

In vitro analysis of hemostatic properties and hemocompatibility of collagen and/or ORC-containing wound dressings



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Introduction

Physiological wound healing is a highly regulated process, which can be divided in the three stages of hemostasis, inflammation, and repair. Hemostasis with fibrin formation contributes to the formation of a protective wound scab. This facilitates the following steps by providing a matrix within which cell migration and angiogenesis can take place. Wound dressings consisting of oxidized regenerated cellulose or collagen are often used in treatment of surgical wounds as well as chronic wound care. These biomaterials offer interesting properties such as being absorbable and possessing hemostatic effects. A comprehensive *in vitro* study was performed to compare the hemostatic properties of wound dressings consisting of collagen and/or oxidized regenerated cellulose.

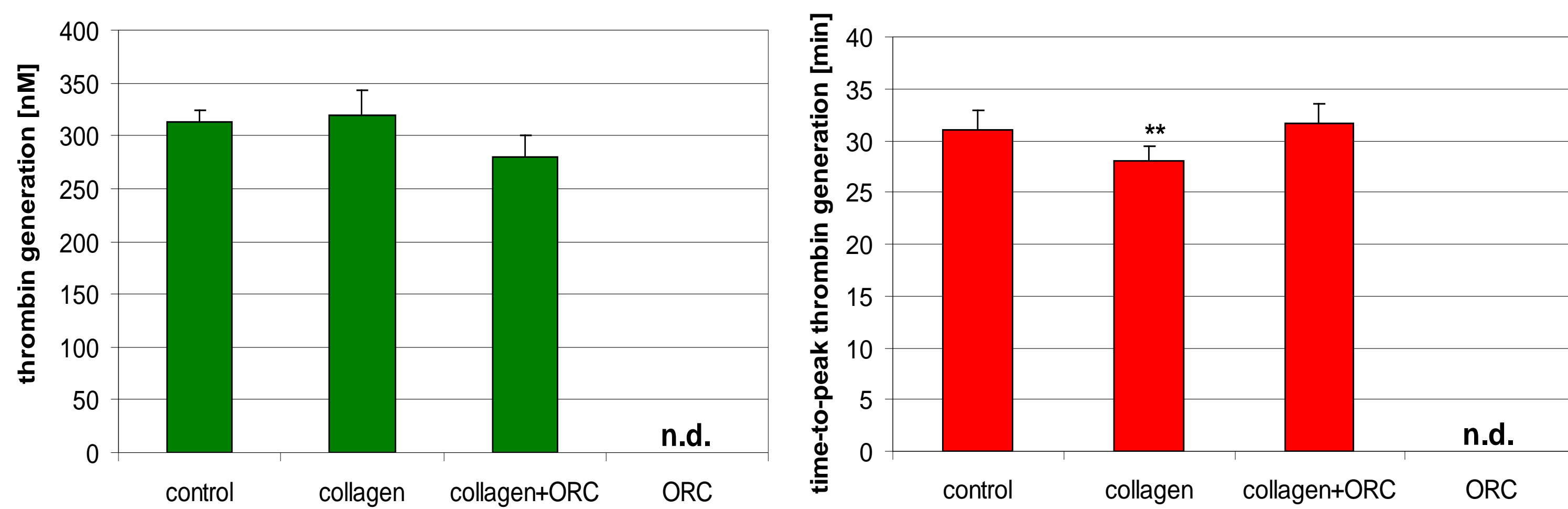


Figure 1: Influence of collagen, collagen+ORC and ORC on the generation of thrombin (left) and the time to peak thrombin generation (right). Data presented as mean \pm SE; ** $p < 0.01$; n.d. – not determined, as the fluorescence of ORC interfered with the assay.

Material & Methods

Wound dressings containing ORC* (oxidized regenerated cellulose), bovine collagen type I#, or collagen+ORC+ have been tested. Influence of the materials on the generation of thrombin in human plasma was assessed using the Thrombin Generation Assay (Technothrombin TGA, Technoclone GmbH). Effect on prothrombin time (PT) and activated partial thromboplastin time (aPTT) was determined with the coagulation analyzer MC1 (Greiner Biochemica GmbH). Impact on clotting of whole blood was analyzed by measurement of the blood clotting index (BCI). Furthermore, the wound dressings were tested for their hemocompatibility, assessing their hemolytic effect and their potential to activate the release of PMN elastase by granulocytes.

