

Hemostatic Gauze for Emergency Medicine

Merrill Bone, NREMT-P

Abstract

HemoStyp™ Hemostatic Gauze is a collagen-like natural substance created from chemically treated cellulose. It is an effective, patent-pending, hemostatic agent registered with the FDA to help control bleeding from open wounds and in body cavities (mouth, ears, nose, throat, vagina, and anus). The HemoStyp™ material contains no chemical additives, thrombin or collagen and is hypoallergenic. When it comes in contact with blood it expands slightly and converts to a gel that subsequently dissolves into glucose and saline. Because of its purity and the fact it simply degrades to these end products, it does not cause significant delay in healing as do other hemostatic materials that may have a similar appearance.

For Emergency Medicine HemoStyp™ Hemostatic Gauze has been used for a variety of procedures to stop bleeding in emergency situations. It is especially useful in hard to bandage areas as with lacerations to the head and extremities. Professionals involved in Emergency Medical Services like the efficiency and speed with which the gauze works. It allows the EMTs and Paramedics to have both hands free to work on other injuries, eliminating the need to concentrate all their attention on stopping the flow of blood.

HemoStyp™ Hemostatic Gauze is a proprietary hemostatic agent that originates from cellulose. It is chemically treated during a manufacturing process, after which it becomes readily accepted by the body. When first in contact with blood, it expands slightly. It rapidly converts to a gel and then dissolves to saline and glucose.

The work of HemoStyp™ Hemostatic Gauze takes place in each of its three stages: absorbing, swelling, and dissolving. It starts as a solid, relatively rough surface to slow down bleeding which allows certain clotting factors more time to spread through the wound. As it swells, it unites with platelets and the blood clot to more rapidly create a “plug” to reduce or stop bleeding. Finally, it reaches its soluble state where it continues to contribute to hemostasis and wound healing. These mechanisms are detailed in the paragraphs below. Part of this product’s success is in the unique timing with which it passes through the three stages.

HemoStyp™ Hemostatic Gauze is especially powerful in that, unlike some other materials, it has a three-fold usefulness: 1) chemical, 2) biochemical, and 3) physical. As it contributes to hemostasis, if one of these three effects loses its capability, one or both of the others can continue working, most notably in the swelling and liquid-phase activation processes. This soluble material is much more potent than other insoluble substances on the market – even without the addition of chemical or bovine byproducts.

Another special characteristic of this material is its bacteriostatic properties. This is especially important in contaminated wounds or in body cavities in which it is difficult or impossible to maintain a sterile field.¹

The Hemostatic Process

When a blood vessel is injured, blood escapes for as long as the vessel remains open and pressure within the vessel is greater than pressure outside. The normal hemostatic response to damaged fascular endothelium can be divided into three stages: 1) initial vasoconstriction, 2) platelet aggregation on and around the lesion and the formation of a platelet plug, and 3) activation of the reactions of blood coagulation. Platelet plugs can stop bleeding from the smallest vessels. When bleeding is from larger vessels, blood clot formation is required. HemoStyp™ Hemostatic Gauze is an essential ingredient in expediting hemostasis.

Uses for Emergency Medicine

HemoStyp™ Hemostatic Gauze is a valuable tool for Emergency Medicine. It is especially useful for areas that are difficult to wrap with a normal bandage including scalp and extremity lacerations. When using a normal bandage or wrap, at least one of the EMS personnel at the scene of an accident must focus his or her attention on applying pressure to control bleeding of wounds since this is a major concern. Because of the unusual shape of the head, regular dressing and bandaging can be challenging in the case of a head wound. The back of the head or occipital region is the only thing on which to anchor a bandage. Because the head is so vascular, head wounds, even smaller ones, create a disproportionate amount of bleeding. Even a small laceration to the head can result in significant bleeding. When treating a head wound an EMT or Paramedic has to be extremely cautious in the amount of pressure applied, since there is a possibility of skull fracture if too much force is used.

In addition, infection from head wounds can go directly to the brain. Therefore, it is important that bleeding is controlled and the wound be kept as clean as possible until debridement and suturing can be done in the emergency room.

These factors create unique challenges in treating head wounds. In managing bleeding from such wounds HemoStyp™ Hemostatic Gauze is especially helpful because it controls bleeding without the need for excessive pressure and its bacteriostatic properties create a cleaner environment for the wound.

