bleeding • Coagulation • Coagulopathy • Trauma • Inflammation
• Massive hemorrhage • Viscoelastic • Damage control resuscitation

Key points

- Coagulation and inflammation are 2 major biologic response systems following tissue trauma.
- A complex interaction between these 2 systems after severe injury may result in coagulopathy and an increased likelihood of poor outcomes.
- Improved understanding of the bleeding seen in severe trauma settings has informed our treatment of poorly controlled bleeding in the operating room.
- Massive hemorrhage is a serious and rapidly changing situation associated with significant increase in mortality rates.
- Identification of high-risk patients and procedures allows preprocedure consideration and preparation promoting good outcomes.

INTRODUCTION

Coagulation and inflammation are biologic damage-response systems activated and amplified after tissue injury. Although they were once thought to be separate and distinct processes, we now know that they are intrinsically linked and interactive systems [1].

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Bleeding, thrombosis, and maladaptive inflammatory responses are major causes of perioperative morbidity and mortality for trauma and "nontrauma" patients [2–4]. Thus, coagulation and inflammation warrant serious consideration by all who care for surgical patients. New information regarding care of the bleeding trauma patient have led us to revisit our core concepts of caring for other patients with massive bleeding as well.

In this article, we briefly review the different models of coagulation, discuss management of the acute coagulopathy associated with severe trauma, and relate that to the care of other bleeding patients.

CLASSICAL COAGULATION CASCADE

Observation leading to discovery

Astute physicians, noting unusual bleeding tendencies in their patients, in collaboration with brilliant scientists deduced the proteolytic activation of zymogens in plasma leading to fibrin formation. This "waterfall/cascade" described more than 50 years ago, has been the basis for testing and monitoring anticoagulant effects of various medications for decades (Fig. 1) [5].

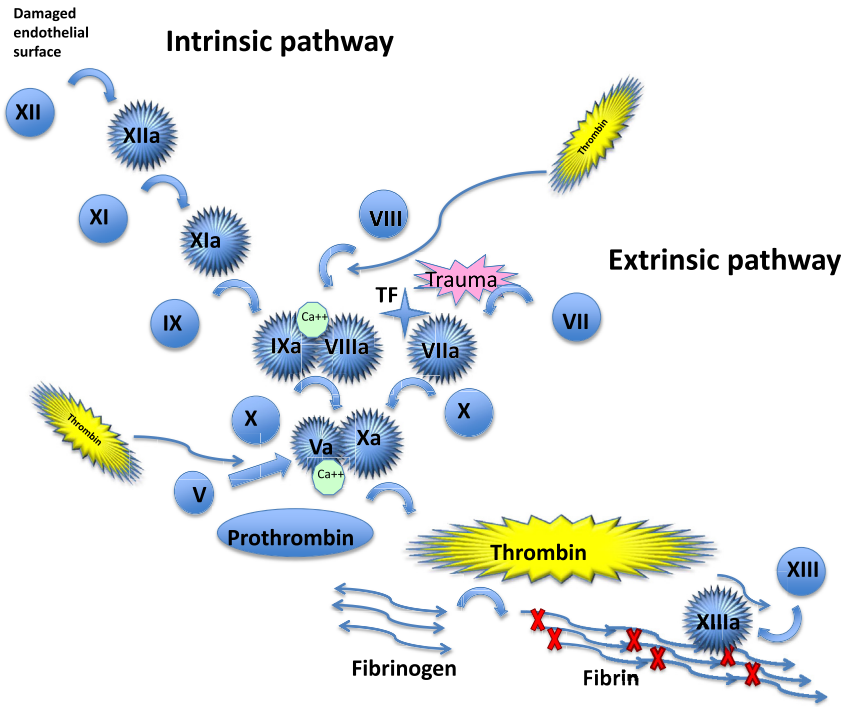

Fig. 1. Waterfall cascade, the classical description of coagulation. Roman numerals indicate the numbered coagulation factors. When followed by an "a," they represent their active forms. Ca++, calcium; TF, tissue factor.