

Short communication: A Breakthrough in Hemostatic Agents for Dentistry: Will They Be a Game Changer?

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ABSTRACT

Background: Bleeding can occur during or after surgery which can be troublesome for both patient and the surgeon and if uncontrolled can lead to serious life threatening consequences. Bleeding may also compromise visibility. Hemostatic agents provide control of external bleeding by enhancing the natural clotting process via various physical reactions between the agent and blood factors. Various hemostatic agents like Hemcon® (chitosan-based), TraumaDEX® (Potato starch-based microparticles), QuickClot® (zeolite-based), STARSIL Hemostat, SURGISPON, CELOX BioHemostat etc, are available which have proved their effectiveness in major surgeries (Cardiothoracic, Urological, Abdominal, etc). They have been successfully introduced in the field of dental surgery recently, which is a boon in major and minor maxillofacial surgical procedures.

Conclusion: The local hemostatic agents may be a great help in providing clear and bloodless field, alleviating patient anxiety, and improving patient-surgeon compliance. Newer agents are really a breakthrough in the surgical procedures, and further research is still going on for future betterment. This will be a great news for dental surgeons as bleeding is always one of the major complications in dentistry, and dentists face the problem routinely.

Keywords: Hemostasis, Local hemostatic agents, Oral surgery, Bleeding.

Article Information

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INTRODUCTION

Bleeding can occur during and after surgery, posing a significant challenge to both surgeon and patient if it is uncontrolled. It may lead to severe complications, such as hypovolemic shock, which can be life-threatening. Bleeding is always the burning issue in dental surgery. In major oral and maxillofacial procedures and periodontal surgery electrocautery and ligature are most commonly used to control bleeding from small and major vessels. But if generalised oozing is present and use of pressure pack is ineffective and the use of electrosurgical instruments could endanger teeth or adjacent tissue or nerves, hemostatic agents are the most successful

remedy. Hemostatic agents provide control of external bleeding by enhancing the natural clotting process via various physical reactions between the agent and blood factors.

Now a days a various ranges of hemostatic agents are available with highly micro-bioengineered properties, which meticulously interact with clotting factors to form a stable clot and prevent its dislodgement in order to arrest reactionary and secondary bleeding along with maintenance of a aseptical condition by resisting the growth of certain microorganisms. Various hemostatic agents like Hemcon® (chitosan-based), TraumaDEX® (Potato starch-based microparticles), QuickClot® (zeolite-based),

STARSIL Hemostat, SURGISPON, CELOX BioHemostat etc, are available which have proved their effectiveness in major surgeries (Cardiothoracic, Urological, Abdominal, etc). They have been successfully introduced in the field of dental surgery recently, which is a boon in major and minor maxillofacial surgical procedures.

The three classes of action for topical hemostatic agents include factor concentrators, mucoadhesive agents, and procoagulants. Factor concentrators rapidly absorb water content of blood and concentrate the cellular and protein components of the blood; this promotes clot formation. TraumaDEX is an example of this type of hemostatic agent. It uses microporous polysaccharide hemospheres from potato starch to promote hemostasis by a gelling action to concentrate natural clotting components. This product doesn't produce an exothermic reaction when used like the original QuikClot product did. While TraumaDEX is considered safe and easy to use, it has not been utilized by U.S. military forces because the product appears more effective with minor to moderate wounds, not the severe wounds seen in combat.

Mucoadhesive agents work through a strong adherence to damaged tissues and physically seal bleeding wounds. Chitosan-based products, available from multiple manufacturers, are examples of this type of agent. These include HemCon Bandage, ChitoGauze, and Celox Gauze, etc. Chitosan is a natural polysaccharide (polymer made of sugars) and made of basic sugars (glucosamine & N-acetylglucosamine). When the product makes contact with blood, the chitosan swells, gels and sticks together to make a gel-like clot without generating an exothermic reaction.

These products work completely independent of body's clotting system, which is one of the benefits of these agents. In addition to controlling severe bleeding, HemoCon also offers an antibacterial barrier against a wide range of gram-positive and gram-negative

organisms, including antibiotic-resistant *Staphylococcus aureus* (MRSA), *Enterococcus faecalis* (VRE), and *Acinetobacter baumannii*. HemoCon Dental Dressing (HDD) has been proven to be a clinically effective hemostatic device that significantly minimizes the post-operative bleeding time (BT), including patients on anticoagulant therapy (OAT). Patients reached primary hemostasis (including OAT patients) in 1 min compared to those using control (gauge) where hemostasis occurred in average 9.53 min (J. Oral and Maxillofacial Surg; 2008, American Association of Oral & Maxillofacial Surgeons). HemoCon Dressings are extremely adherent, sealing the wound by positively charged design, which attracts negatively charged red blood cells to stabilize and to form a platelet plug. This advantage makes it widely used in periodontal flap surgery, biopsy, soft tissue wound, extraction socket, maxillofacial trauma, epistaxis etc.

