

JOINT TRAUMA SYSTEM CLINICAL PRACTICE GUIDELINE



High Bilateral Amputations and Dismounted Complex Blast Injury

Indications for and the procedures associated with the initial management of bilateral lower extremity amputations with associated pelvic/perineal injuries

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SUMMARY OF CHANGES

1. Inclusion of data from the DoD Trauma Registry (DoDTR) on incidence/prevalence and resuscitation requirements of this unique population.
2. Considerations for Zone 3 resuscitative endovascular balloon occlusion of the aorta (REBOA) for proximal control in casualties with high bilateral amputations.
3. Updated initial transfusion requirements and guidelines. **Whole blood should be used preferentially, and crystalloid should not be used** for resuscitation of these patients secondary to their profound shock state.
4. Clarified PI metrics to include the addition of:
 - Number/percentage of patients who undergo REBOA placement upon arrival to the medical treatment facility (MTF).
 - Documentation and tracking of transfusion requirements.
 - Use standardized OR sheet to be included in notes to Performance/Adherence Metrics (Appendix A: DCBI H&P supplement).

HIGH BILATERAL AMPUTATIONS AND DISMOUNTED COMPLEX BLAST INJURY

Survival depends on
Hemorrhage Control • Massive Transfusion • Resuscitation

STOP THE BLEED

- Open thoracic/abdominal aortic occlusion vs REBOA
- Vascular control distal to int/ext Iliac arteries if possible
- Extremity tourniquets prn during volume resuscitation
- Shunt/repair Iliac vein
- Shunt arterial injuries

GU INJURIES

- Hemorrhage control
- Debridement/irrigation
- Bladder repair/ Urinary diversion on subsequent operations.
- Preserve tissue for reconstruction

INITIAL EVALUATION AND TREATMENT

T – Tourniquets (TQ) on all injured extremities for hemorrhage control, pelvic binder for unstable pelvis –assess TQ effectiveness frequently

A – Access – Reliable Intravenous access for resuscitation – large bore (16 Ga or larger) IVs or supradiaphragmatic central venous access (8.5Fr cordis)

R – Resuscitate with blood - massive transfusion protocol – 8 units whole blood per above the knee amputation

O – Operative intervention

T – Temporize at index operation, damage control surgery only, shunt injured vessels to restore flow, temporary abdominal closure

Take back to OR planning – second debridement within 24 hours

KEEP IT CLEAN

- Debride devitalized tissue, remove gross contamination
- Proctoscopy/Flex Sig to rule out rectal injury. If clear injury, fecal diversion on next operations
- Temp abdominal closure
- Avoid long-term empiric broad spectrum antibiotics

TRIAGE

requires assessment of:

- Multidisciplinary surgical teams
- Equipment
- Time
- Blood (re)supply capabilities
- Walking Blood Bank feasibility

POST AMPUTATION GUIDANCE

- Most distal level possible
- No guillotine/open circular amputations
- Debride non-viable soft tissue and bone
- Repeat within 24hrs. Then q 24-48hrs
- Coordinate debridement timing with evacuation schedule
- Prone positioning prn after pelvic stabilization
- Prophylactic fasciotomies due to warm time ischemia
- DVT/PE prophylaxis as soon as clinically feasible

- ✓ Pelvis stabilized in all LE amputations
- ✓ Temporary abdominal closure at first operation
- ✓ DRE/Proctoscopy documented with perineal/perirectal penetrating wounds
- ✓ GU injuries: Conservation of tissue
- ✓ Second debridement within 24 hrs of initial debridement
- ✓ VTE prophylaxis within 24 hrs or documented contraindication



This information is pulled from the evidence-based JTS High Bilateral Amputations and Dismounted Complex Blast Injury Clinical Practice Guideline (CPG). JTS CPGs can be found at the [JTS CPG website](#) or the [JTS Deployed Medicine site](#).

BACKGROUND

The Dismounted Complex Blast Injury (DCBI) injury is a devastating trauma incurred when a casualty operating in a foot patrol posture either steps on or is in extremely close proximity to an improvised explosive device (IED)/buried explosive. These injuries were common during 'cordon and knock' operations in Afghanistan from 2010 to 2012. During this type of operation, counterinsurgency forces assemble around an area to provide security ("cordon") and then obtain permission to search the area from residents ("knock"). The relative decreased physical protection of troops on foot patrols put service members at risk for these injury patterns.

In 2011, active engagement with senior military leaders on these devastating injury patterns changed tactics, techniques, and procedure. An ad hoc committee was established that produced a DCBI report, *Report of the Army Dismounted Complex Blast Injury Task Force*, which influenced changes in military tactics and demonstrates the criticality and power of rapid cycling of clinical data to not just impact clinical care and the trauma system but change operational policy and military tactics.^{1,2}

While this injury pattern has been less common over the last 10 years, it still exists and will likely exist in future combat scenarios. **Every military medical provider must know its role in the management of these critically injured service members, as every minute matters** given how rapidly these casualties die from hemorrhage.

The DCBI pattern of injuries consists of:

1. bilateral (generally proximal) lower extremity amputations
2. pelvic/perineal injuries to include testicular and penile injuries
3. usually, an upper extremity amputation/injury
4. open pelvic fractures
5. spinal fractures, more commonly of the sacral and lumbar spines as extension from lower extremity axial loading
6. thoraco-abdominal injuries, though less likely (but must be ruled out with imaging)

DCBI represents one of the most challenging cohorts of surgical patients to manage from time of initial injury through definitive reconstruction. These injuries are associated with a high incidence of both physical and psychological morbidity, as well as mortality. Survival is initially contingent upon **rapid hemorrhage control and massive transfusion being delivered in <40 minutes**, through well-resourced and rehearsed resuscitation protocols.³

Data from the DoDTR on 385 casualties from 2010-2021 with bilateral lower extremity amputations secondary to DCBI were transfused an average of 45 units of blood in the first 24 hours, with the highest volume of blood recorded in a survivor from this injury being over 200 units of blood product.

