What’s New in Critical Illness and Injury Science? Coagulants for local application in the surgical armamentarium!

Dear Editor,

Coagulants form an important part of surgical hemostasis, especially during liver resection. This issue of the journal has an interesting article, “Comparison of the haemostatic effects of Ankaferd blood stopper (ABS), oxidised cellulose and calcium alginate in an experimental animal model of liver parenchyma bleeding.” The process of coagulation along with the various available agents is discussed here with regard to their safety, composition, hemostatic and biodegradable properties.

There are often times when after attaining hemostasis after a major liver resection, there is persistent oozing from the surface uncontrolled with pressure, ligature, or electrocautery. Coagulation, the process by which blood changes from a liquid to gel, forming a clot results in hemostasis. Platelet activation by the tissue factor is the first initiation step for the coagulation cascade. Local application of hemostats act as tissue factors and stop capillary, venous, and arteriolar bleeding effectively when conventional methods are either ineffective or impractical [Figure 1].

The most commonly used products have been the Gelfoam®/Spongostan™ gelatinized sponge and the Surgicel® (oxidized cellulose). They provide a strong matrix for platelet adhesion and aggregation, accelerating the formation of a platelet plug and acting as a catalyst in forming a fibrin clot. The other less commonly used agents include thrombin, calcium alginate, and collagen.

Gelatin sponge is an off-white, water-insoluble, porous, malleable, porcine gelatin absorbable sponge. It can be used dry or saturated with the saline solution, with or without the addition of thrombin.

Oxidized cellulose is a water-insoluble derivative of cellulose produced by the action of an oxidizing agent, such as chlorine, hydrogen peroxide, peracetic acid, chlorine dioxide, nitrogen dioxide, persulfates, permanganate, dichromate-sulfuric acid, hypochlorous acid, hypohalites, or periodates and a variety of metal catalysts. Oxidized cellulose may contain carboxylic acid, aldehyde, and/or ketone groups, depending on the nature of the oxidant and reaction conditions. Oxidized cellulose products generally turn into a gelatinous mass in contact with the fluid and disaggregate. Surgicel® Fibrillar™ absorbable hemostat is lightweight, versatile, and its easily separable layers conform and tufts peel off as little or as much as desired. It has 33% faster hemostasis compared to surgicel. It has proven bactericidal properties. Gelita-Cel® is a natural hemostat made of biodegradable 100% organic oxidized cellulose extracted from natural alpha grade cotton with hollow fibers and greater capacity to absorb oxidizing agents, greater instability, and enhanced biodegradability. Its low pH causes localized vasoconstriction, further enhancing the hemostatic effect. In addition, the low pH exhibits antibacterial properties, minimizing the risk of infection. Gelita-Cel® is stable ensuring easy handling and repositioning on the wound as needed and completely biodegradable in <4 weeks with reduced risk of encapsulation.

Calcium alginate is a water-insoluble, gelatinous, cream-colored substance that can be created through the addition of aqueous calcium chloride to aqueous sodium alginate extracted from seaweed, broken into pieces and stirred with a hot solution of an alkali, usually sodium carbonate. It is also incorporated into wound dressings as a hemostatic agent.
Avitene™ Microfibrillar collagen is an active absorbable collagen hemostat, proven to accelerate clot formation by enhancing platelet aggregation and release of proteins to form fibrin, resulting in hemostasis. Gauze soaked in epinephrine/adrenaline has also been used to reduce surgical bleeding. Botropase available in injection form is composed of hemocoagulase. It contains batroxobin, a hemostatic agent, a thrombin-like enzyme, obtained from the venom of the serpent Bothrops atrox. The Tisseel® tissue glue, a fibrin sealant, is a relatively new addendum but is expensive and not readily available.

ABS, a novel coagulant agent, has demonstrated promising results in various sources of bleeding. ABS is a Turkish herbal product comprising five plants: Thymus vulgaris, Glycyrrhiza glabra, Vitis vinifera, Alpinia officinarum, and Urtica dioica, developed by Hüseyin Cahit Firat, the first Turkish medical product officially accredited by the Turkish Ministry of Health. It is used in hospitals and ambulances in Turkey to stop bleeding from external bodily injuries and operations due to its antihemorrhagic properties. Goker et al. demonstrated that when ABS is added to plasma or serum, it induces a rapid formation of a protein network and erythrocyte aggregation without affecting the levels of coagulation factors such as II, V, VII, VIII, IX, X, XI, and XIII. Plasma fibrinogen activity and antigen levels were decreased along with prolonged thrombin time. Total protein, albumin, and globulin levels decreased after the addition of ABS. These findings suggested that ABS stimulated the formation of an encapsulated protein network that provides focal points for erythrocyte aggregation, thus possessing antihemorrhagic potential.

ABS has been used to control gastrointestinal, variceal bleeding, presacral bleeding, and epistaxis. While some authors have found it to be as effective as Surgicel® in controlling bleeding from liver laceration, others have demonstrated superior results. Livers with ABS application completed their regeneration process with minimal signs of inflammation as demonstrated on histopathology and better intra-abdominal adhesion scores.