

ALL BLEEDING STOPS... EVENTUALLY

Peter D'Souza, MD

Jessica Pierog, DO

Division of Emergency Medicine

Stanford University School of Medicine

May 20, 2010

DISCLOSURES

- ✘ Presenters have no financial interest in any of the products or companies discussed in this presentation

GOALS AND OBJECTIVES

- ✘ Describe the controversies regarding hemorrhage control
- ✘ Review methods of hemorrhage control
 - + Direct Pressure
 - + Pressure Point
 - + Tourniquets
 - + Hemostatic Agents
- ✘ Address different strategies depending on the environment and type of injury

DIRECT PRESSURE AND PRESSURE POINT

- ✘ Do they work?
 - + Standard part of most curriculums
 - + Can be effective if done correctly
- ✘ But, what are the challenges to these techniques?
 - + Do you have any other tasks to perform?
 - + How long do you have to hold pressure?
- ✘ Which patients can you use this on?
 - + Single system vs. Polytrauma

CHALLENGES OF HOLDING DIRECT PRESSURE



Apply direct pressure on external wounds with sterile cloth or your hand, maintaining pressure until bleeding stops

SINGLE SYSTEM VS. POLYTRAUMA



IDLE HANDS?



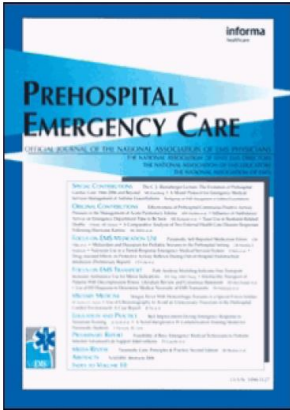
WHAT ABOUT TOURNIQUETS

- ✘ They do free up the provider to perform other tasks and can be effective
 - + Much of their use has been in blast injuries involving massive tissue loss
 - + These injuries are not common in the civilian population
- ✘ Tourniquets are not without side effects

TOURNIQUETS: A REVIEW OF CURRENT USE WITH PROPOSALS FOR EXPANDED PREHOSPITAL USE

Gerard S. Doyle, MD, MPH, Peter P. Taillac, MD

PREHOSPITAL EMERGENCY CARE APRIL / JUNE 2008 VOLUME 12 / NUMBER 2



- ✘ Tourniquet use can result in venous complications
 - + Increased bleeding if improperly applied
 - + Thrombosis from venous stasis
- ✘ Compartment syndrome – may be due to injury itself
- ✘ Pain from tourniquet itself