A coordinated team approach is essential to provide hemorrhage control and whole blood resuscitation. If low titer O+ whole blood (LTOWB) is not immediately available, then using a balanced component resuscitation is essential while either type specific or low liter Group O fresh whole blood is being obtained from a Walking Blood Bank (WBB). Airway management is less of a priority in these casualties unless they have an airway injury or a significantly altered level of consciousness affecting the casualty's ability to protect their own airway. *Hemorrhagic shock results in mortality in these patients; early focus on airway interventions comes at the risk of wasting minutes that must be focused on blood resuscitation.* Keep in mind that the initial decreased mental status in these patients is most likely secondary to severe blood loss and shock. **Inducing general anesthesia, intubating these casualties, and providing positive pressure ventilation prior to resuscitation will result in cardiovascular collapse.** Initial airway management should be performed with a nasopharyngeal airway and ventilation assist; simultaneous airway management, volume resuscitation (ideally with Whole Blood (WB) or balanced ratio transfusions), and immediate control of life-threatening hemorrhage.⁴

Later risks for morbidity and mortality include sepsis, including invasive fungal infection, and multisystem organ dysfunction. These injuries can broadly be divided into two categories: those with a perineal/pelvic floor injury and those without. Counterparts or similar injury patterns in civilian trauma are rare. An organized, aggressive continuum of care from the Point of Injury (POI) onwards by medics,

enroute care teams, anesthetists, general/trauma surgeons, orthopedic surgeons, and intensivists is critical to optimize outcomes in these devastating injuries.

Figure 1. DCBI injury examples



EVALUATION AND TREATMENT

INITIAL RESUSCITATION

These casualties typically arrive in extremis shortly after injury. Due to the severity of injury and exsanguinating hemorrhage, DCBI casualties with long field/transport times, particularly with no access to prehospital whole blood will likely die prior to arrival to the Role 2 or Role 3 medical treatment facility (MTF). Tourniquets (TQs) should be in place on all injured extremities. If the TQs are not in place, the extremities will rarely be significantly bleeding secondary to profound hemorrhagic shock. These casualties might arrive with a sternal or humeral head Intraosseous (IO) in place. Blood must be transfused through these access portals immediately, if it is not already being transfused. One challenge to the MTF provider is that IOs frequently get dislodged during transport. Do not rely solely on the IO. A large bore resuscitation line should be placed in the neck or an uninjured upper extremity. The best resuscitation line to place is the one that can be placed the fastest. Every minute matters in these casualties and the faster blood can be transfused through a central line or large bore IV (or rapid infusion catheter) the better the chance of survival.

This injury pattern mandates **immediate activation of massive transfusion protocol** with the preferential use of whole blood and no crystalloid as part of the resuscitation. If there is prior notification of a DCBI casualty, warm whole blood should be ready to transfuse on a rapid transfuser (Belmont or Level 1) prior to the casualty arriving. A good starting formula for transfusion requirement is **8 units of whole blood for each above knee amputation (AKA)**. Thus, a casualty with bilateral AKAs should have 16 units of whole blood, or 16 red blood cells (RBCs), 16 fresh frozen plasma, and 3 units of platelets ready to transfuse in the first 60 minutes of presentation. Teams that do not have this blood supply should activate the WBB. If the casualty's blood type can

Initial Evaluation & Treatment

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A – Access – Reliable Intravenous access for resuscitation – large bore (16 Ga or larger) IVs or supradiaphragmatic central venous access (8.5Fr cordis)

R – Resuscitate with blood - massive transfusion protocol – 8 units whole blood per above the knee amputation

O – Operative intervention

- Obtain proximal vascular control
- Orthopedic Intervention – pelvic stabilization, control extremity bleeding, debride devitalized tissue, remove gross contamination
- Ongoing Resuscitation – continue blood transfusion, obtain blood gases

T – Temporize at index operation, damage control surgery only, shunt injured vessels to restore flow, temporary abdominal closure

Take back to OR planning – second debridement within 24 hours

be tested and there is the appropriate manpower and administrative support, then a type-specific WBB should be activated. If there are multiple casualties or if the recipient's blood type is not known, then a LTOWB WBB should be activated.

Data from the DoDTR on 385 casualties from 2010-2021 with bilateral lower extremity amputations secondary to DCBI were transfused an average of 45 units of blood in the first 24 hours, with the highest volume of blood recorded in a survivor from this injury being over 200 units of blood product. This underscores the imperative that **massive (>10 units of PRBCs/WB in 24 hours) and ultra-massive transfusion (>20 units of PRBCs/WB in 24 hours) are necessary for these casualties to survive.**

These casualties are resource intensive, and time to resuscitation is critical if they are to survive. While it is understood at the time of the update of this clinical practice guidance (CPG), that the DOD is preparing for large scale combat operations (LSCO), if during the next conflict, multiple DCBI casualties are generated daily, the resources required to care for these casualties will test every aspect of the trauma system including field care and evacuation, blood supply, OR resources, personnel resources, and the movement from the theater of operations. This CPG outlines the optimal clinical management of these patients with the understanding that one of these patients will keep many providers in a well-equipped Role 3 busy for hours. The reality of the number of resources and care these casualties require must be recognized and triaged as appropriate for the operational and clinical scenario. If the trauma system is resourced appropriately for the demand signal, then these injuries, while devastating are survivable with early hemorrhage control (tourniquets), massive transfusion, and

transport to a surgical capability. The role for early (and effective) tourniquets and blood products cannot be overemphasized. Minutes matter for survival for these injuries.

