

JOINT TRAUMA SYSTEM CLINICAL PRACTICE GUIDELINE (JTS CPG)



High Bilateral Amputations and Dismounted Complex Blast Injury (CPG ID: 22)

To review indications for and the procedures associated with the initial management of bilateral lower extremity amputations with associated pelvic/perineal injuries.

Contributors

LtCol Wade Gordon, USAF, MC
 LCol Max Talbot, RCMS, CF
 CDR Mark Fleming, MC, USN

John Shero, MHA
 LTC Benjamin Potter, MC, USA
 CAPT Zsolt Stockinger, MC, USN

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BACKGROUND

The Dismounted Complex Blast Injury (DCBI) injury pattern consists of (generally proximal) bilateral lower extremity amputations with associated pelvic/perineal injuries and frequently also includes upper extremity injuries (which may be bilateral but most commonly involve the left side due to weapon carrying stance at the time of injury) as well as frequent thoracoabdominal or neuraxial injuries. DCBIs represent one of the most challenging cohorts of surgical patients from management of the initial injury through definitive reconstruction. These injuries are associated with a high incidence of both morbidity and mortality. Survival is initially dependent upon hemorrhage control and massive transfusion and resuscitation protocols. A coordinated team approach is essential to provide simultaneous airway management, volume resuscitation (ideally with Whole Blood (WB) or ratio transfusion), and immediate control of life threatening hemorrhage.¹

Later risks for mortality include sepsis 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 injuries in civilian trauma remain rare. An organized aggressive continuum of care from the Point of Injury (POI) onwards by medics, anesthetists, general and orthopaedic surgeons and intensivists is critical to optimize outcomes.

EVALUATION AND TREATMENT

INITIAL RESUSCITATION

These patients typically arrive in extremis shortly after injury. Tourniquets are often in place on all injured extremities. Due to profound shock and associated upper extremity amputations, IV access may not be obtained in the field. Rapid placement of Intra-Osseous (IO) lines is sometimes a useful adjunct to begin resuscitation prior to venous access. Large bore central venous access should be considered early and placed by an experienced proceduralist. This injury pattern mandates immediate activation of massive transfusion protocols, the preferential use of fresh packed red blood cells (< 21 days old), minimal use of crystalloid products, and early consideration for the use of WB, if blood resources are limited. Refer to the Damage Control Resuscitation (DCR) and WB Transfusion CPG for specific recommendations.^{2,3}

ROLE OF RESUSCITATIVE THORACOTOMY

Occasionally these patients arrive with CPR in progress. When signs of life are present, consideration of resuscitative thoracotomy should be given according to established CPGs. Outcome data from OIF suggest a reasonable survival rate in properly selected patients.^{4,5} Another alternative described with exsanguination in civilian extremity injuries is the use of a brief period of CPR with concomitant massive blood product resuscitation before resorting to a resuscitative thoracotomy. A review of the Department of Defense Trauma Registry (DoDTR) in 2011, suggests the mortality associated with bilateral high amputations, pelvic injury and emergency department thoracotomy is very high (>90%). Experienced military surgeons debate the optimal approach to prevent ongoing hemorrhage in this population – thoracic, distal aortic or bilateral iliac proximal vascular control. Endovascular aortic balloon occlusion may offer an elegant alternative for proximal vascular control in the future.⁶

TRIAGE CONSIDERATIONS

These patients can consume massive amounts of blood products and utilize multiple surgical assets to include operative teams, equipment and operative hours. In multiple casualty scenarios, a prudent assessment of resource allocation should be done prior to proceeding with resuscitative thoracotomy.

PREOPERATIVE STUDIES

Useful preoperative studies may include chest radiograph, anterior-posterior pelvic radiograph, Point-of-Care Ultrasound and Diagnostic Peritoneal Lavage, but should not delay surgical control of hemorrhage. Expeditious computed tomography of the head may be considered in patients displaying lateralizing signs consistent with severe traumatic brain injury requiring operative intervention, but should not degrade resuscitation or delay surgical hemorrhage control.