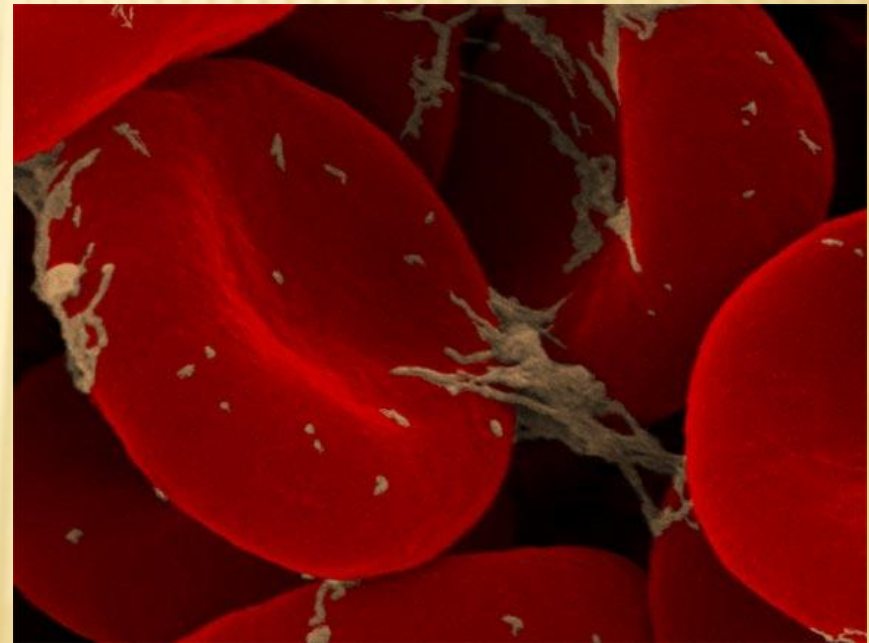
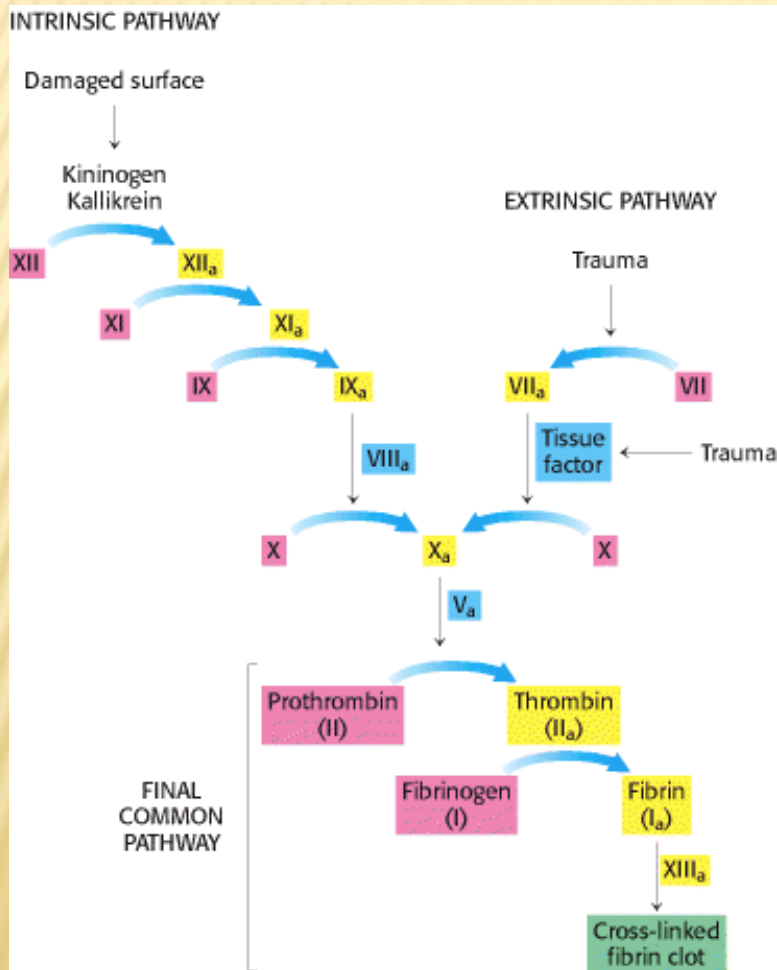
TOO MUCH LATE NIGHT TV...

- ✘ Ideally, you want to stop the bleeding – “just set it and forget it”
- ✘ Bleeding, even arterial bleeding, is not unexpected
 - + The body is designed to form clots and, depending on degree of injury, maintain flow – but sometimes it needs a little bit of help



WHAT IS THE BEST BLEEDING CONTROL?

- ✘ The components are already in the blood!



ENTER THE WORLD OF HEMOSTATIC AGENTS

- ✘ A hemostatic agent is designed to help create a clot, preventing further hemorrhage
- ✘ Ideally, once the clot is formed, there will not be a need for continued direct manual pressure
- ✘ This could free up the provider to perform other tasks
- ✘ Depending on the injury, may still have perfusion, preventing ischemic injury

Making Sense of the Preclinical Literature on Advanced Hemostatic Products

Anthony E. Pusateri, PhD, John B. Holcomb, MD, Bijan S. Kheirabadi, PhD, Hasan B. Alam, MD, Charles E. Wade, PhD, and Kathy L. Ryan, PhD

Review Article

The Journal of TRAUMA® Injury, Infection, and Critical Care
J Trauma. 2006;60:674–682.