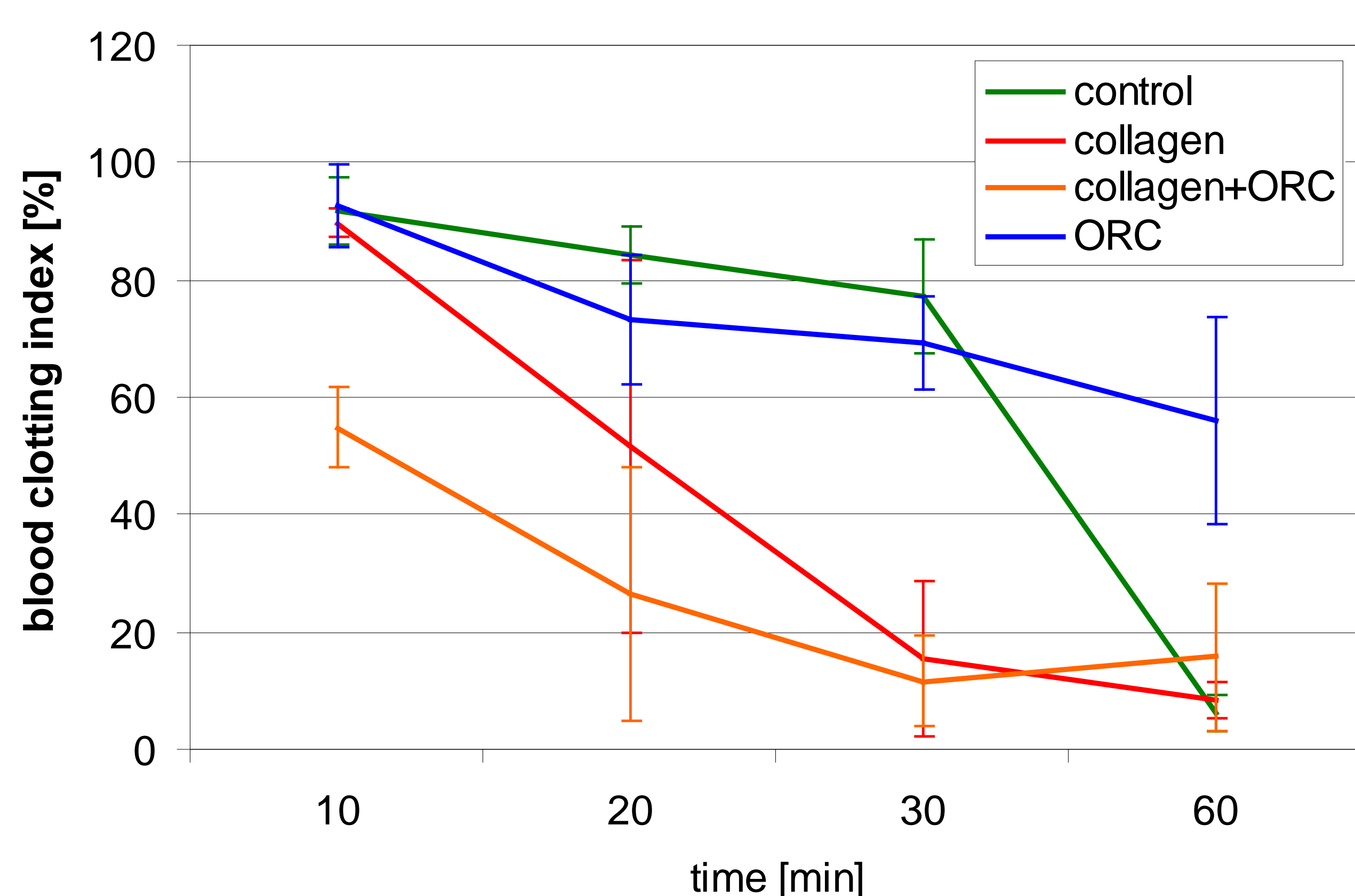


Figure 2: Collagen and collagen+ORC led to a significantly faster blood clot formation while ORC had no effect. Data presented as mean \pm SE.