OPERATIVE APPROACH

PRIORITIZATION AND SURGICAL TEAMS

The initial operative goal is hemorrhage control and control of contamination. Due to the nature of these injuries, this is best achieved using a team of general and orthopaedic surgeons working concurrently on the patient, when possible. For example, two surgeons can achieve proximal control and address intra-abdominal injuries while a second team focuses on the amputations. A third team can be utilized to address upper extremity injuries, if present. This approach maximizes efficiency and limits prolonged physiologic insult to a severely injured patient. Prior to operation, the most critical procedures (e.g. proximal hemorrhage control, control of contamination, completion amputations, bladder repair and potential colonic diversion) should be listed, keeping in mind reasonable parameters to terminate surgery.

PROXIMAL VASCULAR CONTROL

The level of proximal vascular control is dictated by several clinical variables: previous resuscitative thoracotomy, associated pelvic disruption, level of tourniquet placement and level of amputation(s). Typically vascular control should be achieved at the most distal level possible, including control via a retroperitoneal approach or in the groin. A strategy of walking the clamps down in patients with massive pelvic injuries is prudent. This involves laparotomy, infra-renal aortic control, and movement of control distal to the internal and external iliacs.⁷ In the case of pelvic floor injuries with open pelvic wounds and active posterior bleeding, temporary control of the internal iliacs is prudent. This can be achieved with vascular clamps, vessel loops, Rummel tourniquets, or vascular clips. The benefit of achieving hemorrhage control must be balanced against the risk of ischemic tissue at the site of injury and subsequent infection and diminished wound healing. An attempt to reperfuse the internal iliacs should be made at the index or subsequent procedure. Ligation of both internal iliac arteries is to be avoided if at all possible; in cases of ongoing pelvic hemorrhage despite pelvic packing and angiographic embolization if available, bilateral internal artery ligation may be necessary although significant tissue necrosis (e.g., buttocks) can be anticipated.

ROLE OF PROXIMAL DIVERSION

In patients with an obvious need to divert the fecal stream due to pelvic disruption or an open pelvic fracture, stapled interruption of the sigmoid colon at the pelvic brim should be performed early to facilitate pelvic exposure and vascular control. Formal colostomy should be delayed until subsequent operative procedures when the patient is more stable.

ORTHOPEDIC CONSIDERATIONS

It is common for these patients to present with traumatic bilateral lower extremity amputations at various levels from transtibial amputations to very high transfemoral amputation's, often with extremely complex soft tissue blast wounds up to and including the perineal and gluteal region. (See Figure 1 on next page.) Associated traumatic amputation of the non-dominant upper extremity is also common. The most challenging cases involve open pelvic ring and peri-acetabular fractures (Figure 2 next page) and dislocations associated with severe perineal injuries. Initial orthopaedic resuscitative involvement entails assuring that extremity hemorrhage control is sufficient with tourniquets. After the initiation of volume resuscitation, patients can often bleed

through in-place field tourniquets; in this case, they require placement of additional field tourniquets or pneumatic ones (if available) to control bleeding until optimized in the operating theater. Quick 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 trochanters.

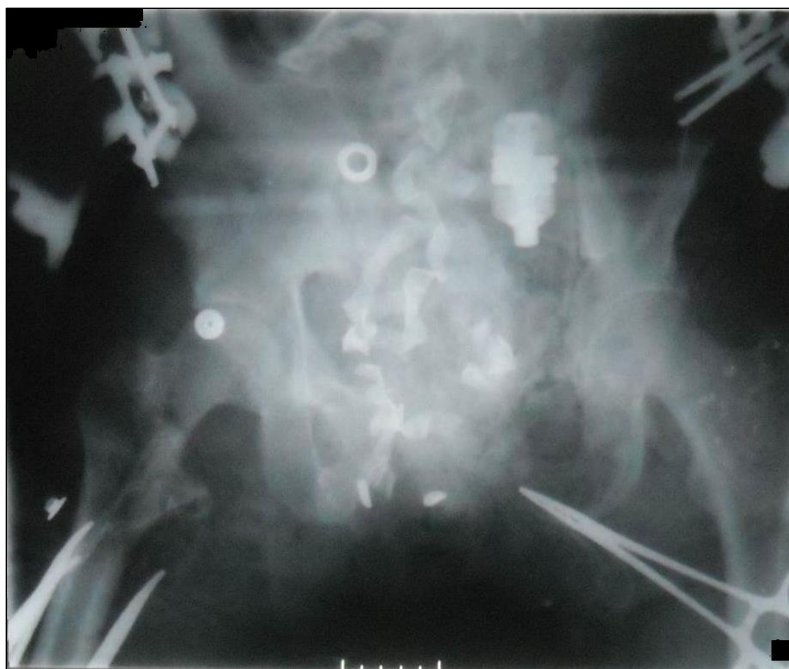
Figure 1. Dismounted Complex Blast Injuries