CELOX is another chitosan-based hemostat granule optimized to control bleeding fast. CELOX granules are very high surface area flakes. When they come in contact with blood, CELOX swells, gels, and sticks together to make a gel-like clot, without generating any heat. It works independently of the body's normal clotting mechanism, works in hypothermic conditions and clots blood containing the blood-thinning drug heparin.

On contact, the ultra-hygrosopic STARSIL HEMOSTAT® particles rapidly absorb fluid from the blood. The process leads to a local concentration of corpuscular blood particles such as erythrocytes, thrombocytes as well as serum proteins and thrombin, accelerating the natural coagulation cascade. It forms a dense gel matrix that seals the wound and further blood flow from the wound is inhibited. STARSIL HEMOSTAT® is not affected by the patients clotting status, therefore it is also suitable for patients under anticoagulation therapy. Unlike many other surgical hemostats it is absorbed without residues within 48 to 72 hours through

endogenous amylase, preventing foreign body reactions or granuloma formation and once fully irrigated, will not swell post operatively.

Poly-N-acetyl glucosamine (pGlcNAc) is another effective hemostat, specially in patients taking anticoagulant and blood thinners. It works by activating platelets and accelerating the clotting cascade, and thus helps in fibrin clot formation. Nanofibers consisting of poly-N-acetyl glucosamine (pGlcNAc), as the functional component of products for surface hemostasis, have been shown to activate platelets and thereby the clotting mechanism. The pGlcNAc nanofibers were found to accelerate fibrin polymerization in whole blood and platelet-rich plasma. Treatment with eptifibatide (an inhibitor of the platelet GPIIb/IIIa receptor) and corn trypsin inhibitor inhibited clotting of whole blood and platelet-rich plasma. The inhibition was reversed by treatment with pGlcNAc nanofibers. It is yet to be introduced in the field of dentistry, but once they will come into play, the rule of stoppage of anticoagulant/blood thinner before extraction will be altered.

SURGISPON® is one of the recent hemostatic device introduced in the dental field. SURGISPON® standard can be used in dry form as a Haemostat in Surgery. Gelatin-thrombin combinations are beneficial in achieving faster haemostasis. They are also used as a vehicle for drugs or antibiotics such as penicillin. It has a porous structure that activates the thrombocytes at the moment blood comes in contact with the matrix of Sponge, this causes the thrombocytes to release a series of substances that promote their aggregation at the same time as their surface change character, thus enabling them to act as catalyst for the formation of thrombin. Absorbed within 3-4 weeks when implanted in tissues with no residue and no encapsulation. This property allows them to be left in large defects for weeks which also acts as a scaffold for healing. Similar mechanism and property is exhibited by another hemostat

Floseal which is nothing but bovine derived gelatin granules coated with human derived thrombin which also stabilize the clot and resorbed in body after 6-8 weeks. Fibrin sealants are one of the newest synthetic hemostat consists of fibrinogen, fibrin stabilizing factor and thrombin specially used in surgical bony cavity, bone grafting procedures, and Sinus lift surgery.

In invasive operative field, bleeding is unavoidable, but the challenge is hemostasis, especially in patients with congenital or acquired bleeding disorders, hypertension, or OAT. Different traditional methods sometimes are quite effective, but when the modalities fail or are unavailable, the local hemostatic agents may be a great help in providing a clear and bloodless field, alleviating patient anxiety, and improving patient-surgeon compliance. Newer agents are really a breakthrough in the surgical procedures and further research is still going on for future betterment. This will be a great news for dental surgeons as bleeding is always one of the major complications in dentistry, and dentists face the problem routinely.

CONCLUSION

Local hemostatic agents are beneficial in controlling bleeding during oral surgical procedures in patients with congenital and acquired bleeding disorders, and also in patients who are on antithrombotic medications for their systemic conditions. The local hemostatic agents may be a great help in providing clear and bloodless field, alleviating patient anxiety, and improving patient-surgeon compliance. Newer agents are really a breakthrough in the surgical procedures and further research is still going on for future betterment. This will be a great news for dental surgeons as bleeding is always one of the major complications in dentistry and dentists face the problem routinely.

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