If they arrive in cardiac arrest:

- Establish large bore IV access or supradiaphragmatic (SCV or IJ) central venous access (8.5Fr cordis)
- Transfuse blood- MTP
- Rule out cardiac/thoracic injury with ultrasound
- Bilateral chest tubes
- Obtain proximal vascular control - resuscitative thoracotomy for aortic occlusion (cross clamp) or REBOA

(Refer to [JTS Damage Control Resuscitation \(DCR\) and Whole Blood Transfusion CPGs](#) for further guidance on the resuscitation.^{5,6})

Occasionally, these patients arrive with CPR in progress. If the mechanism of injury (MOI) is DCBI, the presumption must be made that they have gone into **cardiac arrest secondary to hemorrhage, and the casualty needs rapid blood product resuscitation.** CPR should be continued while a subclavian or IJ central line for rapid transfusion is placed. U.S. service members with DCBI as the MOI wear body armor, therefore, thoracic injuries were not prominent with this MOI, but another provider should ultrasound the chest to rule out thoracic injury. Outcome data from in military casualties from recent conflicts do suggest a reasonable survival rate in properly selected patients who undergo emergency resuscitative thoracotomy; however, **the priority must be resuscitation with blood.**^{7,8} Since these casualties have often exsanguinated, **prior to a resuscitative**

thoracotomy, blood must be started while high quality CPR continues. As the casualty gets resuscitated and the blood pressure returns – all extremity TQs should be assessed and usually need to be tightened or additional TQs added. It is also necessary to ensure the casualty stays warm. Once cardiac activity returns, the casualty should be intubated. As mentioned above, prioritizing intubation over establishing circulation (and filling the heart) will result in cardiac arrest in the exsanguinated DCBI casualty.

HEMORRHAGE CONTROL PRIOR TO OPERATIVE INTERVENTION & STABILIZATION

When a DCBI casualty arrives at the Role 2 or Role 3, **immediate blood transfusion and hemorrhage control are the priority. All TQs should be assessed for continued hemostasis** and may frequently need to be tightened after transfusion starts and the casualty's blood pressure improves. In some circumstances with high AKAs or bad perineal wounds, the injuries are too proximal for TQ to successfully control the hemorrhage. In these scenarios, there are currently three procedures which can help with hemorrhage control – but they should not delay the casualty getting to the operating room.

1. The first is a junctional TQ. Junctional TQs compress the common femoral vessels. It takes practice to be able to apply effectively. They are non-invasive and some can also act to bind/stabilize a pelvic fracture.
2. The abdominal aortic junctional (AAJT) TQ is a device that likely has some efficacy but has never been well adopted. It was developed for prehospital use, but because it is bulky and causes pain with application, medics have not

included it in their aid bags. However, it has efficacy at distal aortic occlusion in animal studies. The AAJT can be applied relatively rapidly, but the casualty will require pain control or intubation. The devices use pressure on the aortic bifurcation to provide proximal control. Ensuring that bleeding is from below the aortic bifurcation is important. There is also a concern that application of this device may cause enteric injury.

3. The last option is Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA). REBOA has emerged as a hemorrhage control adjunct in traumatic shock. The use of REBOA is not widely adopted because the data for Zone 1 occlusion has been mixed.⁹⁻¹¹ However, Zone 3 (distal aortic) REBOA would provide inflow control for high AKAs (not amenable to a high and tight TQ) and pelvic/perineal injuries from DCBI. Proper REBOA use requires training and should be done by an experienced provider. If the casualty does not have evidence of intraabdominal injuries (will not require a laparotomy), the use of Zone 3 REBOA just prior to the OR, or in the OR is very effective at proximal hemorrhage control. Like any method of arterial occlusion, REBOA causes distal ischemia and subsequent reperfusion injury; if Zone 3 REBOA is being used, close monitoring of the time of balloon occlusion must be monitored. The longer the distal tissue is ischemic – the higher risk of further tissue damage/necrosis; invasive fungal infection (IFI), and continued myonecrosis. While a safe timeline for Zone 3 occlusion is unknown, **the duration of aortic occlusion should be as short as possible**. Once the balloon is deflated, distal perfusion must be assessed to avoid secondary ischemic injury to tissue that is already greatly compromised from the primary injury.¹² It should be noted that the utility of the REBOA may be significantly limited by the morphology of injury, particularly if affecting the standard femoral access sites.¹³⁻¹⁵

Refer to [*JTS Resuscitative Endovascular Balloon Occlusion of the Aorta \(REBOA\) for Hemorrhagic Shock*](#) CPG for further guidance.¹²

TRIAGE CONSIDERATIONS

DCBI casualties require massive amounts of blood products and can stress any surgical team given the intensive resources required. Walking Blood Bank initiation is common for casualties with this MOI. These casualties can potentially overwhelm a small Role 2 surgical team, whose goal is further stabilization and movement along the continuum of care. Role 2 surgical teams exist to bridge the gap between point of wounding and higher levels of battlefield care, but faced with one or two DCBI patients simultaneously, these teams will quickly exhaust all their resources. Mass casualty planning and ensuring small teams are augmented with base resources to support the WBB are necessary force multipliers.

Secondary to this MOI, DCBI events usually produce multiple casualties – but because of tactics (space on patrols) only 1-2 are critically injured and the rest, while they likely have injuries requiring surgery, do not require the immediate, resource-intensive interventions that the casualty closest to the blast requires. While this was the scenario most likely seen during U.S. Central Command operations with buried IEDs – further conflicts using artillery or drones could result in the same devastating injury patterns. Triage considerations for LSCO may require a different calculus; however, it is important to 'take care of the patient in front of you' and maintain situational awareness of the operational environment and constantly track blood and other life-saving resources. REBOA and AAJT may be adjuncts to facilitate hemorrhage control if there are casualties from multiple DCBI events. If more than one patient with this injury pattern is set to arrive to a Role 2 or Role 3 MTF, then it is pragmatic to activate the WBB for (previously) prescreened Low Titer Group O donors.

PREOPERATIVE STUDIES

Useful preoperative studies include chest radiograph, anterior-posterior pelvic radiograph, and a Focused Assessment with Sonography for Trauma exam. Preoperative studies should be utilized to identify source(s) of hemorrhage, but **blood transfusion and initial hemorrhage control should be prioritized in an unstable patient**.

At the Role 3, if there is substantial concern of a TBI requiring operative intervention, and there is a neurosurgeon available, then an expeditious head CT can be considered on the way to the OR (if the patient is hemodynamically stable). If no axial imaging (CT) was performed preoperatively, total body CT scan (trauma scan) should be considered post op on the way to the ICU (if the patient is hemodynamically stable).