Figure 2. Open Pelvic Ring and Acetabular Fractures



Figure 3. Same Patient After Pelvic External Fixation



Index operative procedures should be prioritized with surgical team leader.⁸ Hemorrhage control of traumatic amputated limbs and peri-pelvic sources is the priority. Pelvic and perineal packing is helpful for tiny vessel

hemorrhage control and cases with continued oozing due to coagulopathies. In the multilevel amputee, limb length is inversely proportional to later energy expenditure. Revision or completion amputations should occur at the most distal viable level with double ligation of all named vessels in an open, length-preserving fashion. Atypical rotational flaps are greatly preferred over guillotine-style or open circular amputations. 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. When necessary, maintained pelvic ring stabilization with external fixation (Figure 3 above) is preferable to prolonged use of binders due to proximity of wounds and serial debridements that will be required. Anterior superior iliac spine/iliac crest or anterior inferior iliac spine pins are both appropriate, with the latter offering the greatest reduction control but requires available fluoroscopy and surgeon experience. Consideration should be given for later reconstructive orthopaedic pelvic incisions so as to appropriately divert the location of colonic and urinary streams. External fixation of long bone fractures should be accomplished during the index procedure, when possible. Smaller bone and joint fractures can be addressed if the patient remains stable, otherwise they are cared for after the initial operative resuscitation, such as splinting in the intensive care unit or during subsequent surgical procedures.

SOFT TISSUE DEBRIDEMENT

(See Management of War Wounds CPG⁵)

Adequate initial surgical debridement is critically important. DCBI wounds are typically complex and extensive. They may be grossly contaminated with dirt, fragment debris, clothing and foliage. Wounds should be incised with well-planned incisions extending from the primary zone of injury to healthy tissue. Systematic debridement of nonviable skin, subcutaneous tissue, fascia, muscle, periosteum and bone is critical to reduce the bioburden and later risk of sepsis.^{9,10} Blast wounds tend to evolve; if tissue is questionable and not contaminated it should be maintained and addressed at later surgical interventions. However, since the timing of the next operation (often at the next echelon of care) is unpredictable, avoid leaving marginally viable tissue behind as many of these complex wounds will develop progressive necrosis. When present, pelvic/perineal and pelvic wounds need to be similarly addressed.

ASSOCIATED VASCULAR INJURIES

DCBI injury pattern appears to be associated with iliac vein injury. When possible these injuries should be shunted or repaired rather than ligated. Unless easily repairable, arterial injuries in these critically injured patients should be managed initially with shunting followed by formal repair at subsequent operation. Care should be taken to avoid exclusion of the profunda femoris during shunting or repair, in order to perfuse the soft tissue and muscle.¹¹

ASSOCIATED GU INJURIES

Associated injuries to the ureters, urethra, bladder, scrotum, penis, and prostate are common. These should be addressed if feasible with a focus on hemorrhage control, urinary control or diversion, and preservation of tissue for later reconstruction. See *JTS Urologic Trauma Management* CPG for specific recommendations.⁹

ASSOCIATED (OCCULT) RECTAL INJURIES

Computerized Tomography (CT) alone may not always accurately exclude penetrating distal rectal injury in the setting of multiple perineal or perirectal fragmentation wounds with scatter artifact and random trajectories. Therefore, fragmentation wounds to the perineum and perianal regions should generally prompt proctoscopic examination of the rectum 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 proctoscopic exam should be done prior to completing laparotomy as colonic diversion may

be indicated even if there is no other strict indication based on the proximity of blast wounds to the fecal stream. If clot or active bleeding is identified on proctoscopic 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 always necessary unless there is bulky retained stool in the presence of a suspected penetrating injury.

