














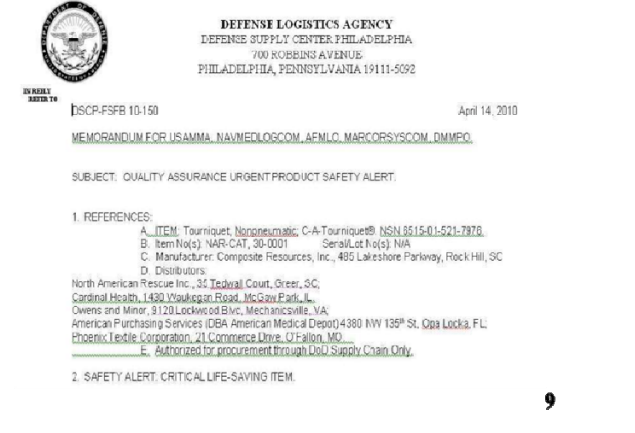



<p>Tactical Combat Casualty Care August 2011</p>  <p>Direct from the Battlefield: TCCC Lessons Learned in Iraq and Afghanistan</p>	<p>Tactical Combat Casualty Care August 2011</p> <p>Direct from the Battlefield: TCCC Lessons Learned in Iraq and Afghanistan</p>	
<p>TCCC Lessons Learned in Iraq and Afghanistan</p> <ul style="list-style-type: none"> • Reports from Joint Trauma System (JTS) weekly Trauma Telecons – every Thursday morning – Worldwide telecon to discuss every serious casualty admitted to a Level III hospital from that week • Published medical reports • Armed Forces Medical Examiner’s Office reports • Feedback from doctors, corpsmen, medics, and PJs 	<p>TCCC Lessons Learned in Iraq and Afghanistan</p> <ul style="list-style-type: none"> • Reports from Joint Trauma System (JTS) weekly Trauma Telecons – every Thursday morning • Worldwide telecon to discuss every serious casualty admitted to a Level III hospital from that week • Published medical reports • Armed Forces Medical Examiner’s Office reports • Feedback from doctors, corpsmen, medics, and PJs 	<p>This is the BREAKING NEWS in battlefield trauma care!</p>
<p>Train ALL Combatants in TCCC</p> <ul style="list-style-type: none"> • Potentially preventable deaths averaging about 20% of all fatalities • Units that train all members in TCCC have drastically reduced this incidence • Need to train <u>ALL</u> combatants in TCCC 	<p>Train ALL Combatants in TCCC</p> <ul style="list-style-type: none"> • Potentially preventable deaths averaging about 20% of all fatalities • Units that train all members in TCCC have drastically reduced this incidence • Need to train <u>ALL</u> combatants in TCCC 	<p>Some units have almost ELIMINATED preventable deaths by training everyone in TCCC. Kotwal – Archives of Surgery 2011 Savage – Journal of Trauma 2011</p>

 <p>Fatal Extremity Hemorrhage</p> <p>This casualty was wounded by an RPG explosion and sustained a traumatic amputation of the right forearm at the mid-forearm level and a right leg wound. He bled to death from his leg wound despite the placement of three field-expedient tourniquets.</p> <p>What could have saved him C.A.T. Tourniquet TCCC training for <u>all</u> unit members <i>*Note: Medic killed at onset of action</i></p> 	<p>Fatal Extremity Hemorrhage</p> <p>This casualty was wounded by an RPG explosion and sustained a traumatic amputation of the right forearm at the mid-forearm level and a right leg wound. He bled to death from his leg wound despite the placement of three field-expedient tourniquets.</p> <p>What could have saved him? C.A.T. Tourniquet TCCC training for <u>all</u> unit members</p> <p><u>*Note: Medic killed at onset of action</u></p>	<p>This kind of event can be prevented with good TCCC training for everyone in the unit. TCCC – it’s not just for medics and corpsmen anymore!</p>
 <p>Tourniquets</p> <ul style="list-style-type: none"> • Get tourniquets on BEFORE onset of shock <ul style="list-style-type: none"> – Mortality is very high if casualties already in shock before tourniquet application • If bleeding is not controlled and distal pulse not eliminated with first tourniquet – use a second one just proximal to first <ul style="list-style-type: none"> – Increasing the tourniquet WIDTH with a second tourniquet controls bleeding more effectively and reduces complications 	<p>Tourniquets</p> <ul style="list-style-type: none"> • Get tourniquets on BEFORE onset of shock <ul style="list-style-type: none"> – Mortality is very high if casualties already in shock before tourniquet application • If bleeding is not controlled and distal pulse not eliminated with first tourniquet – use a second one just proximal to first <ul style="list-style-type: none"> – Increasing the tourniquet WIDTH with a second tourniquet controls bleeding more effectively and reduces complications 	<p>COL John Kragh from the Army Institute of Surgical Research – 3 great tourniquet papers Journal of Trauma 2008 Annals of Surgery 2009 Journal of Emergency Medicine 2009</p>
 <p>Tourniquet Case Report Afghanistan – Nov 2009</p> <ul style="list-style-type: none"> • Soldier with gunshot wound to left leg • Open fracture left femur • Injury to popliteal artery and vein • Three CAT tourniquets placed • Life saved • Leg doing well • 2-3 casualties/week being saved with tourniquets 	<p>Tourniquet Case Report Afghanistan – Nov 2009</p> <ul style="list-style-type: none"> • Soldier with gunshot wound to left leg • Open fracture left femur • Injury to popliteal artery and vein • Three CAT tourniquets placed • Life saved • Leg doing well • 2-3 casualties/week being saved with tourniquets 	<p>Tourniquets are saving lives on the battlefield EVERY WEEK.</p>

