

system (Hemochron ACT Meter Model 801 and tubes FTCA510; from International Technidyne Corp., Edison N.J.).

In a first set of experiments, shown in FIG. 1, freshly drawn rabbit blood was mixed with either normal saline or with a photopolymerizable macromer material. The macromer contained a polyethylene glycol core, with short polylactic acids blocks on each end, terminated with acrylate groups. It was added in the form of an aqueous solution containing salts, buffers, and other excipients, in a form suitable for use in humans. It was found that dilution of the blood with saline did not significantly alter the clotting time, while dilution with the macromer solution retarded clotting, implying an inherent anticoagulant effect of the material.

In a second set of experiments, the results of which are shown in FIG. 2, the effect of known hemostatic agents on the clotting time of rabbit blood diluted with saline (control) or with macromer solution was determined, as measured by the ACT test. The same macromer was used. The three bars to the left are controls. In the saline controls, it was found that 1% thrombin greatly accelerated the rate of clotting in the ACT, although fibrinogen alone or calcium alone had no significant effect. It was found that thrombin also greatly accelerated the rate of clotting in the macromer containing blood, while further addition of calcium and fibrinogen further accelerated clotting.

Although the hydrogel sealant material on its own inhibited clotting, as compared to the control, it allowed clotting when combined with the hemostatic agents thrombin, calcium, and fibrinogen. The utility of the sealant/hemostat is its ability to act as a sealant, which assists in retarding blood flow on its own, combined with its ability to provide hemostasis at the site of injury. Moreover, the sealant ability of the hydrogel should be improved because accelerated clotting of bleeding from a surface to be treated should improve the adherence of the sealant to the tissue surface.

Modifications and variations of the present invention will be obvious to those skilled in the art from the foregoing detailed description and are intended to be encompassed by the following claims.

We claim:

1. A hemostatic tissue sealant, comprising:
 - a biocompatible, biodegradable hydrogel tissue sealant comprising crosslinkable groups having incorporated therein an effective amount of a hemostatic agent to stop the flow of blood from tissue in a medically acceptable period of time.
2. A hemostatic tissue sealant as in claim 1, wherein the hemostatic agent is selected from the group consisting of coagulation factors, coagulation initiators, platelet activators, vasoconstrictors, and fibrinolysis inhibitors.
3. A hemostatic tissue sealant as in claim 1, wherein the hemostatic agent is selected from the group consisting of epinephrine, adrenochrome, collagens, thrombin, fibrin, fibrinogen, oxidized cellulose, and chitosan.

4. A hemostatic tissue sealant as in claim 1, wherein the crosslinkable materials are self-crosslinking to form a seal.

5. A hemostatic tissue sealant as in claim 1, wherein the hydrogel is a photopolymerizable gel.

6. A hemostatic tissue sealant as in claim 1, wherein the hydrogel tissue sealant is formed of crosslinkable materials which contain crosslinkable groups, hydrophilic regions, and biodegradable regions.

7. A hemostatic tissue sealant as in claim 6, wherein the crosslinkable materials covalently crosslink by free radical initiated polymerization.

8. A hemostatic tissue sealant as in claim 6, wherein the crosslinkable materials are crosslinked by the application of one or more initiators of polymerization.

9. A hemostatic tissue sealant as in claim 8, wherein the one or more initiators of polymerization comprise oxidizers, heat and light.

10. A hemostatic tissue sealant as in claim 6, wherein the crosslinkable materials covalently crosslink by free radical initiated polymerization.

11. A hemostatic tissue sealant as in claim 6, wherein the hydrophilic regions comprise polyethylene glycol, the crosslinkable groups comprise hydrocarbon unsaturated groups and the biodegradable regions comprise poly(hydroxy acid).

12. A hemostatic tissue sealant composition comprising a biodegradable, biocompatible crosslinkable material that will function as a tissue sealant when crosslinked, having incorporated therein a hemostatic agent in an amount sufficient to stop the flow of blood from a tissue surface in a medically acceptable amount of time.

13. A method for forming a hemostatic sealant on a tissue surface, comprising:

- applying the hemostatic sealant composition of claim 12 to the tissue surface; and
- crosslinking the crosslinkable groups.

14. The method of claim 13, wherein the crosslinkable material includes crosslinkable groups, hydrophilic regions, and biodegradable regions.

15. The composition of claim 12, wherein the hydrophilic regions comprise polyethylene glycol, the crosslinkable groups comprise hydrocarbon unsaturated groups and the biodegradable regions comprise poly(hydroxy acid).

16. The method of claim 13, further comprising the step of applying an initiator primer to the tissue surface prior to application of the hemostatic sealant composition.

17. The composition of claim 12, wherein the hemostatic agent is selected from the group consisting of coagulation factors, coagulation initiators, platelet activators, vasoconstrictors, and fibrinolysis inhibitors.

18. The composition of claim 12, wherein the hemostatic agent is selected from the group consisting of epinephrine, adrenochrome, collagens, thrombin, fibrin, fibrinogen, oxidized cellulose, and chitosan.

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