Oxidized cellulose as the cause of an acute ischemic event after coronary revascularization

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ABSTRACT

Absorbable topical hemostatic agents are commonly used in cardiac surgery. In this study we report an unusual case of an acute ischemic event after coronary revascularization produced by interaction between oxidized cellulose and epsilon aminocaproic acid. An in vitro study was also performed to test the interaction between oxidized cellulose and epsilon aminocaproic acid.

Key Words: Ischemic event, Oxidized cellulose, Coronary revascularization.
CLINICAL SUMMARY

Postoperative bleeding is one of the most frequent complications in cardiac surgery [1]. Bleeding necessitating reoperation occurs in 4 % to 7 % of patients after CPB and 50% to 70% of them will not have a surgical bleeding source. Fibrinolysis has been reported to be the cause of 25% to 45% of postoperative bleeding [2] and the use of both systemic antifibrinolytic agents and absorbable topical hemostatic agents is commonplace during cardiac surgical procedures [3,4]. The adverse effects after systemic use of antifibrinolytic agents is one of the reasons these agents are applied topically [5]. Until recently there were no reports in the literature describing ischemic events produced by the interaction of oxidized cellulose with topical epsilon aminocaproic acid (EACA).

We report the case of a 79-year-old man with unstable angina who was referred to our department for surgical revascularization. The coronariography showed significant left main coronary artery and right coronary artery lesions. The patient had insulin-dependent diabetes and chronic obstructive lung disease. A routine coronary revascularization with left internal Mammary artery to Anterior Descending and saphenous veins to Right Coronary artery and 1st Marginal (OM) was performed under cardiopulmonary bypass. Oxidized cellulose was placed around the OM anastomotic suture because of a continous oozing and before proceeding with the sternal closure the pericardial cavity was washed with 100 ml of saline solution containing 8 g of EACA. During the sternal closure, a severe hypotension with ST elevation in the posterior leads and a ventricular fibrillation occurred. Defibrillation was performed and because the ST modifications remained, the oxidized cellulose which had formed a solid and rigid shape, was removed. The ST elevation immediately disappeared. The subsequent intraoperative and postoperative course was uneventful. An in vitro study was performed using three different doses of EACA (4, 8, 12 Gr). When the oxidized cellulose contacted the saline solution containing EACA, it rolled
up immediately and it turned into a rigid shape (Fig 1). A segment of the saphenous vein with a hemostatic clip at the distal end was gently distended and a piece of oxidized cellulose was placed around the vein. Then we placed the vein in a saline solution containing EACA and when the oxidized cellulose turned into the rigid shape, the vein became constricted (Fig 2).

Figure 1.- The rigid shape that the oxidized cellulose takes after contact with EACA. We show a control, unexposed piece for comparison.

Figure 2.- Saphenous vein constriction caused by oxidized cellulose (in vitro study).
DISCUSSION

Postoperative bleeding requiring re-exploration occurs in 4% to 7% of patients after cardiopulmonary bypass and an identifiable surgical bleeding source cannot be found in more than 50% of these occurrences [1]. Brown and colleagues [3] conducted a meta-analysis to compare the effectiveness of aprotinin, EACA, and tranexamic acid with placebo. They concluded that all antifibrinolytic agents were effective in reducing blood loss and transfusion. However, intravenous antifibrinolytic agents administration have been associated with an increased risk of thromboembolic events and early graft closure after coronary revascularization [6] and new data have emerged regarding an increase in adverse outcomes associated with the systemic use of antifibrinolytic agents and most of these effects are avoided by topical application [5,7]. The fact that after topical use of Tranexamic acid and Aprotinin, they could not be detected in any of the blood samples [8] strongly suggest that their effects were due to topical action. On the other hand, topical hemostatic agents are efficacious in reducing blood loss during surgery [4] and they can be temporarily administered to avoid sternal bleeding complications [9]. Canver [10] reported a draping technique to prevent coronary bypass graft kinking and sutureline oozing using oxidized regenerated cellulose.

Oxidation is the only process that renders cellulose bioabsorbable in man, however a major problem with oxidation is the difficulty of producing materials that are homogeneous in chemical and physical properties. Oxidized cellulose is a fabric material that is obtained by the oxidation of cotton gauze or other cellulose fabric using nitrous oxide to achieve oxidation. The oxidation reaction makes the material soluble at physiological conditions. Oxidized regenerated cellulose similar to oxidized cellulose, but natural cellulose is first dissolved and then extruded as a continuous fiber. The fabric made from the fiber is very uniform in chemical composition and its oxidation therefore is more closely regulated. This uniform oxidation results in less variation in stability and absorbability of the material.
In our in vitro study, when the oxidized regenerated cellulose contacted EACA, it turned a yellowish brown color and became gelatinous. However when the oxidized cellulose contacted EACA, it rolled up immediately and turned into a rigid shape. Within a few days, most of the fibrous structure is gone.

The information presented in this report is the first case of adverse interactions between oxidized cellulose and topical epsilon aminocaproic acid and we do not advise the use of this combination.
REFERENCES


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