OPERATIVE APPROACH

PRIORITIZATION AND SURGICAL TEAMS

DCBI patients undergo dozens of operations over their course of care. The goal of the first operation is simple but not easy: hemorrhage control and debride dead tissue while removing contamination (from the soil and device fragmentation). There must be coordination and communication between the anesthesia and surgical teams throughout the entire case. The OR should be warmed to as hot as it can get, since these casualties are always hypothermic, even if the ambient temperature is 100° Fahrenheit. Blood loss is ongoing throughout these cases and the anesthesia provider must keep up with transfusion requirements. Vasopressors should be avoided until it is clear the patient is euvoletic. There should be a low threshold to activate a WBB for warm fresh whole blood even if the blood bank has ample supply of stored blood.

Intraoperative management of DCBI patients requires a team approach, best achieved with general/trauma surgeons and orthopedic surgeons working concurrently when possible. For example, the general/trauma surgeon can achieve proximal vascular control if necessary and address any truncal injuries, if present, while the orthopedic surgeon deals with obtaining hemostasis in the wound, stabilizing the pelvis when indicated, and debriding dead and devitalized soft tissue. If the wounds are only in the extremities, two surgeons working together on each extremity is more efficient. Keeping OR times as short as possible, while achieving hemorrhage and contamination control, should be the goal. If there is a third team, they can address the upper extremity injuries. This approach maximizes efficiency and limits prolonged physiological insult to a severely injured patient. Without evidence of intraabdominal or visceral injury, colonic diversion should not be done during the first operation. Additionally, the wounds should not be placed in vacuum assisted closure (VAC) dressings on the initial operation since 1) they will be returning to the OR in <24 hours; 2) in patients who are coagulopathic and have a capillary leak – the negative pressure dressings can result in more bleeding and can create a detrimental cycle of blood loss and increase transfusion requirements. When VACs are placed on the patients, the blood loss might get underrecognized in a busy ICU, post-operatively. During the first operation: be expeditious and efficient, keep the casualty warm, get hemorrhage control in the wounds, debride dirt, particulate matter and tissue that is clearly dead or devitalized.

Dress the wounds with wet to dry or Dakin's dressings. Using mesh gauze and staplers, dressings can be fashioned to fit these challenging wounds. If the casualty has an open pelvic fracture and the perineum and abdomen are connected or there is evisceration through the perineal injury, then laparotomy is needed to assess for and repair abdominal injuries. This approach, while successful, should be a planning factor when considering triage.

PROXIMAL VASCULAR CONTROL

The level of proximal vascular control required to control bleeding is dictated by several factors: associated pelvic disruption, level of tourniquet placement and level of traumatic amputation(s). Typically, vascular control should be achieved at the most distal level possible, including control via a retroperitoneal approach or in the groin. If a laparotomy is performed, walking the clamps down the internal and external iliac arteries in patients with massive pelvic injuries is another excellent technique to control hemorrhage. This technique can be augmented by Zone 3 REBOA with distal aortic occlusion while vascular control is being obtained in the pelvis or groin.¹⁹ In cases of pelvic floor injuries with open pelvic wounds and active external posterior bleeding, temporary control of the internal iliac arteries is crucial as these wounds have a very high lethality.²⁰ This iliac vascular control can be achieved with clamps, vessel loops or Rommel tourniquets based on facility resources. Achieving hemorrhage control must be prioritized, but the risk of ischemic tissue at the site of injury and subsequent infection, overwhelming infection, and diminished wound healing must be recognized.

Proximal control, particularly when involving ligation of iliac vessels, should not be done as it is associated with significant pelvic girdle, perineum, and thigh necrosis, as well as angioinvasive fungal infections, potentially leading to hip disarticulation or trans-pelvic amputation, hemipelvectomy and death.²¹ An attempt to re-perfuse the internal iliac arteries should be made at the index or subsequent procedure. Ligation of both internal iliac arteries must be avoided if at all possible. However, in cases of ongoing pelvic hemorrhage despite pelvic packing and angiographic embolization, bilateral internal iliac artery temporary occlusion may be necessary. These casualties must return to the OR, because significant tissue necrosis should be anticipated. In the case of prolonged warm ischemia time, prophylactic fasciotomies of the residual limb are often necessary as compartment syndrome occurs frequently, even in the presence of large open wounds.

Refer to [JTS Acute Extremity Compartment Syndrome and the Role of Fasciotomy in Extremity War Wounds CPG](#) for further guidance.²²

ROLE OF PROXIMAL DIVERSION

So much experience has been gained with creative use of wound care and VAC dressings (using stoma paste, staplers, Ioban, Lonestar retractor elastics, etc.) as well as fecal management systems, that colostomy can usually be avoided. Colostomy is indicated in DCBI patients with diagnosed rectal injury or massive pelvic disruption/open pelvic fracture with extremely high suspicion for anorectal injuries. There is rarely a need to do a colostomy on the initial operative intervention.

ORTHOPAEDIC CONSIDERATIONS

It is common for DCBI patients to present with traumatic bilateral lower extremity amputations at various levels from transtibial to very high transfemoral levels. These are often associated with extremely complex soft tissue blast wounds that include the perineal and gluteal region (see Figure 1). In addition to lower extremity amputations, these injury patterns are often associated with complex pelvis and acetabular injuries (see Figure 2). Traumatic amputation of the non-dominant upper extremity can also be seen in these complex patterns due to weapons holding stance.

Optimal orthopedic care entails:

1. Ensuring extremity hemorrhage control
2. Pelvic external fixation if there is hemorrhage from a pelvic fracture, especially with sacroiliac disruption
3. Stabilization of extremity fractures in salvageable limbs / limb remnants
4. Debridement of devitalized tissue

Once in the operating room, hemorrhage control in the wound can be accomplished by replacing field TQ with pneumatic TQ. Total TQ time should be recorded, and it is imperative to communicate with anesthesia when the TQs are being released. These patients can have profound hypotension when the TQs are released and anesthesia must be ready with blood, calcium, bicarb and be prepared to hyperventilate the patient to manage the large acid load from reperfusion of the ischemic limb as inflow is restored. It is important to note that examination of the pelvic ring should be performed to address stability. Pelvic fractures can be stabilized with the use of clamped sheets or commercial pelvic binders centered over the greater trochanters, or a pelvic external fixator if resources and ability allow for this.