 <p>Tourniquets</p> <ul style="list-style-type: none"> • Tighten velcro band on tourniquets as tight as possible before starting to use windlass – a loose velcro band contributes to tourniquet malfunction <ul style="list-style-type: none"> – Should be effective with approximately three 180 degree turns of windlass – Use second tourniquet as needed 	<p>Tourniquets</p> <ul style="list-style-type: none"> • Tighten velcro band on tourniquets as tight as possible before starting to use windlass – a loose velcro band contributes to tourniquet malfunction <ul style="list-style-type: none"> –Should be effective with approximately three 180-degree turns of windlass –Use second tourniquet as needed 	<p>Common tourniquet mistake – not getting the velcro band tight before starting to crank the windlass. Recommendations from COL John Kragh at USAISR</p>
 <p>Tourniquets</p> <ul style="list-style-type: none"> • Fake CAT tourniquets that are prone to malfunction are turning up in theater – ensure that you have this NSN tourniquet: • NSN 6515-01-521-7976 	<p>Tourniquets</p> <ul style="list-style-type: none"> • Fake CAT tourniquets that are prone to malfunction are turning up in theater – ensure that you have this NSN tourniquet: • NSN 6515-01-521-7976 	<p>Make sure you have the right tourniquets!</p>
 <p>Counterfeit C-A-Ts</p> 	<p>Counterfeit C-A-Ts</p> 	<p>Message from Defense Logistics Agency outlining problem This letter lists authorized C.A.T. distributors</p>



Counterfeit C-A-Ts

2 SAFETY ALERT: CRITICAL LIFE-SAVING ITEM.

A. REASON: DLA has become aware of similar products manufactured to closely resemble the C-A-Tourniquet® and available for purchase through non-DoD procurement gateways. These products were first encountered several years ago in a depot in Afghanistan and thought to be a substitute for the real thing. Today the product is very difficult to distinguish from the C-A-Tourniquet® down to duplicate markings and symbols.

B. RECOMMENDED STRATEGY: The above distributors, supplying the Composite Resources product exclusively, are the only authorized source for this device.

The FDA regulates this product as a Class 1 device, which means that there is no requirement for a premarket notification application and FDA clearance is not required before marketing the device in the U.S. However, these manufacturers are required to register their establishment with FDA. If you have purchased these devices from any other source, it is recommended that they be suspended from use and replaced by the recommended product. Please report suspended quantities to your logistical supply office.

Some examples of non-authorized Internet sources for duplicate product that may be hazardous are: www.world-element.com; ID No. EX 159; and http://www.airsoftglobal.com/product_info.php?products_id=11454;ID_EL-ACC-EX159-AG.

10

Counterfeit C-A-Ts

Counterfeit C-A-Ts

2. SAFETY ALERT: CRITICAL LIFE-SAVING ITEM.

A. REASON: DLA has become aware of similar products manufactured to closely resemble the C-A-Tourniquet® and available for purchase through non-DoD procurement gateways will supply only the approved commercial part from authorized distributors. These products were first encountered several years ago in a depot in Afghanistan and thought to be a substitute for the real thing. Today the product is very difficult to distinguish from the C-A-Tourniquet® down to duplicate markings and symbols.

Although there is no direct evidence against these duplicate products, several reports indicate that they are of inferior design and may cause serious injury or death.

B. RECOMMENDED STRATEGY: The above distributors, supplying the Composite Resources product exclusively, are the only authorized source for this device.

The FDA regulates this product as a Class 1 device, which means that there is no requirement for a premarket notification application and FDA clearance is not required before marketing the device in the U.S. However, these manufacturers are required to register their establishment with FDA. If you have purchased these devices from any other source, it is recommended that they be suspended from use and replaced by the recommended product. Please report suspended quantities to your logistical supply office.

Some examples of non-authorized Internet sources for duplicate product that may be hazardous are: www.world-element.com; ID No. EX 159; and http://www.airsoftglobal.com/product_info.php?products_id=11454;ID_EL-ACC-EX159-AG.

10

Fake tourniquets are of inferior design and may not work
May be hard to distinguish from real C-A-T

CAT (GEN III) vs. F-CAT

Executive Summary

Introduction:

1. The Element Cat (E-CAT) is a very carefully made counterfeit CAT tourniquet.
2. It is manufactured in Hong Kong for \$8.50 (USD) per item.
3. There are no limits to the number that can be purchased.
4. They are available on the internet, and anyone can purchase them.
5. They were designed to look, feel and act like a CAT (GEN III).
6. They ARE a counterfeit tourniquet.










CAT (GEN III) vs. F-CAT













Executive Summary






Introduction:



1. The Element Cat (E-CAT) is a very carefully made counterfeit CAT tourniquet.
2. It is manufactured in Hong Kong for \$8.50 (USD) per item.
3. There are no limits to the number that can be purchased.
4. They are available on the internet, and anyone can purchase them.
5. They were designed to look, feel and act like a CAT (GEN III).
6. They ARE a counterfeit tourniquet.