Case report #1: In one case, a patient had a wound from a knife fight that extended from the parietal to the occipital regions of his head. This created a flap of loose skin which allowed significant bleeding. A 2"x2" piece of HemoStyp™ Gauze was folded and placed beneath the flap of skin. The bleeding stopped immediately. This allowed the EMT to have both hands free to work on other wounds which also needed attention.

Case report #2: In a second case a gunshot incident was illustrative of the effectiveness of HemoStyp™ Hemostatic Gauze in an emergency situation. A bullet went straight through the patient's forearm. The radius and ulna were both shattered and major bleeding occurred from both entrance and exit wounds. The EMTs only had one 2"x2" piece of HemoStyp™ Hemostatic Gauze which was folded once and applied to the entrance wound. They then wrapped a roller bandage on top of the HemoStyp™ Hemostatic Gauze, after which the bleeding stopped almost immediately. Normal dressing and bandaging were then applied to the exit wound. They had to apply constant pressure to that wound and the bandaging needed to be augmented before arriving at the hospital since the wound continued to bleed through. In contrast, the entrance wound needed no additional attention until the patient was admitted to the hospital.

Application

HemoStyp™ Hemostatic Gauze is applied by simply folding the gauze once or twice, depending on the size of the wound, and then putting it as far into the wound as possible. Putting a bandage on top of the gauze is optional and in many cases unnecessary. On smaller cuts, it may be helpful to first cut the Gauze in half before applying it to the wound. When this is done, it may not be necessary to fold it first. Since EMS work is pre-hospital, rinsing the gauze out with saline or water is not necessary. This is because after the patient reaches the hospital, a wound will be debrided and possibly reopened prior to suturing.

Advantages of HemoStyp™ Hemostatic Gauze in Emergency Medicine

By controlling bleeding quickly and efficiently, HemoStyp™ Hemostatic Gauze allows EMTs or Paramedics to work on other wounds and needs of the patient. It is a cleaner, more sanitary way to stop bleeding, thereby reducing the risk of infection. Also, it is effective for wounds in hard to bandage areas of the body, such as the head.

Enhancing Platelet Function utilizing HemoStyp™ Hemostatic Gauze

After an injury to the body, platelets become activated – changing from a discoid to spherical shape and extending pseudopodia. They release enzymes, that stimulate other platelets to activate, and chemicals that promote adhesion to blood vessel linings, collagen, glass, metal, fabric, and each other. Platelet aggregation is the capability of platelets to clump with each other to form a platelet plug.

HemoStyp™ Hemostatic Gauze, which is in a fabric-like state, increases platelet adhesion, thereby helping to promote clotting. This is similar to adherence of platelets to damaged collagen (the fibrous protein found in connective tissue that underlies the endothelial cells).

Enhancement of Blood Clotting with HemoStyp™ Hemostatic Gauze

Blood coagulation is the replacement of a relatively unstable platelet plug with a stronger, more resilient blood clot through a series of interdependent, enzyme-mediated reactions that bring about the generation of thrombin and the formation of fibrin from fibrinogen. This is accomplished through intrinsic and extrinsic pathways.²

a. Intrinsic Pathway - All components necessary for the clotting process to proceed are located in blood. As such, proteins required for such clotting to take place are part of the intrinsic pathway of blood coagulation. The effectiveness of the intrinsic pathway is assessed with the activated partial thromboplastin time test (PTT).

b. Extrinsic Pathway - The pathway of blood coagulation activated by tissue factor, a protein extrinsic to blood, is known as the extrinsic pathway. Tissue factor serves as a cofactor with factor VII to allow the activation of factor X. With the exception of factor VII, all components of the extrinsic pathway are also components of the intrinsic pathway. Activity of the extrinsic pathway may be assessed in the lab using the prothrombin time test (PT).

Research has demonstrated that PPT and PT are both decreased (clotting time accelerated) with the presence of HemoStyp™ Hemostatic Gauze in the wound. It is useful in both pathways.

1. The intrinsic pathway is initiated by the activation of factor XII by certain negatively charged surfaces, such as glass, kaolin, some synthetic plastics, and fabrics. They activate factor XII to its enzyme form, factor XIIa. **As HemoStyp™ Hemostatic Gauze dissolves and comes in contact with iron in red blood cells, it forms negatively charged colloidal particles that promote the activation of blood coagulation factor XII. HemoStyp™ Hemostatic Gauze works faster than many other hemostatic agents.**³