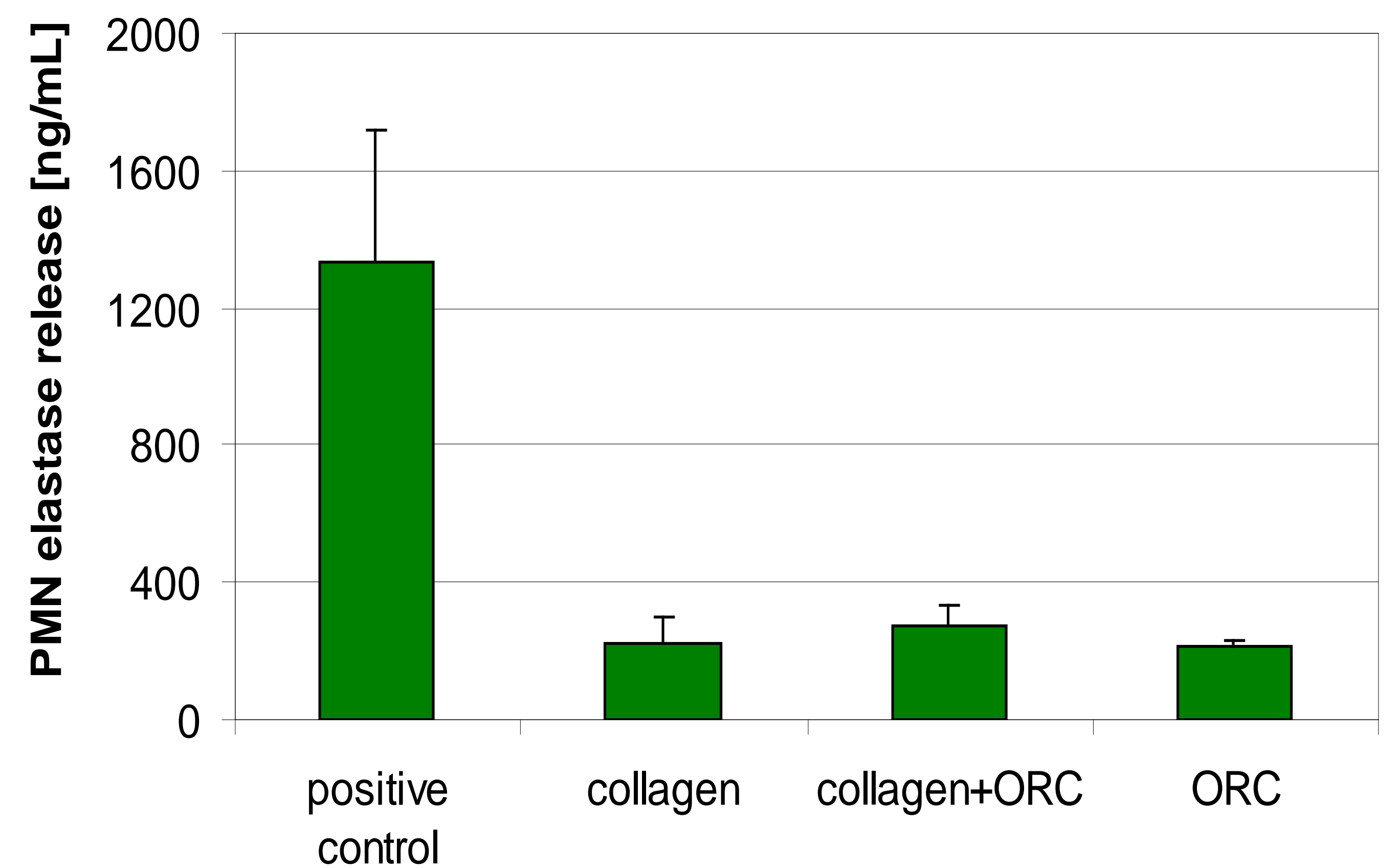


Figure 3: None of the dressings tested led to a distinct release of PMN elastase from granulocytes. Data presented as mean \pm SE.

Results

All biomaterials tested were found to overall enhance coagulation. However, they yielded different results in the various *in vitro* tests used. None of the materials affected PT and aPTT (data not shown). Only bovine collagen achieved a significant shortening of the time to thrombin generation in the thrombin generation assay (Figure 1). A pronounced effect on the blood clotting index was observed for collagen and collagen+ORC (Figure 2). Furthermore, none of the materials led to a distinct release of PMN elastase from granulocytes (Figure 3). However, a slight hemolytic effect of ORC and collagen+ORC was detected (Figure 4).