- I. Stop large-vessel arterial and venous bleeding within 2 minutes of application, even when applied to an actively bleeding site through a pool of blood
- II. Ready to use – no mixing or prep
- III. Simple to apply with minimal training
- IV. Lightweight and durable
- V. Long shelf life even in extreme conditions
- VI. Safe to use – no risk of infection or injury
- VII. Inexpensive

FIRST GENERATION

- ✘ 1999
- ✘ Red Cross Dry Fibrin Dressing
 - + Add thrombin, fibrinogen, and factor 13 to biodegradable gauze
 - + These agents are purified from human blood
- ✘ Effective in animal models but was never FDA approved for routine use, only in combat
- ✘ \$1000 per bandage

SECOND GENERATION

- ✘ Second generation agents focused on concentrating the clotting factors already present in the blood
- ✘ Zeolite granules – QuikClot
 - + Adsorbs the liquid from the plasma, leading to concentration of the clotting factors
 - + Exothermic reaction: issue with burns
 - + QuikClot sponge was designed to keep granules from spreading and also minimize heat production
- ✘ Chitosan – cross link RBCs to form clot independent of usual clotting mechanisms
 - + Celox granules: cross link RBCs and adsorbs water
 - + Hemcon dressing: stiff material – serves as a matrix to attract RBCs and start clot formation

QUIK CLOT



CHITOSAN



HemCon® Bandage (4" x 4")



How the HemCon® Bandage Works:



THIRD GENERATION

- ✘ Attempts to address complications previously noted
- ✘ New trend: use gauze impregnated with the clotting agent
- ✘ QuikClot: new material – kaolin
 - + Activates the clotting cascade
- ✘ Celox Gauze
- ✘ ChitoGauze: by HemCon