2. Injury to the blood vessel lining and contact of blood with tissues outside the vessel stimulates thrombin production by the activation of the clotting system. Thrombin causes platelet aggregation. Platelets exposed to thrombin secrete their granules and release their contents into surrounding plasma. Thrombin also initiates a reaction leading to a fibrin clot. **In research studies, the texture and initial solid state of HemoStyp™ Hemostatic Gauze slowed the blood flow and reduced the time in which thrombin was released into the wound. This increased platelet and whole blood adhesion rates, thereby improving hemostasis speed and function.**

3. The enzyme form of clotting factor XII (factor XIIa) catalyzes the conversion of factor XI to its enzyme form (factor XIa). Factor XIa catalyzes the conversion of factor IX to the activated form factor IXa in a reaction that requires calcium ions. Factor IXa assembles on the surface of membranes in complex with factor VIII. The factor IXa/factor VIII complex requires calcium to stabilize certain structures on these proteins associated with their membrane-binding properties. Factor Xa forms a complex with factor V on membrane surfaces in a reaction that also requires calcium ions. **In research studies, HemoStyp™ Hemostatic Gauze not only adhered to calcium ions, but because its surface area initially increases as it dissolves, it also expanded contact surfaces with blood coagulation factors needing calcium, thus increasing its overall effectiveness.**

4. HemoStyp™ Hemostatic Gauze helps stabilize new clots by accelerating the formation of fibrin cross-linkages.

5. HemoStyp™ Hemostatic Gauze increases whole blood viscosity significantly in a wound, thus promoting the aggregation of red blood cells. At the same time, it helps restrict the loss of red blood cells and platelets,

accelerating hemostasis. Unlike most other materials used for hemostasis, HemoStyp™ Hemostatic Gauze increases blood viscosity even in patients with coagulation defects.

Indications for the Use of HemoStyp™ Hemostatic Gauze

1. Trauma and/or surgery for healthy, non-medicated patients with profuse bleeding.

2. Trauma and/or surgery for patients on certain medications:

- **Aspirin:** inhibit platelet aggregation by inhibiting the pathway of the cyclooxygenase enzyme.
- **Anti-inflammatory:** similar mechanism as aspirin but effect more limited patient may be on drugs that reduce the number of circulating platelets.
- ❖ **Anticoagulants:** inhibit synthesis of vitamin K-dependent coagulation factors.
- ❖ **Antibiotics:** altered intestinal flora which can decrease production of Vitamin K.
- **Anticancer drugs:** patient may be on drugs that reduce the number of circulating platelets

3. Trauma and/or surgery for patients with:

- Liver damage from alcoholism (may have decreased production of liver-dependent coagulation factors).
- Non-alcoholic liver disease.
- Primary hepatitis
- Hypertension (elevated systolic blood pressure, 180-200 systolic, may cause prolonged bleeding)

4. Trauma and/or surgery for patients with⁴:
(May be in addition to drugs or infusions that stimulate or replace deficient clotting factors.)

- Hemophilia A (factor VIII deficiency)
- Hemophilia B or Christmas disease (factor IX deficiency)
- Hemophilia C (factor XI deficiency)
- Von Willebrand's disease (absent or reduced levels of factor VIII)
- Thrombocytopenia (defective or decreased production of platelets) Acquired or congenital.
- Disseminated intravascular coagulation or DIC (lack of clotting factors and platelets at the site where required)
- Hypoprothrombinemia (deficiency in prothrombin or factor II) Acquired or congenital.

Contraindications:

The presence of infection.

Conclusion:

In emergency medicine, HemoStyp™ Hemostatic Gauze is an excellent tool to stop bleeding in hard to bandage areas, such as the head and extremities. It is a cleaner, more sanitary method, which reduces the possibility of infection. By controlling bleeding quickly, it also allows the EMS professional to focus on other needs of the patient.

The author:

Merrill Bone, NREMT-P has been involved in many aspects of Emergency Medical Services for 23 years. His experience includes Ambulance Service, Fixed and Rotor Wing Transport, Industrial Clinics, and Firefighter Paramedic Service.

United Health Products, Inc is the registered provider for the HemoStyp™ Gauze product. For additional product information contact:

United Health Products, Inc
Phone: (732) 239-3444
www.unitedhealthproductsinc.com

¹Bioburden Test. Final Report. Aug. 9, 2001. Nelson Laboratories Salt Lake City, UT. Report available upon request.

²Furie, B. Bleeding and blood clotting. Encyclopedia Britannica. 2003.

³Partial Thromboplastin Time Test, Final Report. May 13, 2004. Nelson Laboratories Salt Lake City, UT. Report available upon request.

⁴Norris, TG. Gale Encyclopedia of Medicine. 1st ed. 2000.