Fake C-A-Ts made in Hong Kong
Here are some ways to tell them apart
Date stamp on real CAT Generation III tourniquets is a good way







<p>CAT (GEN III) vs. F-CAT Executive Summary</p> <p>CAT (GEN III) Package from NARP, Inc. Looks nothing like the F-CAT package.</p> <p>E-CAT: Packaged in plastic bag with paper top. The sticker on the bag call the tourniquet the "Combat Application Tourniquet" and lists the NSN assigned to NARP.</p> 	<p>CAT (GEN III) vs. F-CAT Executive Summary</p> <p>CAT (GEN III) Package from NARP, Inc. Looks nothing like the F-CAT package.</p> <p>E-CAT: Packaged in plastic bag with paper top. The sticker on the bag call the tourniquet the "Combat Application Tourniquet" and lists the NSN assigned to NARP.</p> <p>CAT</p> <p>E-CAT</p> 	<p>It's much easier to spots the fakes if they are still in the wrapper! Totally different packaging</p>
<p> CAT Generation VI</p> <p>10060209 Length of Tourniquet changed to 37 1/2" Manufacturer and Lot Stamp with date manufactured added to the strap.</p>  <p>13</p>	<p>CAT Generation VI</p> <p>10/06/2009 Length of Tourniquet changed to 37 1/2" Manufacturer and Lot Stamp with date manufactured added to the strap</p> 	<p>New Generation VI C-A-T has the white time band Also a new manufacturer and date stamp</p>
<p> Ft. Hood Shootings 2009 Officer Kim Munley</p> <ul style="list-style-type: none"> • 12 dead; 31 wounded on 5 Nov 09 • Officer Munley got shooter; shot in both thighs • Direct pressure and makeshift tourniquets used by several physicians unsuccessful at controlling hemorrhage – went into shock • Saved by Army 68W medic with a CAT tourniquet on left thigh 	<p>Ft. Hood Shootings 2009 Officer Kim Munley</p> <ul style="list-style-type: none"> •12 dead; 31 wounded on 5 Nov 09 •Officer Munley got shooter; shot in both thighs •Direct pressure and makeshift tourniquets used by several physicians unsuccessful at controlling hemorrhage – went into shock •Saved by Army 68W medic with a C-A-T on left thigh 	<p>Officer Kim Munley – Hero of Fort Hood Shootings Shot in leg – femoral bleeding Direct pressure had failed and she was going into shock Saved by Army medic who used a C-A-T</p>


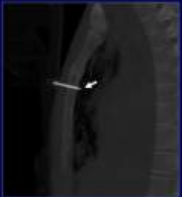
 <p>Tourniquet on Uninjured Arm</p> <ul style="list-style-type: none"> • JTS Trauma Telecon 8 April 2010 • IED casualty • Arrived at Kandahar with C-A-T in place on left arm • Evaluation: no injuries sustained on left arm • Follow-up: No explanation available • Lessons Learned: <ul style="list-style-type: none"> – No injury = No tourniquet – Remember to reassess your casualties <p>15</p>	<p>Tourniquet on Uninjured Arm</p> <ul style="list-style-type: none"> •JTS Trauma Telecon 8 April 2010 •IED casualty •Arrived at Kandahar with C-A-T in place on left arm •Evaluation: no injuries sustained on left arm •Follow-up: No explanation available •Lessons Learned: <ul style="list-style-type: none"> –No injury = No tourniquet –Remember to reassess your casualties 	<p>This mistake could have been avoided if the casualty had been reassessed in TFC.</p>
 <p>Wear Your Eye Protection!</p> <ul style="list-style-type: none"> • Jan 2010 • 22 y/o near IED without eye protection • Now blind in both eyes • Don't let this happen to you – see slides below  <p>With eye pro – eyes OK</p>  <p>Without eye pro – both eyes being removed</p>	<p>Wear Your Eye Protection!</p> <ul style="list-style-type: none"> •Jan 2010 •22 y/o near IED without eye protection •Now blind in both eyes •Don't let this happen to you – see slides below 	<p>Prevention, prevention, prevention.....</p>
 <p>Eye Armor – It Works!</p>    	<p>Eye Armor – It Works!</p>	<p>On left – large shrapnel fragment stopped by eye armor On right – multiple shrapnel wounds to face; eyes unharmed thanks to eye armor</p>
 <p>Penetrating Eye Trauma</p> <ul style="list-style-type: none"> • Rigid eye shield for obvious or suspected eye wounds - often not being done – SHIELD AND SHIP! • Not doing this may cause permanent loss of vision – use a shield for any injury in or around the eye • Eye shields not always in IFAKs  <p>Shield after injury</p>  <p>No shield after injury</p>	<p>Penetrating Eye Trauma</p> <ul style="list-style-type: none"> •Rigid eye shield for obvious or suspected eye wounds - often not being done – SHIELD AND SHIP! •Not doing this may cause permanent loss of vision – use a shield for any injury in or around the eye •Eye shields not always in IFAK 	<p>The eye on the left has a good chance of recovering vision. The eye on the right will have to be surgically removed.</p>