QUIKCLOT GAUZE

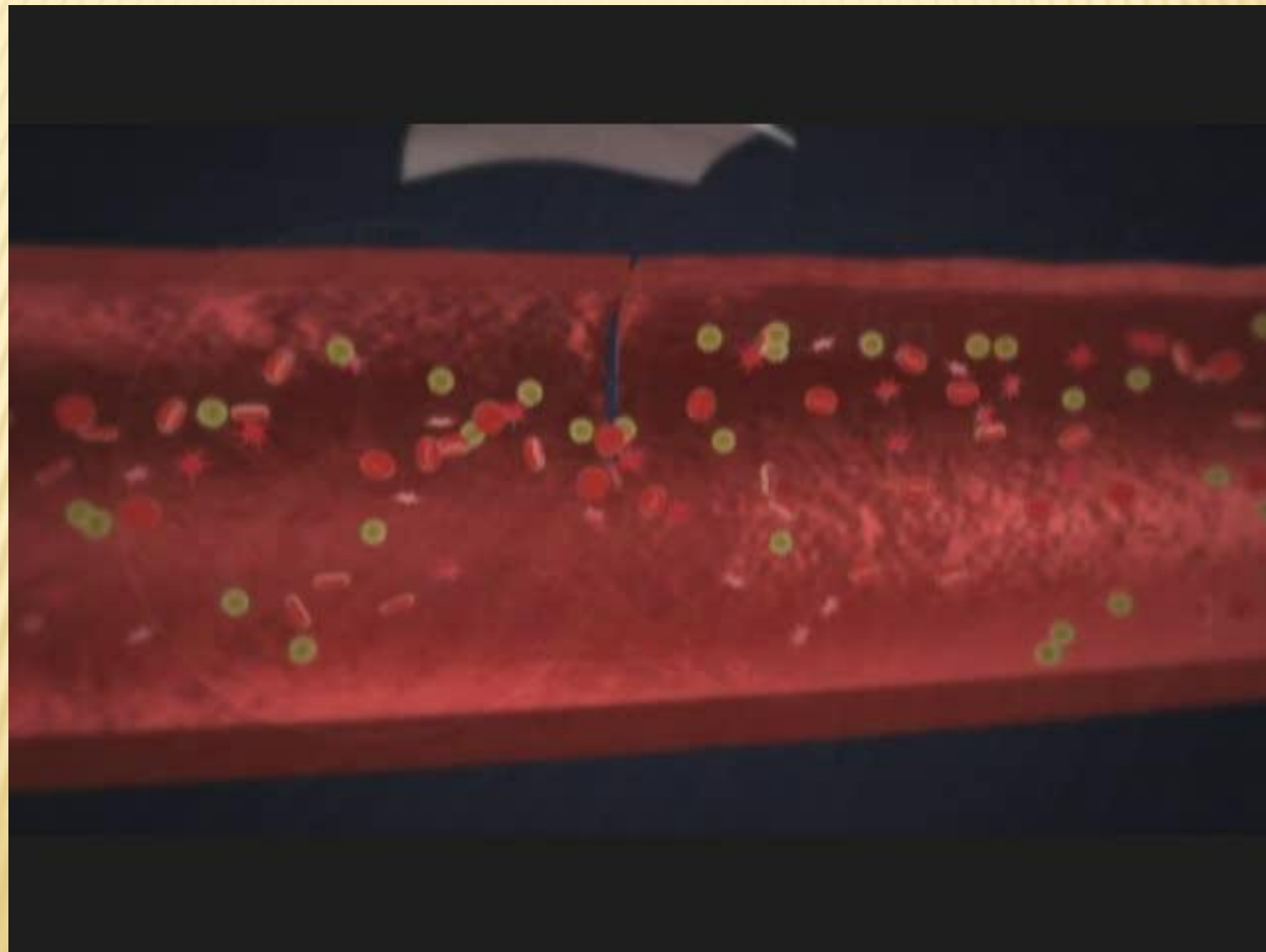


✘ 4 inch x 4 inch gauze

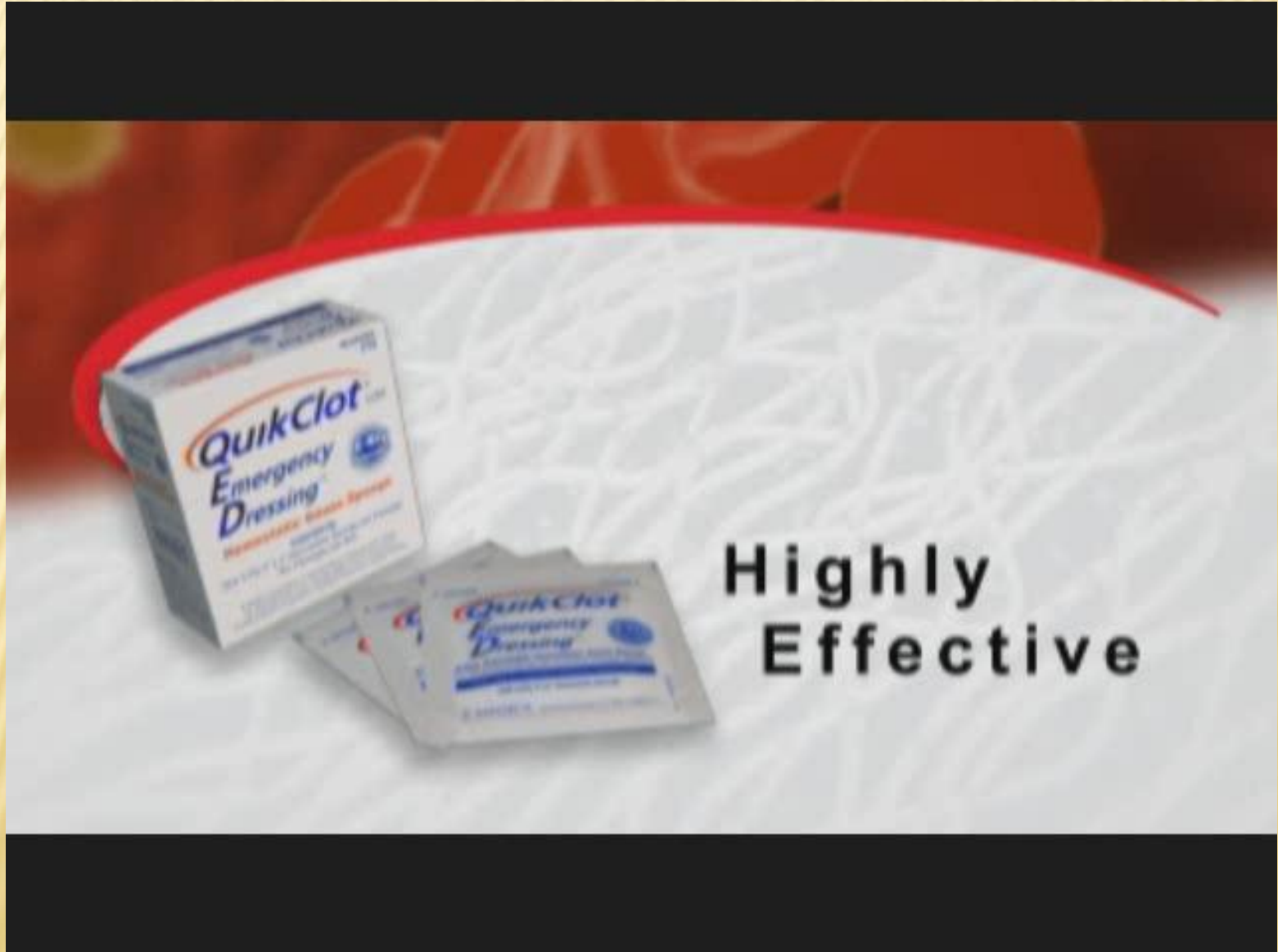


✘ 3 inches x 12 feet

KAOLIN IN ACTION



THE CATH LAB EXPERIENCE



**Highly
Effective**

CELOX GAUZE



✘ 3 inches x 5-10 feet

CHITOGAUZE



✘ 4 inches x 12 feet

ARE THEY SAFE?

Safety Evaluation of New Hemostatic Agents, Smectite Granules, and Kaolin-Coated Gauze in a Vascular Injury Wound Model in Swine

The Journal of TRAUMA® Injury, Infection, and Critical Care • Volume 68, Number 2, February 2010

Bijan S. Kheirabadi, PhD, James E. Mace, MD, Irasema B. Terrazas, MS, Chriselda G. Fedyk, MS, J. Scot Estep, DVM, Michael A. Dubick, PhD, and Lorne H. Blackbourne, MD

- ✘ Compared kaolin-coated gauze to smectite granules
 - + Smectite granules caused endothelial damage and made them nonviable for primary surgical repair
 - ✘ NOTE: WoundStat product (smectite) was pulled by the FDA in 2009 over concerns of embolization
 - + Vessels treated with QuikClot gauze or control (Kerlix dressing) remained patent with no thrombus or blood clot in their lumen

Making Sense of the Preclinical Literature on Advanced Hemostatic Products

Anthony E. Pusateri, PhD, John B. Holcomb, MD, Bijan S. Kheirabadi, PhD, Hasan B. Alam, MD, Charles E. Wade, PhD, and Kathy L. Ryan, PhD

Review Article

The Journal of TRAUMA® Injury, Infection, and Critical Care
J Trauma. 2006;60:674–682.

- I. Stop large-vessel arterial and venous bleeding within 2 minutes of applications, even when applied to an actively bleeding site through a pool of blood
- II. Ready to use – no mixing or prep
- III. Simple to apply with minimal training
- IV. Lightweight and durable
- V. Long shelflife even in extreme conditions
- VI. Safe to use – no risk of infection or injury
- VII. Inexpensive