Figure 1. Dismounted Complex Blast Injuries **Figure 2. Open Pelvic Ring Injury**



Index operative procedures should be prioritized with the surgical team leader; these surgeries require a team approach with constant communication.²⁰ Hemorrhage control of traumatic amputations and peri-pelvic sources is the main priority along with restoration of blood volume and keeping the patient warm. Pelvic and perineal packing with hemostatic dressings such as Combat Gauze may be helpful for small-vessel hemorrhage control and cases with continued oozing due to coagulopathy.

Revision or completion amputations should occur at the most distal viable level with suture ligation or double ligation of all named vessels in an open, length-preserving fashion. Limb length is inversely proportional to later energy expenditure (i.e. life expectancy) so preserving as much bony length as possible is preferable. Any viable skin and soft tissue should be preserved; **guillotine-style or open circular amputations are contraindicated**. Care should be given to salvaging healthy tissue for flap coverage, even if it is an atypical rotational flap in the face of destroyed or missing conventional flap tissue. If the pelvic ring is unstable, a pelvic external fixator should be used instead of a binder, to facilitate access to the groins, debridement of proximal wounds and other procedures. Pin placement in the iliac crest or anterior inferior iliac spine are both appropriate, with the latter offering greater reduction control but requiring fluoroscopy and surgeon experience. If the patient requires a colostomy and/or suprapubic (SP) catheter, these procedures must be coordinated with orthopedic surgery to determine optimal placement, so they do not interfere with future pelvic approaches necessary for fixation. External fixation of long bone fractures should be accomplished as soon as possible depending upon the acuity of the patient. Smaller bone and joint fractures can be addressed if the patient remains stable, otherwise they are deferred until after the initial operative resuscitation.

Refer to [JTS Amputation: Evaluation and Treatment CPG for further guidance](#).²¹

SOFT TISSUE DEBRIDEMENT

An appropriate balance of adequate surgical debridement and restoration of physiology is critically important during the initial surgical procedure for DCBI patients. DCBI MOI results in wounds that are complex and extensive. They are grossly contaminated with dirt, fragment debris, clothing, and foliage. Wounds should be incised with well-planned incisions extending longitudinally from the primary zone of injury to healthy tissue with consideration of future reconstructive or closure options.²² Systematic irrigation and debridement of nonviable skin, subcutaneous tissue, fascia, muscle, periosteum, and bone is critical to reduce the bioburden and later risk of sepsis.²² Blast wounds tend to evolve and repeat surgical irrigation/debridement should be performed at least every 24 hours until the wound stabilizes and there is no further evidence of contamination, or ongoing myonecrosis. If tissue is questionable and not contaminated, it should be maintained and addressed at the subsequent surgical debridement the following day. However, since the timing of the next operation (often at the next role of care) is unpredictable, avoid leaving marginally viable tissue behind while in theater, as many of these complex wounds will develop progressive necrosis. When present, pelvic/perineal and pelvic wounds need to be similarly addressed.²³

Refer to [JTS War Wounds: Wound Debridement and Irrigation CPG for further guidance](#).¹⁹

ADDITIONAL VASCULAR CONSIDERATIONS

If the DCBI is associated with a venous injury: iliac or common femoral; these injuries should be shunted or repaired rather than ligated, to preserve venous outflow. Unless easily repairable, arterial injuries in these critically injured patients should be managed initially with shunting followed by formal repair at subsequent operation within 12 -24 hours depending upon patient stability.²⁴ During the index operation, restoring inflow is critical and restoring outflow is optimal. Even if the venous shunt goes down, or the vein clots after repair, the initial restoration of outflow is beneficial for the remaining tissue. If there are viable limbs and muscle contained by fascial compartments, fasciotomies are necessary as compartment syndrome can occur even in the presence of large open wounds if the fascia remains intact.

Refer to [JTS Vascular Injury and Acute Extremity Compartment Syndrome and the Role of Fasciotomy in Extremity War Wounds CPGs for further guidance](#).^{24,19}

ASSOCIATED GENITOURINARY (GU) INJURIES

DCBI is associated with perineal wounds and injuries to genitalia. Bladder and ureter injuries are less common, but if a large perineal wound is present, appropriate studies should be undertaken to assess for potential injury to these GU organs. Perineal, genital, and urethral wounds should be addressed with urinary management and basic wound care. Since the initial focus on the index operation is hemorrhage control, debridement and irrigation of wounds, definitive management of GU wounds should be staged. If scrotal skin is missing, the testicles should be wrapped in Adaptec or Vaseline gauze to prevent the tunica from desiccating. In the case of a penile or urethral injury, a foley catheter should be attempted and tissue temporarily closed over the urethra. A penile or distal urethral injury is not a reason for an SP tube if a urinary catheter can be placed. Adjuncts to help place a catheter include ureterscope, wires, and fluoroscopy, but should be performed at an interval operation once the casualty is stabilized. A retrograde urethrogram should be performed if a urethral injury is suspected. In the case of urethral disruption and inability to place a catheter over a wire, a suprapubic catheter (tube) should be placed either percutaneously or open. If available, seek the consult or assistance of a urologist.

Refer to [JTS Genitourinary Injury Trauma Management CPG](#) for further guidance.²³

ASSOCIATED (OCCULT) RECTAL INJURIES

DCBI casualties with perineal wounds or many fragments to the perineum, buttocks or groin should undergo a proctoscopy prior to leaving the operating room. Most of these casualties do not have the opportunity to undergo full CT scan prior to going to the OR and CT does not reliably exclude rectal injury. Therefore, fragmentation wounds to the perineum and perianal regions should generally prompt examination of the rectum (proctoscopy or flexible sigmoidoscopy) even if digital rectal examination in the emergency room is negative for blood. This may be difficult in the supine position and may be readily completed in the supported lateral position. Completion of the anorectal exam should be done prior to completing laparotomy to aid decision making with respect to colonic diversion. If clot, active bleeding, or injury is identified on anorectal examination, the distal sigmoid colon/proximal rectum should be divided and later matured at a subsequent operation into an end colostomy once the patient is stabilized further along the evacuation chain. Distal rectal wash out is not necessary unless there is bulky retained stool in the presence of a suspected penetrating injury.