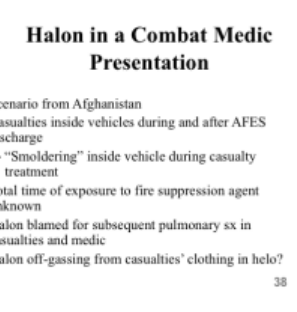
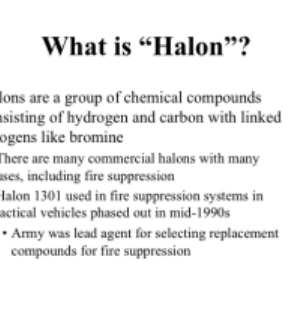
 <p>Eye Protection</p>  <ul style="list-style-type: none"> • Use your tactical eyewear to cover the injured eye if you don't have a shield. • Using tactical eyewear in the field will generally prevent the eye injury from happening in the first place! 19 	<p>Eye Protection</p> <ul style="list-style-type: none"> • Use your tactical eyewear to cover the injured eye if you don't have a shield. • Using tactical eyewear in the field will generally prevent the eye injury from happening in the first place! 	<p>Tactical eyewear can be used to protect the eye if no eye shield is available. Use of tactical eyewear is an excellent way to prevent this type of injury from happening in the first place.</p>
 <p>JTTS Trauma Telecon 9 Sept 2010</p> <ul style="list-style-type: none"> • Recent case of endophthalmitis (blinding infection inside the eye) • Reminder – shield and moxifloxacin in the field for penetrating eye injuries • Also – need to continue moxi both topically and systemically in the MTFs • Many antibiotics <u>do not penetrate well</u> into the eye 	<p>JTTS Trauma Telecon - 9 Sept 2010</p> <ul style="list-style-type: none"> • Recent case of endophthalmitis (blinding infection inside the eye) • Reminder – shield and moxifloxacin in the field for penetrating eye injuries • Also – need to continue moxi both topically and systemically in the MTFs • Many antibiotics <u>do not penetrate well</u> into the eye 	<p>Eye infections can cause permanent loss of vision after eye injury. Give antibiotics in the Combat Pill Pack to help prevent!</p>
 <p>Patched Open Globe 22 July 2010</p> <ul style="list-style-type: none"> • Shrapnel in right eye from IED • Had rigid eye shield placed • Reported as both pressure patched and as having a gauze pad placed under the eye shield without pressure • Extruded uveal tissue (intraocular contents) noted at time of operative repair of globe • Do not place gauze on injured eyes! COL Robb Mazzoli: Gauze can adhere to iris tissue and cause further extrusion when removed <u>even if no pressure is applied to eye.</u> 	<p>Patched Open Globe 22 July 2010</p> <ul style="list-style-type: none"> • Shrapnel in right eye from IED • Had rigid eye shield placed • Reported as both pressure patched and as having a gauze pad placed under the eye shield without pressure • Extruded uveal tissue (intraocular contents) noted at time of operative repair of globe • Do not place gauze on injured eyes! COL Robb Mazzoli: Gauze can adhere to iris tissue and cause further extrusion when removed <u>even if no pressure is applied to eye.</u> 	<p>COL Robb Mazzoli was formerly the Army Surgeon General's Consultant for Ophthalmology Reminder: Rigid eye shields GOOD, pressure patch BAD for eye trauma Should put no gauze underneath the shield at all – may cause problems as noted above</p>




 <p>Surgical Airways</p> <ul style="list-style-type: none"> • Joint Trauma System e-mail of 24 September 09 • 3 field crics done incorrectly in OIF • One was done through the center of the thyroid cartilage and through one of the vocal cords <p>22</p>	<p>Surgical Airways</p> <ul style="list-style-type: none"> • Joint Trauma System e-mail of 24 September 09 • 3 field crics done incorrectly in OIF • One was done through the center of the thyroid cartilage and through one of the vocal cords 	<p>Surgical airways are probably the most technically difficult intervention in TCCC. Some have been done incorrectly.</p>
 <p>Surgical Airways: The Rest of the Story</p> <p><small>*The setting of the casualty care was at night in a non-permissive environment. The medic had sustained a sacral injury and damaged his NVGs during a hard landing on infil. The casualty had sustained a gunshot wound to the jaw. The medic was not called to the scene for ten minutes due to an ongoing firefight. The jaw was shattered and he had heavy maxillofacial bleeding. The recovery position was attempted repeatedly but the casualty refused to remain like that. Anxiolysis was attempted with Versed to facilitate maintaining the airway with position alone, but did not work. The casualty became increasingly combative and the decision was made to perform the cric out of fear of completely losing the airway during evacuation. Due to the fact that the medic's NVGs were damaged, an operator (former 18D with two successful prior combat cric's) attempted the procedure with assistance by the medic. By then all landmarks had disappeared due to soft tissue swelling of the neck. Although complications resulted from the procedure, a definitive airway was established under extremely difficult conditions and the casualty lived.*</small></p>	<p>Surgical Airways: The Rest of the Story</p> <p>“The setting of the casualty care was at night in a non-permissive environment. The medic had sustained a sacral injury and damaged his NVG's during a hard landing on infil. The casualty had sustained a gunshot wound to the jaw. The medic was not called to the scene for ten minutes due to an ongoing firefight. The jaw was shattered and he had heavy maxillofacial bleeding. The recovery position was attempted repeatedly, but the casualty refused to remain like that. Anxiolysis was attempted with Versed to facilitate maintaining the airway with position alone, but did not work. The casualty became increasingly combative and the decision was made to perform the cric out of fear of completely losing the airway during evacuation. Due to the fact that the medic's NVGs were damaged, an operator (former 18D with two successful prior combat cric's) attempted the procedure with assistance by the medic. By then all landmarks had disappeared due to soft tissue swelling of the neck. Although complications resulted from the procedure, a definitive airway was established under extremely difficult conditions and the casualty lived.”</p>	<p>Another dramatic example of how difficult it can be to provide trauma care on the battlefield.</p>