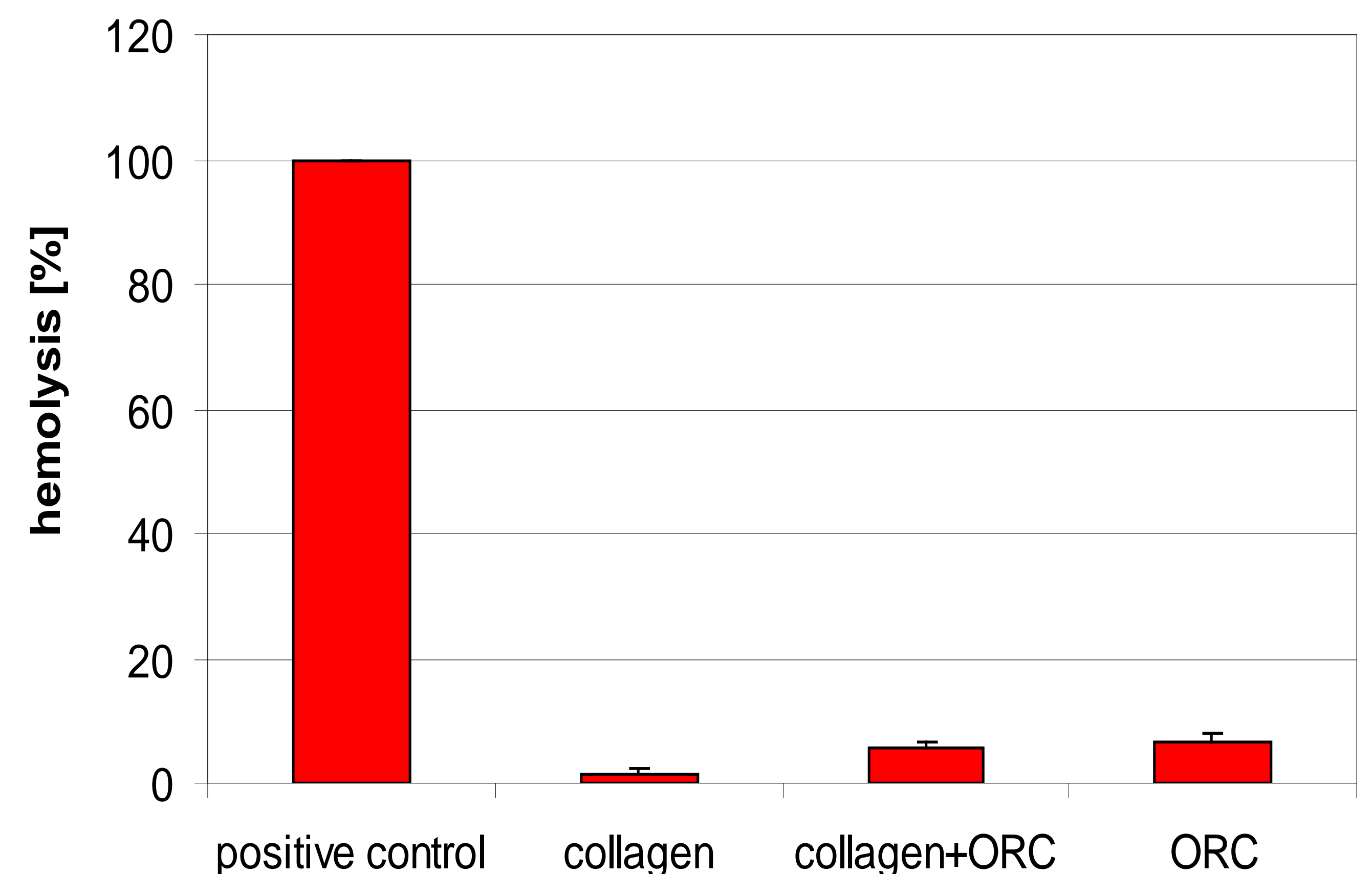


Figure 4: Collagen showed no hemolytic effect while a slight hemolytic activity was observed for collagen+ORC and ORC alone. Data presented as mean \pm SE.

Discussion

The use of *in vitro* techniques enables the direct comparison of the hemostatic properties of wound dressings under standard conditions. Biomaterials have different effects on hemostasis. Bovine collagen type I# was the only dressing that shortened the time to thrombin generation in the tests. Moreover, it exhibited the highest hemocompatibility *in vitro*, as both, ORC* and collagen+ORC+ had a slight hemolytic effect. Hence, products consisting only of collagen might be superior to the combination of collagen and ORC.

*ORC = Tabotamp®, Johnson & Johnson

#bovine collagen type I = Suprasorb® C, Lohmann & Rauscher

*collagen+ORC = Promogran, Systagenix