CONSIDERATION OF LATERAL OR PRONE POSITIONING

In most patients, the posterior soft tissue injuries can be addressed with elevation of the amputated stumps or with the patient in a lateral position after the supine portion of the case has been completed. However, certain injury patterns have a large posterior element. In these cases, prone or lateral positioning is sometimes necessary, **after hemorrhage control**, to adequately debride wounds in the gluteal and low back region. This decision should not be made lightly, due to the time requirements and risks involved. This can often be deferred to secondary procedures. Lateral positioning is preferred as it allows for easier airway control, but the latter may be needed for complex bilateral lower extremity and truncal wounds. A Jackson table can facilitate a safe transition to the prone position. Unstable pelvic ring injuries should be stabilized prior to prone positioning, as this position can exacerbate hemorrhage.

WOUND DRESSINGS

Traumatic wounds should not be definitively closed until multiple adequate debridement and irrigation procedures have been performed. A series of surgical debridement and high-volume irrigation (9L/limb) is necessary to prepare wounds for closure or coverage. Wound closure and tissue coverage can take weeks. Serial wound stability without evidence of infection or continued myonecrosis is required. The wound should not be closed the first day it looks healthy. Serial intraoperative wound inspections are necessary. The risk of early wound closure is an infection that will require more debridement and possible loss of limb length. The extensive soft tissue destruction and degree of contamination in DCBI wounds make them infected until proven otherwise. Once there is no evidence of myonecrosis, tension can be placed on healthy skin and soft tissue to prevent loss of tissue domain and skin retraction. The preferred initial wound dressings are wet-to-dry gauze with Dakin's (combat gauze can be used at initial operation as a hemostatic adjunct). After the risk of bleeding has subsided, negative pressure wound therapy can be used and is very useful for fixed wing evacuation.

INVASIVE FUNGAL INFECTIONS (IFI)

Invasive fungal infections were first described in DCBI casualties from Afghanistan during combat operations from 2009 - 2011.²⁵ IFI is associated with continued wound progression and myonecrosis. Patients are at risk for invasive fungal infection if three of the following factors are present:

- Dismounted blast injury
- Above knee immediate amputation
- Extensive perineal/genitourinary/rectal injury
- Ultra massive transfusion of >20 units in the first 24 hours

For these patients, it is recommended that the irrigation solution be switched to high-volume Dakin's solution. The IFI and blast protocol should be followed. Daily OR trips for wound inspection must occur until there is no further evidence of fungal infection.²²

Refer to [JTS Invasive Fungal Infection in War Wounds CPG](#) for further guidance.¹⁸

PERIOPERATIVE MANAGEMENT

NEED FOR RADIOLOGIC IMAGING

These injuries are associated with a significant transfer of energy to the casualty, resulting in high risk for associated injuries of a blunt and penetrating nature. Once the patient is physiologically stabilized, complete imaging including "Pan Scan" CT and plain film examination should be obtained to evaluate for occult injury,⁵ this is rarely completed prior to the first operation.

NEED FOR REPEATED DEBRIDEMENTS

The treatment team must appreciate the phenomenon of wound evolution and the high risk for invasive fungal infection and expectation that viability of the soft tissues will fluctuate over the course of several days. In the acute phase (<72 hours from injury) wounds should be frequently inspected in the operation room every 24 hours. In the later, sub-acute phase (3-7 days from injury) wounds may require less frequent treatment based on the presence of viable tissue and absence of ongoing necrosis or persistent contamination. Multiple debridements are routinely required and the severely injured, physiologically deranged patient should not undergo excessive surgical procedures during the initial operation other than those required to control hemorrhage and gross contamination.

Refer to [JTS War Wounds: Wound Debridement and Irrigation and Invasive Fungal Infection in War Wounds CPGs](#) for further guidance.^{22,18}

ROLE OF SYSTEMIC AND TOPICAL ANTIBIOTICS

Initial antibiotic selection should avoid empiric broad spectrum coverage but rather focus on narrow spectrum antibiotics, such as first generation cephalosporins. The liberal use of topical antibiotic delivery via powder or antibiotic beads and/or Dakin's-soaked gauze, pending available resources, is encouraged.

There is no data that supports the use of broad-spectrum antibiotics in these casualties. The most important consideration for antisepsis in the wound is adequate surgical debridement and repeated trips to the operating room. The risk with the overuse of broad-spectrum antibiotics is the development of antibiotic resistant infections. Topical antibiotics might have some efficacy, but the paucity of data does not allow for a strong recommendation.

Refer to the [JTS Infection Prevention in Combat-Related Injuries CPG](#) for further guidance.²⁶

ROLE OF VENOUS THROMBOEMBOLISM (VTE) PROPHYLAXIS

Utilizing the DoDTR, the incidence of deep vein thrombosis (DVT) and pulmonary embolism (PE) in the U.S. military combat casualty population with DCBI is 3.3% and 3.6%, respectively. In those severely injured who required lower extremity amputation(s), the DVT and PE incidence increased to 11.2% and 13.7%. Every patient with a proximal amputation has, by definition, a DVT. Therefore, it is recommended that DCBI patients be started on appropriate VTE prophylaxis as soon as coagulopathy is resolved. If contraindications to prophylactic anticoagulation persist, prophylactic inferior vena cava filter placement should be considered.

Refer to [JTS Prevention of Venous Thromboembolism CPG](#) for further guidance.²⁷

TRANSFER OF CARE

Downrange surgeons should make every effort to coordinate dressing changes and necessary repeat debridement in anticipation of required patient transport to a higher echelon of care. Given the propensity for wounds to evolve in their acute phase, downrange surgeons must maintain a low threshold to perform additional debridement prior to evacuating the casualty to avoid an unacceptable delay between debridements. Given the unpredictable nature of the air evacuation system and to optimize timing of subsequent serial debridements, the patient should remain NPO for flight so that they are prepared for the next operation. Additionally, since wound healing and nutritional support are a challenge in these casualties, early enteral feeding should occur through a nasogastric tube. If the tube is post-pyloric and the casualty has a functioning nasogastric tube, then feeding can occur throughout the continuum of care, as long as strict aspiration precautions are maintained.