<p>Surgical Airways</p> <p>Recommendations:</p> <ul style="list-style-type: none"> • Live tissue training for this procedure if possible • “Sim Man” trainer may be second-best option • Don’t attempt surgical airway just because the casualty is unconscious • Try the “sit-up and lean forward” position prior to attempting a surgical airway 	<p>Surgical Airways</p> <p>Recommendations:</p> <ul style="list-style-type: none"> •Live tissue training for this procedure if possible •“Sim Man” trainer may be second-best option •Don’t attempt surgical airway just because the casualty is unconscious •Try the “sit-up and lean forward” position prior to attempting a surgical airway 	<p>The “Sim Man” trainer is the device used to train Army 68W medics in surgical airways.</p>
<p>Surgical Airways</p> <p>If you cut the endotracheal tube, you must tape it very securely or the tube will slip down into the trachea, cease to function correctly, and have to be surgically removed.</p> <p>Like this one.....</p> 	<p>Surgical Airways</p> <p>If you cut the endotracheal tube, you must tape it very securely or the tube will slip down into the trachea, cease to function correctly, and have to be surgically removed.</p>	<p>Read text</p>
<p>IED Casualties</p> <ul style="list-style-type: none"> • IED blast casualties often have multiple mechanisms of injury <ul style="list-style-type: none"> – Blunt trauma – Penetrating trauma – Blast – Burns • Majority of casualties are now from IEDs 	<p>IED Casualties</p> <ul style="list-style-type: none"> •IED blast casualties often have multiple mechanisms of injury <ul style="list-style-type: none"> –Blunt trauma –Penetrating trauma –Blast –Burns •Majority of casualties are now from IEDs 	<p>Mechanisms of wounding have changed with the increasing use of IEDs.</p> <p>Casualties from IED attacks often have more than just penetrating trauma.</p>
<p>IED Casualties</p> <ul style="list-style-type: none"> •IED casualties – many have spinal fractures, especially thoracic •Try to maintain spinal alignment in blunt trauma casualties 	<p>IED Casualties</p> <ul style="list-style-type: none"> •IED casualties – many have spinal fractures, especially thoracic •Try to maintain spinal alignment in blunt trauma casualties 	<p>This may be done by a second rescuer manually maintaining head and neck alignment if needed.</p>


 <p>IED Casualties</p> <ul style="list-style-type: none"> • IED events – be alert for secondary IEDs or ground assaults after initiation of the IED  <p>28</p>	<p>IED Casualties</p> <ul style="list-style-type: none"> • IED events – be alert for secondary IEDs or ground assaults after initiation of the IED 	<p>Use of a second IED is a common tactic. Move the casualties “Off the X.”</p>
 <p>Do Aviation Personnel Need TCCC? In-Flight Tourniquet -24 June 2010</p> <ul style="list-style-type: none"> • AF Pave Hawk pilot on EVAV mission to pick up wounded UK soldier • GSW both legs • Severe bleeding R leg • PJ crawled up into cockpit and applied tourniquet • Bleeding controlled - pilot completed mission <p>29</p>	<p>Do Aviation Personnel Need TCCC? In-Flight Tourniquet -24 June 2010</p> <ul style="list-style-type: none"> • AF Pave Hawk pilot on EVAV mission to pick up wounded UK soldier • GSW both legs • Severe bleeding R leg • PJ crawled up into cockpit and applied tourniquet • Bleeding controlled - pilot completed mission 	<p>Yes, they do. Especially helicopter crews.</p>
 <p>JTS Trauma Telecon 26 Aug 2010</p> <ul style="list-style-type: none"> • 23 y/o male • GSW left infraclavicular area with external hemorrhage • “Progressive deterioration” • External hemorrhage noted to increase as casualty resuscitated in ED • No record of Combat Gauze use • All injuries noted to be extrapleural • Lesson learned: see following slide <p>30</p>	<p>JTS Trauma Telecon - 26 Aug 2010</p> <ul style="list-style-type: none"> • 23 y/o male • GSW left infraclavicular area with external hemorrhage • “Progressive deterioration” • External hemorrhage noted to increase as casualty resuscitated in ED • No record of Combat Gauze use • All injuries noted to be extrapleural • Lesson learned: see following slide 	<p>Read text</p>
 <p>Combat Gauze™</p>  <p>It doesn't work if you don't use it.</p> <p>31</p>	<p>Combat Gauze™</p> <p>It doesn't work if you don't use it.</p>	<p>Read text</p>


<p>FEEDBACK TO THE FIELD:</p> <p>Perforation of the Sternum by an Intraosseous Infusion Device</p> <p>H T Harcke, COL, MC, USA Chief, Forensic Radiology Armed Forces Institute of Pathology</p> <p>E Mazuchowski, Lt Col (Sel), USAF, MC Deputy Medical Examiner Office of the Armed Forces Medical Examiner</p>	<p>Feedback To The Field:</p> <p>Perforation of the Sternum by an Intraosseous Infusion Device</p>	<p>Some Lessons Learned come from autopsy findings Strong work done by Drs Harcke and Mazuchowski to get word out to combat forces</p>
<p>CASE OVERVIEW</p> <ul style="list-style-type: none"> • IED detonated in the decedent's vicinity. • Catastrophic injury to the lower extremities and pelvis, to include traumatic amputation of the lower legs. • Emergency treatment included tourniquets, sternal IO-IV, and proximal humeral IO-IV's. 	<p>Case Overview</p> <ul style="list-style-type: none"> • IED detonated in the decedent's vicinity. • Catastrophic injury to the lower extremities and pelvis, to include traumatic amputation to the lower legs. • Emergency treatment included tourniquets, sternal IO-IV, and proximal humeral IO-IVs. 	<p>Read casualty scenario</p>
 <p>Note sternal IO in place</p>	<p>Note sternal IO in place</p>	<p>Note sternal IO</p>
<p>Autopsy CT Scan</p> <p>Sagittal MDCT image shows the IO-IV needle passes through the sternum with the tip in the anterior mediastinum (arrow).</p>  <p>This is NOT where you want the infused fluids to go!</p>	<p>Autopsy CT Scan</p> <p>Sagittal MDCT image shows the IO-IV needle passes through the sternum with the tip in the anterior mediastinum (arrow).</p> <p>This is NOT where you want the infused fluids to go!</p>	<p>Infused fluids in this case went INTO THE CHEST CAVITY. NOT GOOD!</p>

