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Dextran as the Dressing Component of FASTCLOT®
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Dextran is a branched-chain polysaccharide that has been used in medicine for many decades. It is available in two forms, the more common "Dextran 40," commonly 10% dextran, and "Dextran 70," commonly 6% and 32% dextran.

Most of the medicinal uses of dextran involve intravenous administration of Dextran 40. Due to its high molecular weight it is an excellent osmotic agent. Therefore, it is administered intravenously where it acts as a volume expander during hemorrhagic shock. It is used in this application for both civilian and combat trauma.[1,2] It also can be used during elective surgery for volume expansion.

Intravenous administration of Dextran 40 exerts an antithrombotic effect on platelets, endothelium and red blood cells by reducing aggregation and adhesiveness. Intravascular clots are less likely to form in the presence of dextran. This property of dextran has made it useful as a prophylactic agent for deep venous thrombosis (DVT) in surgical patients. It also is used to maintain patency of vessels in procedures that require microanastomosis.

Typical intravenous dosages of dextran are a liter or more on the first day followed by a half a liter for several days.

In addition to intravenous administration, dextran has been used topically. Gynecological surgeons have used Dextran 70 as an agent of choice when distending the abdomen and pelvis during laparoscopic and hysteroscopic surgery. Dextran 70 is superior to barriers such as Gelfoam and Surgicel for preventing post-surgical adhesions.[3] It also appears to be superior to normal saline.[4,5]

Generally, from 250 ml to 1 liter of dextran 70 is used for irrigation of the abdomen and pelvis.

The other common topical use of dextran is as a component of ophthalmologic solutions, where it acts as a soothing agent and lubricant. Dosages are measured in drops.

FASTCLOT® is a hemostatic dressing primarily composed of a dry powder of the clotting proteins fibrinogen and thrombin embedded within a solid dextran dressing. There are other minor components to the dressing that act as preservatives and stabilizers.

Dextran was chosen for a number of reasons. First, as a molecule, it is amenable to the process of electrospinning. Electrospinning creates dry nanofibers of dextran that can be configured into any desired size or shape. The resulting product, called a "dextran mat," is highly porous on a nano scale. The pores of the mat are small enough to contain the protein powder, yet large enough to readily admit water.

Secondly, dextran is highly soluble in water, so when water, or blood, contacts the mat it quickly dissolves the mat and liberates the proteins. The dry protein powder solubilizes rapidly, which allows the two clotting proteins to interact, resulting in a stable, tenacious clot. The process is very rapid, and at the stage of clot formation the dextran has been removed from the area of application.[6]

Finally, dextran is the ideal dressing material for FASTCLOT® because of its safety profile. The dextran dosages used in the FASTCLOT® dressings are a fraction of the recommended intravenous use, or the topical intra-abdominal use. The dose of dextran in FASTCLOT® is proprietary, but is several orders of magnitude less per dressing than what is used intravenously in treatment of shock, DVT prophylaxis, or abdominal irrigation.

In summary, electrospun dextran is the ideal dressing material in FASTCLOT® because it is safe, it dissolves rapidly, and it does not leave a trace.

FASTCLOT® could become an ideal platform for the delivery of pharmaco-therapeutic agents. It is possible to embed dry forms of drugs in the FASTCLOT® dressing. For example, antibiotics could be embedded in the dressing, along with fibrinogen and thrombin. The antibiotic would then become embedded in the clot and could elute into the tissues over a period of time, delivering antibiotics directly to a wound. Similarly, it is possible that some chemotherapeutic agents used in cancer treatment could also be embedded in the dressing for local delivery of higher concentrations than could be delivered by intravenous or other methods.

FASTCLOT® is a platform nanotechnology that will have many applications, not only in hemostasis, but as a delivery system for a myriad of medications.

References

1. Watters J, Tieu B, Differdin J, et al. 2006. A single bolus of 3% hypertonic saline with 6% destran provides optimal initial resuscitation after uncontrolled hemorrhagic shock. *J Trauma and Acute Care Surg* 61(1): 75-81.

2. Dubick M, Atkins JL. 2003. Small-volume fluid resuscitation for the far-forward combat environment: current concepts. *J Trauma and Acute Care Surg* 54(5):S43-45.

3. Soules MR, Dennis L, Bosarge A, Moore DE. 1982. The prevention of postoperative pelvic adhesions: an animal study comparing barrier methods with dextran 70. *AJOG* 143(7):829-34.

4. Neuwirth RS, Khalaf SH. 1975. Effect of thirty-two per cent dextran 70 on peritoneal adhesion formation. *AJOG* 121(3):420-22.

5. Buttram VC, Malinak R, Cleary R, et al. 1983. Reduction of postoperative pelvic adhesions with intraperitoneal 32% dextran 70: a prospective randomized clinical trial. *Fertility and Sterility* 40(5):612-19.

6. Padua RA, Olson CE, Floyd CT. Resorption characteristics of a novel fibrin hemostatic dressing. *Orthopedic Research Society Annual Meeting*, Orlando, 2016.