PERFORMANCE IMPROVEMENT (PI) MONITORING

POPULATION OF INTEREST

All combat casualties with bilateral lower extremity amputations, at least one above the knee, with MOI explosive/IED or landmine, dismantled.

INTENT (EXPECTED OUTCOMES)

1. The pelvis is stabilized prehospital or immediately on arrival to the hospital with pelvic binder or junctional tourniquet placement in all patients with bilateral lower extremity amputations.
2. All patients resuscitated by massive transfusion protocol MTP utilizing LTOWB or balanced resuscitation strategy.
3. All patients who undergo laparotomy have temporary abdominal closure at first operation (or reason to safely close abdomen is documented).
4. All patients with high bilateral lower extremity injuries have a documented digital rectal exam and have a documented proctoscopy if perineal/peri-rectal penetrating wounds are present.
5. When GU injury is present, debridement conserves tissue to the greatest extent possible.
6. All patients with dismantled complex blast injury have a second debridement performed within 24 hours of the initial debridement.
7. All patients have VTE prophylaxis started within 24 hours (or documented reason why contraindicated).

PERFORMANCE / ADHERENCE METRICS

1. Number and percentage of patients in the population of interest who have the pelvis stabilized prehospital or immediately on arrival to the hospital with pelvic binder or junctional tourniquet placement.

2. Number and percentage of patients in the population of interest who undergo REBOA placement upon arrival to the hospital.
3. Number and percentage of patients resuscitated by MTP.
4. Number and percentage of patients in the population of interest who undergo laparotomy and the number who have temporary abdominal closure at first operation (or reason to safely close abdomen documented).
5. Number and percentage of patients in the population of interest who have documented digital rectal exam.
6. Number and percentage of patients in the population of interest who have perineal/peri-rectal penetrating wounds who have a documented proctoscopy.
7. Number and percentage of patients in the population of interest who have injury to external genitalia who have preservation of injured testicle(s) at the initial operation.
8. Number and percentage of patients in the population of interest who have a second debridement performed within 24 hours of the initial debridement.
9. Number and percentage of patients in the population of interest who have VTE prophylaxis started within 24 hours (or documented reason why contraindicated).
10. Number and percentage of patients in the population who survive evacuation from first MTF and the number who survive to final discharge from Role 3/Role 4.

DATA SOURCE

- Patient Record
- DoD Trauma Registry

SYSTEM REPORTING & FREQUENCY

The above constitutes the minimum criteria for PI monitoring of this CPG. System reporting will be performed annually; additional PI monitoring and system reporting may be performed as needed.

The system review and data analysis will be performed by the JTS Chief and the JTS PI team.

RESPONSIBILITIES

It is the trauma team leader's responsibility to ensure familiarity, appropriate compliance, and PI monitoring at the local level with this CPG.

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APPENDIX A: JTS HIGH BILATERAL AMPUTATION AND DISMOUNTED COMPLEX BLAST INJURY DOCUMENTATION FORM

| JTS High Bilateral Amputation and Dismounted Complex Blast Injury Documentation Form | | | |
|---|--|---|--|
| Patient and Treatment Team Info | | | |
| Patient Name _____ | Name of MTF _____ | | |
| Provider Name _____ | Name of Unit _____ | | |
| Date of Injury _____ | Role of MTF: <input type="checkbox"/> Role 1 <input type="checkbox"/> Role 2 <input type="checkbox"/> Role 3 | | |
| | Time of Arrival at MTF _____ | | |
| Transfusion/Hemorrhage Control | | | |
| Time of First Transfusion _____ | Proximal Hemorrhage Control at MTF (check all that apply) | | Hemostatic Adjuncts at your MTF/Role of care in ED, OR, ICU: |
| Total Number of Blood Products Transfused _____ | <input type="checkbox"/> TQ | Time up _____ Time down _____ | <input type="checkbox"/> Calcium _____ |
| <input type="checkbox"/> Low Titer O Whole Blood _____ <input type="checkbox"/> Liquid Plasma _____ | <input type="checkbox"/> Junctional TQ | Time up _____ Time down _____ | <input type="checkbox"/> TXA Total Grams _____ |
| <input type="checkbox"/> Fresh Whole Blood _____ <input type="checkbox"/> Freeze Dried Plasma _____ | <input type="checkbox"/> REBOA | Time up _____ Time down _____ | <input type="checkbox"/> Prothrombin _____ |
| <input type="checkbox"/> Packed Red Blood Cells _____ <input type="checkbox"/> Platelets _____ | <input type="checkbox"/> Open Aortic Cross Clamp | Time up _____ Time down _____ | <input type="checkbox"/> Complex Concentrate _____ |
| <input type="checkbox"/> Fresh Frozen Plasma _____ | <input type="checkbox"/> Iliac Clamp | Time up _____ Time down _____ | |
| Other Exams/Procedures | | | |
| Pelvic fracture? <input type="checkbox"/> Y <input type="checkbox"/> N If yes, what type? _____ | | | |
| Perineum injury? <input type="checkbox"/> Y <input type="checkbox"/> N | | | |
| Protoscope? <input type="checkbox"/> Y <input type="checkbox"/> N If yes, findings? _____ | | | |
| Laparotomy? <input type="checkbox"/> Y <input type="checkbox"/> N | | | |
| Temporary abdominal closure at first operation? <input type="checkbox"/> Y <input type="checkbox"/> N | | | |
| Or reason to safely close abdomen documented? <input type="checkbox"/> Y <input type="checkbox"/> N | | | |
| Digital rectal exam? <input type="checkbox"/> Y <input type="checkbox"/> N If yes, findings? _____ | | | |
| VTE Prophylaxis? <input type="checkbox"/> Y <input type="checkbox"/> N Contraindications _____ | | | |
| Antibiotics? <input type="checkbox"/> Y <input type="checkbox"/> N | | | |
| Antibiotics given _____ | | | |
| Time Administered _____ | | | |
| Photo Documentation | | | |
| Insert photo documentation of initial wounds (prior to first OR procedure). | | Insert photo documentation of wound after first OR procedure. | |
| | | | |