 <p>Comparison of the devices. Note size, color and packaging differences.</p> <p>Do you really want to try to tell these two IO needles apart in the dark in a tactical mass casualty scenario?</p>	<p>Comparison of the devices: Note size, color, and packaging differences</p> <p>Do you really want to try to tell these two IO needles apart in the dark in a tactical mass casualty scenario?</p>	<p>Yes they are clearly marked, but don't forget about nighttime operations. Also, the confusion and urgency of a mass casualty scenario in the field.</p>
 <p>Ready Heat Skin Burns</p> <ul style="list-style-type: none"> Do NOT place the ready-Heat Blanket directly on the skin - multiple reports of skin burns from this being done Keep cammie top or T-shirt on 	<p>Ready Heat Skin Burns</p> <ul style="list-style-type: none"> Do NOT place the ready-Heat Blanket directly on the skin - multiple reports of skin burns from this being done Keep cammie top or T-shirt on 	
 <p>Halon in a Combat Medic Presentation</p> <ul style="list-style-type: none"> Scenario from Afghanistan Casualties inside vehicles during and after AFES discharge <ul style="list-style-type: none"> – “Smoldering” inside vehicle during casualty treatment Total time of exposure to fire suppression agent unknown Halon blamed for subsequent pulmonary sx in casualties and medic Halon off-gassing from casualties' clothing in helo? <p>38</p>	<p>Halon in a Combat Medic Presentation</p> <ul style="list-style-type: none"> Scenario from Afghanistan Casualties inside vehicles during and after AFES discharge <ul style="list-style-type: none"> – “Smoldering” inside vehicle during casualty treatment Total time of exposure to fire suppression agent unknown Halon blamed for subsequent pulmonary sx in casualties and medic Halon off-gassing from casualties' clothing in helo? 	<p>In this casualty scenario, the fire suppression agent in the tactical vehicle was blamed for sx of pulmonary irritation that developed in the casualties and the treating medic during helicopter evacuation. The medic who presented this scenario did not think to blame the pulmonary sx on inhalation of toxic byproducts of combustion of structural materials inside the crew compartment.</p>
 <p>What is “Halon”?</p> <ul style="list-style-type: none"> Halons are a group of chemical compounds consisting of hydrogen and carbon with linked halogens like bromine <ul style="list-style-type: none"> – There are many commercial halons with many uses, including fire suppression – Halon 1301 used in fire suppression systems in tactical vehicles phased out in mid-1990s <ul style="list-style-type: none"> • Army was lead agent for selecting replacement compounds for fire suppression 	<p>What is “Halon”?</p> <ul style="list-style-type: none"> Halons are a group of chemical compounds consisting of hydrogen and carbon with linked halogens like bromine <ul style="list-style-type: none"> – There are many commercial halons with many uses, including fire suppression – Halon 1301 used in fire suppression systems in tactical vehicles phased out in mid-1990s Army was lead agent for selecting replacement compounds for fire suppression 	<p>The United States stopped producing halons and many other ozone-depleting compounds in 1995, ahead of the schedule agreed to in international treaties. The Department of Defense was forced to search for a replacement for the halon that was used as a fire suppression agent in tactical vehicles.</p>

 <p>Possible Toxic Byproducts</p> <ul style="list-style-type: none"> • Fires in tactical vehicles can produce a variety of toxic byproducts: <ul style="list-style-type: none"> –Nitrous oxide, nitrous dioxide –Carbon monoxide, carbon dioxide –Hydrofluoric acid, hydrochloric acid, hydrogen cyanide –Acrolein, formaldehyde • These are all pulmonary irritants! 	<p>Possible Toxic Byproducts</p> <ul style="list-style-type: none"> •Fires in tactical vehicles can produce a variety of toxic byproducts: <ul style="list-style-type: none"> –Nitrous oxide, nitrous dioxide –Carbon monoxide, carbon dioxide –Hydrofluoric acid, hydrochloric acid, hydrogen cyanide –Acrolein, formaldehyde •These are all pulmonary irritants! 	
 <p>Field Treatment for Smoke and Toxic Fume Inhalation</p> <ul style="list-style-type: none"> • Prevent by removing the casualty from the burning vehicle as quickly as possible • Pulse oximetry monitoring • Aggressive airway management • Documentation of smoke exposure • Oxygen when available if oxygen saturation is low or if casualty is having respiratory difficulty 	<p>Field Treatment for Smoke and Toxic Fume Inhalation</p> <ul style="list-style-type: none"> •Prevent by removing the casualty from the burning vehicle as quickly as possible •Pulse oximetry monitoring •Aggressive airway management •Documentation of smoke exposure •Oxygen when available if oxygen saturation is low or if casualty is having respiratory difficulty 	
 <p>JTS Trauma Telecon 2011</p> <ul style="list-style-type: none"> • Casualty with a gunshot wound to the neck • Airway was obstructed with blood • Medic noted air bubbles coming from the tracheal wound • No need for an incision in this case – the medic put a cric tube directly into the trachea through the wound • Held it there until the casualty got to a hospital • Casualty did well - great save • With penetrating neck wounds, <u>follow the bubbles</u> if you see them! 	<p>JTS Trauma Telecon 2011</p> <ul style="list-style-type: none"> •Casualty with a gunshot wound to the neck •Airway was obstructed with blood •Medic noted air bubbles coming from the tracheal wound •No need for an incision in this case – the medic put a cric tube directly into the trachea through the wound •Held it there until the casualty got to a hospital •Casualty did well - great save •With penetrating neck wounds, <u>follow the bubbles</u> if you see them! 	<p>Great airway save</p>