CONSIDERATION OF 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 it is sometimes necessary to prone the patient during the index procedure after hemorrhage control, for debridement of deep blast wounds in the gluteal and low back region. This decision should not be made lightly due to the time requirements and risks involved and can often be deferred to secondary procedures. When undertaken, the use of a Jackson table can facilitate a safe transition to the prone position. Unstable pelvic ring injuries should be stabilized prior to proning a patient as this position can exacerbate pelvic volume widening and resulting hemorrhage. Alternatively, lateral positioning with a bean bag may be considered.

TEMPORARY ABDOMINAL CLOSURE

Liberal use of temporary abdominal closure with delayed stoma maturation is advised.

WOUND DRESSINGS

Traumatic wounds should not be definitively closed until multiple adequate debridements have been performed and serial wound stability and maturation demonstrated. By nature, the extensive soft tissue destruction and degree of contamination in these wounds make them infected until proven otherwise, and a series of surgical debridements is necessary to prepare wounds for closure or coverage. If necessary and in the face of clean viable tissue, incisions made to extend the zone of wounds to healthy levels can be loosely approximated to prevent massive skin retraction. The preferred initial wound dressings include moist-to-dry, Dakin's soaked gauze, antibiotic bead pouches or negative pressure wound therapy with reticulated open cell foam or moist gauze.

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.²

NEED FOR REPEATED DEBRIDEMENTS

The treatment team must appreciate the phenomenon of wound evolution and the high risk for invasive fungal infection and expect 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 (e.g. 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 massively injured, physiologically deranged patient should not undergo excessive surgical procedures during the initial operation other than those required to control hemorrhage and gross contamination. See the JTS *Initial Management of War Wounds and Invasive Fungal Infection* CPGs for further guidance.^{10,12}

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, and the liberal use of topical delivery with Dakin's soaked gauze or antibiotic beads. See *JTS Infection Prevention in Combat-Related Injuries* CPG for specific recommendations.¹³

ROLE OF VTE PROPHYLAXIS

DCBI patients are at very high risk of developing proximal deep vein thrombosis (DVT) and associated pulmonary embolus (PE). The presence of lower extremity amputation does NOT reduce this risk. In fact, patients with lower extremity amputations may actually be at higher risk for development of DVT and PE than those with similar injury severity without lower extremity traumatic amputation. It is recommended that these patients be started on appropriate DVT/PE prophylaxis as soon as coagulopathy is reversed. If contraindications to prophylactic anticoagulation persist, prophylactic IVC filter placement should be strongly considered. See *Prevention of Venous Thromboembolism in Combat Trauma Patients* CPG for further recommendations.¹⁴

TRANSFER OF CARE

The down-range surgeons should make every effort to coordinate dressing changes and necessary repeat debridements in anticipation of required patient transport up-range. Given the propensity for wounds to evolve in their acute phase, the down-range surgeons must maintain a low threshold to perform additional debridement prior to evacuating the casualty if the patient would otherwise require an unacceptable interval 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.

PERFORMANCE IMPROVEMENT (PI) MONITORING

INTENT (EXPECTED OUTCOMES)

- All patients at high risk for rectal injury are evaluated to eliminate the chance of missed injury
- All patients who undergo laparotomy have temporary abdominal closure to reduce chance for compartment syndrome and facilitate abdominal re-look and washout up range.
- All patients receive or are considered for VTE prophylaxis as soon as clinically able.

PERFORMANCE/ADHERENCE MEASURES

- Proctoscopic examination was performed and documented during the index operation in these patients with fragmentation wounds to the perineum and perianal areas.
- In these patients undergoing laparotomy for vascular control and/or presence of intraabdominal injury, temporary abdominal closure was employed at the index operation.
- Appropriate VTE prophylaxis was initiated in a timely fashion or, if not, adequate documentation as to why not exists in the medical record and physician note.

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 Joint Trauma System (JTS) Director and the Performance Improvement Branch.

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: ADDITIONAL 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.