APPENDIX B: TELEMEDICINE / TELECONSULTATION

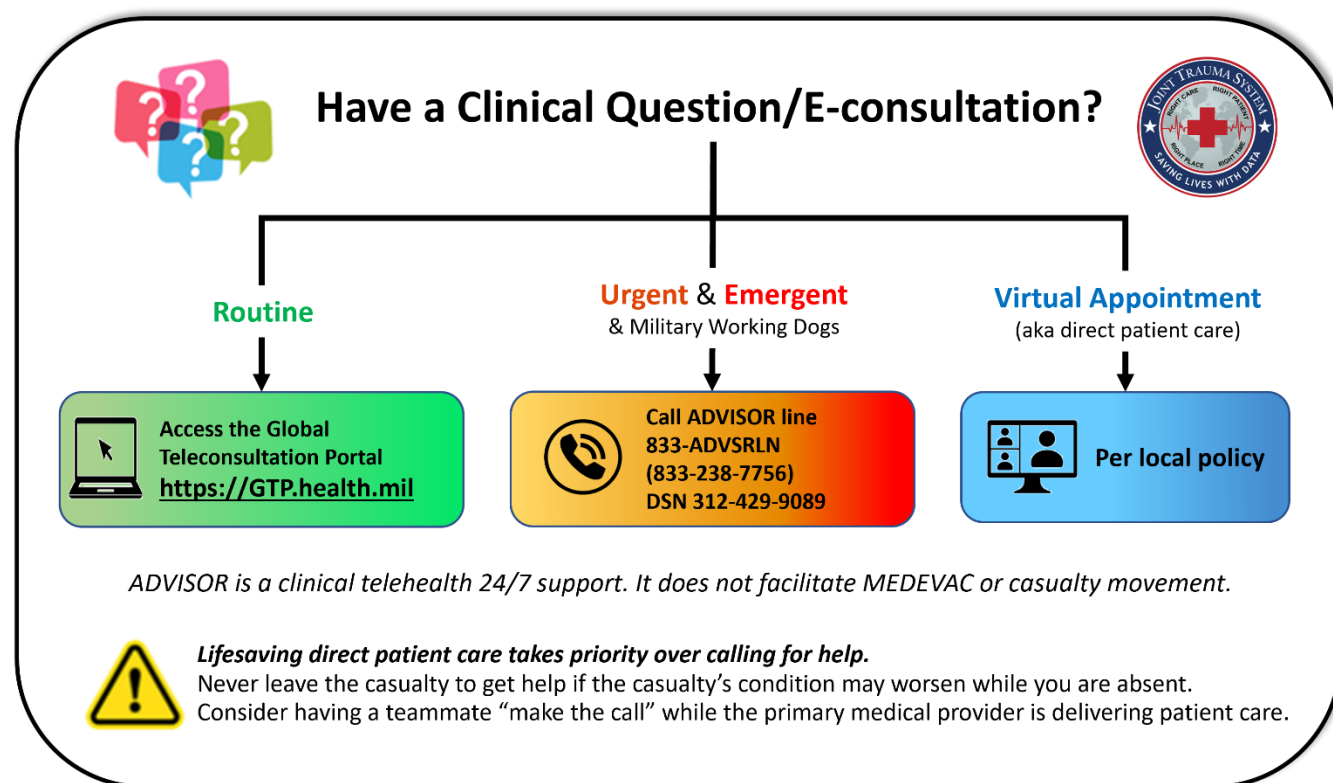


Illustration by Raymond Samonte

GTP: <https://GTP.health.mil>

APPENDIX C: INFORMATION REGARDING OFF-LABEL USES IN CPGS

PURPOSE

The purpose of this Appendix is to ensure an understanding of DoD policy and practice regarding inclusion in CPGs of “off-label” uses of U.S. Food and Drug Administration (FDA)–approved products. This applies to off-label uses with patients who are armed forces members.

BACKGROUND

Unapproved (i.e. “off-label”) uses of FDA-approved products are extremely common in American medicine and are usually not subject to any special regulations. However, under Federal law, in some circumstances, unapproved uses of approved drugs are subject to FDA regulations governing “investigational new drugs.” These circumstances include such uses as part of clinical trials, and in the military context, command required, unapproved uses. Some command requested unapproved uses may also be subject to special regulations.

ADDITIONAL INFORMATION REGARDING OFF-LABEL USES IN CPGS

The inclusion in CPGs of off-label uses is not a clinical trial, nor is it a command request or requirement. Further, it does not imply that the Military Health System requires that use by DoD health care practitioners or considers it to be the “standard of care.” Rather, the inclusion in CPGs of off-label uses is to inform the clinical judgment of the responsible health care practitioner by providing information regarding potential risks and benefits of treatment alternatives. The decision is for the clinical judgment of the responsible health care practitioner within the practitioner-patient relationship.

ADDITIONAL PROCEDURES

Balanced Discussion

Consistent with this purpose, CPG discussions of off-label uses specifically state that they are uses not approved by the FDA. Further, such discussions are balanced in the presentation of appropriate clinical study data, including any such data that suggest caution in the use of the product and specifically including any FDA-issued warnings.

Quality Assurance Monitoring

With respect to such off-label uses, DoD procedure is to maintain a regular system of quality assurance monitoring of outcomes and known potential adverse events. For this reason, the importance of accurate clinical records is underscored.

Information to Patients

Good clinical practice includes the provision of appropriate information to patients. Each CPG discussing an unusual off-label use will address the issue of information to patients. When practicable, consideration will be given to including in an appendix an appropriate information sheet for distribution to patients, whether before or after use of the product. Information to patients should address in plain language: a) that the use is not approved by the FDA; b) the reasons why a DoD health care practitioner would decide to use the product for this purpose; and c) the potential risks associated with such use.