  <p>Questions?</p>	<p>Questions?</p>																													
 <p>Direct from the Battlefield</p> <p>Additional Information on Halon</p>	<p>Direct from the Battlefield</p> <p>Additional Information on Halon</p>																													
 <p>AFES Performance Criteria</p> <table border="1" data-bbox="210 927 531 1049"> <thead> <tr> <th>PARAMETER</th> <th>REQUIREMENT</th> </tr> </thead> <tbody> <tr> <td>Fire Suppression</td> <td>Extinguish all flames without re-flash</td> </tr> <tr> <td>Skin Burns</td> <td>Less than second degree burns (<2400°F-sec over 10 seconds or heat flux < 3.9 cal/cm²)</td> </tr> <tr> <td>Overpressure</td> <td>Less than 11.6 psi</td> </tr> <tr> <td>Agent concentration</td> <td>Not to exceed LOAEL*</td> </tr> <tr> <td>Acid gasses</td> <td>Less than 1,000 ppm peak</td> </tr> <tr> <td>Oxygen levels</td> <td>Not below 16%</td> </tr> </tbody> </table> <p>* LOAEL – Lowest Observed Adverse Effects Level</p> <p><small>Copyright © 2008, Swanson, Dennis, "Fire Survivability Parameters for Combat Vehicle Crewmen," Department of the Army, Office of the Surgeon General, 20 February 1987.</small></p>	PARAMETER	REQUIREMENT	Fire Suppression	Extinguish all flames without re-flash	Skin Burns	Less than second degree burns (<2400°F-sec over 10 seconds or heat flux < 3.9 cal/cm ²)	Overpressure	Less than 11.6 psi	Agent concentration	Not to exceed LOAEL*	Acid gasses	Less than 1,000 ppm peak	Oxygen levels	Not below 16%	<p>AFES Performance Criteria</p> <table border="1" data-bbox="598 821 1171 1036"> <thead> <tr> <th>PARAMETER</th> <th>REQUIREMENT</th> </tr> </thead> <tbody> <tr> <td>Fire Suppression</td> <td>Extinguish all flames without re-flash</td> </tr> <tr> <td>Skin Burns</td> <td>Less than second degree burns (<2400°F-sec over 10 seconds or heat flux < 3.9 cal/cm²)</td> </tr> <tr> <td>Overpressure</td> <td>Less than 11.6 psi</td> </tr> <tr> <td>Agent concentration</td> <td>Not to exceed LOAEL*</td> </tr> <tr> <td>Acid gasses</td> <td>Less than 1,000 ppm peak</td> </tr> <tr> <td>Oxygen levels</td> <td>Not below 16%</td> </tr> </tbody> </table> <p>* LOAEL – Lowest Observed Adverse Effects Level</p> <p>From MEDCOM: Swanson, Dennis, “Fire Survivability Parameters for Combat Vehicle Crewmen,” Department of the Army, Office of the Surgeon General, 20 February 1987.</p>	PARAMETER	REQUIREMENT	Fire Suppression	Extinguish all flames without re-flash	Skin Burns	Less than second degree burns (<2400°F-sec over 10 seconds or heat flux < 3.9 cal/cm ²)	Overpressure	Less than 11.6 psi	Agent concentration	Not to exceed LOAEL*	Acid gasses	Less than 1,000 ppm peak	Oxygen levels	Not below 16%	<p>The Army Surgeon General specified performance criteria for Automatic Fire Extinguishing Systems (AFESs) that protect crew-occupied spaces in tactical vehicles. These criteria guided the Army’s search for a replacement for Halon 1301. An AFES is required to extinguish all flames and prevent re-flash in 250 milliseconds or less. Note that acid gasses are the by-products of heating of the fire suppression agent, and they are pulmonary irritants.</p>
PARAMETER	REQUIREMENT																													
Fire Suppression	Extinguish all flames without re-flash																													
Skin Burns	Less than second degree burns (<2400°F-sec over 10 seconds or heat flux < 3.9 cal/cm ²)																													
Overpressure	Less than 11.6 psi																													
Agent concentration	Not to exceed LOAEL*																													
Acid gasses	Less than 1,000 ppm peak																													
Oxygen levels	Not below 16%																													
PARAMETER	REQUIREMENT																													
Fire Suppression	Extinguish all flames without re-flash																													
Skin Burns	Less than second degree burns (<2400°F-sec over 10 seconds or heat flux < 3.9 cal/cm ²)																													
Overpressure	Less than 11.6 psi																													
Agent concentration	Not to exceed LOAEL*																													
Acid gasses	Less than 1,000 ppm peak																													
Oxygen levels	Not below 16%																													

 <p>US Army Ground Vehicle Crew Compartment Halon Replacement Program (U)</p> <ul style="list-style-type: none"> • HFC-227ea <ul style="list-style-type: none"> - Heptafluoropropane (CF₃CHF₂CF₃) - Ozone Depletion Potential = 0 - LOAEL = 10.5% by volume. - NOAEL = 9% by volume. - Decomposes by reaction with high temperature (open flames, glowing metal surfaces, etc.) forming hydrofluoric acid, carbonyl fluorides, carbon monoxide and carbon dioxide. - Leaves no residue <p><small>48</small></p>	<p>US Army Ground Vehicle Crew Compartment Halon Replacement Program (U)</p> <ul style="list-style-type: none"> •HFC-227ea <ul style="list-style-type: none"> -Heptafluoropropane (CF₃CHF₂CF₃) -Ozone Depletion Potential = 0 -LOAEL = 10.5% by volume. -NOAEL = 9% by volume. -Decomposes by reaction with high temperature (open flames, glowing metal surfaces, etc.) forming hydrofluoric acid, carbonyl fluorides, carbon monoxide and carbon dioxide. -Leaves no residue 	<p>HFC-227ea was the fire suppressant selected to replace Halon 1301. It is a colorless, odorless gas that is stored as a liquid under pressure and dispensed as a colorless, electrically nonconductive, gaseous vapor. Its primary action is through physically cooling the fire at the molecular level. That is, it removes the thermal energy from the fire to the extent where combustion cannot be sustained.</p> <p>LOAEL is the Lowest Observable Adverse Effect Level. This is the lowest concentration at which an adverse toxicological or physiological effect has been observed in lab testing with animals.</p> <p>NOAEL is the No Observed Adverse Effect Level. This is the highest concentration at which no adverse toxicological or physiological effect has been observed.</p> <p>The adverse effect first noticed in testing was cardiac sensitization. This manifests typically as the appearance of Premature Ventricular Contractions (PVCs) in the presence of elevated adrenaline levels. Sx of pulmonary irritation have not been observed in testing at NOAEL and LOAEL concentrations.</p>
--	--	---



ASSESSMENT OF THE FIRE SUPPRESSION MECHANICS FOR HFC-227ea COMBINED WITH NaHCO³

Table 4. (U) Phase II (w/chatter) Baseline Test Data

Agent ‡	Total Weight (lbs.)	Bottle Config # x n ¹	IR fire-out (msec)	Video fire-out (msec)	2-Min Ave HF (ppm)	Peak HF (ppm)
1301	9.9	3x144	777-1023	750-1000	2063	10348
1301	16	4x144	150-167	150-180	1789	3483
1301	12	4x144	170-193	180-220	1472	2031
1301	10	4x144	189-268	220-250	1086	1302
FM-200	16	4x144 ‡	172-216	180-240	844	1051
FM-200	12	4x144	185-220	190-260	1344	1636
FM-200 + BCS †	12+1	4x144	173-214	180-220	70	134

† - All tests used the 'standard' Army equipment bottles, valves and nozzles.

‡ - All tests used the 'standard' Army equipment bottles, valves and nozzles.

ASSESSMENT OF THE FIRE SUPPRESSION MECHANICS FOR HFC-227ea COMBINED WITH NaHCO³

Table 4. (U) Phase II (w/chatter) Baseline Test Data


Agent ‡	Total Weight (lbs.)	Bottle Config # x n ¹	IR fire-out (msec)	Video fire-out (msec)	2-Min Ave HF (ppm)	Peak HF (ppm)
1301	9.9	3x144	777-1023	750-1000	2063	10348
1301	16	4x144	150-167	150-180	1789	3483
1301	12	4x144	170-193	180-220	1472	2031
1301	10	4x144	189-268	220-250	1086	1302
FM-200	16	4x144 ‡	172-216	180-240	844	1051
FM-200	12	4x144	185-220	190-260	1344	1636
FM-200 + BCS †	12+1	4x144	173-214	180-220	70	134

‡ - All tests used the 'standard' Army equipment bottles, valves and nozzles.

In Automatic Fire Extinguishing Systems (AFESs) in tactical vehicles, HFC-227ea is mixed with sodium bicarbonate. Mixing the two helps in two ways. First, the sodium bicarb helps extinguish the fire, thus reducing the amount of HFC-227ea needed to extinguish the fire. That in turn reduces the amount of hydrofluoric acid (HF) and other toxic byproducts produced when the AFES is discharged to suppress a fire. Second, sodium bicarb also reacts directly with hydrofluoric acid, converting it to non-toxic compounds.

In testing, the mixture of HFC-227ea and sodium bicarb eliminates fire in the required time (220 ms < required 250ms), while producing acceptable levels of toxic gasses (134 ppm < required 1000 ppm). It achieves this outcome with a peak concentration of HFC-227ea of about 7.5% by volume. This is below the NOAEL (9%) and far below the LOAEL (10.5%) for HFC-227ea.

Theoretically, the AFES can extinguish a fire in a crew compartment, and allow the crew to keep fighting the vehicle. The chance of pulmonary irritation resulting from the designed discharge of modern AFESs is extremely low.



Possible Fires in Tactical Vehicles

- Class A fires involving air filters, canvas, paper
- Class B hydrocarbon fuel fires fed by vehicle fuel, hydraulic fluid, lubricants, and miscellaneous materials such as paint
- Class C electrical fires including batteries
- Class D ammunition fires.

Possible Fires in Tactical Vehicles

- Class A fires involving air filters, canvas, paper
- Class B hydrocarbon fuel fires fed by vehicle fuel, hydraulic fluid, lubricants, and miscellaneous materials such as paint
- Class C electrical fires including batteries
- Class D ammunition fires.

Fires in crew compartments in tactical vehicles can involve a variety of materials. Crew compartments are isolated from ammunition compartments in modern tactical vehicles, so crew members are unlikely to be exposed to toxic byproducts of ammunition fires.