The Use of Pelvic Binders in Tactical Combat Casualty Care

TCCC Guidelines Change 1602

7 November 2016

Stacy Shackelford, MD; Rick Hammesfahr, MD; Daniel Morissette, SO-ATP; Harold Montgomery, SO-ATP; Win Kerr, SO-ATP; Michael Broussard, PA-C; Brad Bennett, PhD, NREMT-P; Warren Dorlac, MD; Stephen Bree, MD; Frank Butler, MD

Proximate Cause for This Change

Blast injuries resulting from improvised explosive device (IED) attacks have been a major cause of combat injury in the Afghanistan conflict.[1,2] Dismounted IED attacks are frequently associated with pelvic fractures,[3] which in turn may result in massive hemorrhage and death.[4] Pelvic fracture is also frequently caused by penetrating trauma and high-energy blunt trauma such as motor vehicle crash.[5]

The Committee on Tactical Combat Casualty Care (CoTCCC) reviewed the use of pelvic binders in 2008 and decided at the time that there was insufficient evidence of benefit to warrant their addition to the TCCC Guidelines. At the February 2016 meeting of the CoTCCC, CAPT Stephen Bree, the UK Liaison Officer to the US military and an experienced combat medical provider, was asked to present the top three items that he thought needed to be changed about TCCC. One of those three items was to add the use of pelvic binders to the TCCC Guidelines. Col Stacy Shackelford presented a review of this topic for the committee. An extensive review of the literature and consideration by the CoTCCC led the committee to recommend that pelvic binders be reconsidered for addition to the TCCC Guidelines.

Background

Pelvic fractures are common in combat injuries, and may be highly lethal. Twenty-six percent of service members who died during Operations Iraqi and Enduring Freedom had a pelvic fracture. The pelvic fractures resulting from direct combat, to include blast injury and gunshot wounds, had a much higher mortality than those resulting from motor vehicle crash or fall.[6] Bleeding pelvic fractures associated with hemodynamic instability may have up to 40% mortality.[4] Anterior compression injuries (open book fractures) are associated with the highest mortality (48%).[7] Among military casualties, 76% of fatal pelvic fractures are caused by blast injury, 15% by gunshot wounds, and 4.5% by motor vehicle crash.[5]

Emergent treatment options for pelvic fractures include pelvic binder, external fixation, internal fixation, direct surgical hemostasis, preperitoneal pelvic packing, and pelvic angiography and embolization.[8] Of these, the only treatment available to prehospital providers is the pelvic binder.

Although definitive evidence demonstrating improved survival with pelvic binder use is lacking, every publication identified in our review addressing the management of pelvic hemorrhage recommends pelvic binder use for initial management of pelvic fracture hemorrhage[4,9–24] including both civilian[25–29] and military practice guidelines.[30–32] In general, the risk:benefit assessment of the intervention and the potentially devastating nature of pelvic hemorrhage have led numerous authors to recommend the use of pelvic binders for initial control of pelvic hemorrhage.

In 2016, the Committee on Tactical Combat Casualty Care considered whether the use of pelvic binders should be included in the TCCC guidelines. Seven specific questions were addressed regarding the prehospital use of pelvic binders:

1. Does a pelvic binder stabilize the pelvic fracture?
2. Does a pelvic binder control bleeding from a fractured pelvis?
3. Does a pelvic binder improve survival?
4. Who should get a pelvic binder?
5. Is there any harm in applying a pelvic binder?
6. What is the best type of pelvic binder?
7. Where does pelvic binder fit into priorities?

The PubMed, MEDLINE, and Cochrane databases were searched 1 Jan 1990–1 Apr 2016 for articles under combinations of the keywords *pelvic fracture, pelvic*

binder, pelvic sling, pelvic orthotic device, pelvic circumferential compression device, hemorrhage, and *prehospital*. A total of 1,984 articles were identified; 114 abstracts were reviewed; 60 articles were identified for full review, and 53 articles selected for final inclusion. The references of selected articles were also reviewed as potential additional sources, identifying an additional 7 articles.

Does a Pelvic Binder Stabilize the Pelvic Fracture?

The effectiveness of a pelvic binder to stabilize fracture fragments has been assessed in human cadaver studies where various unstable fracture patterns were created and the fracture motion measured after pelvic binder application. Commercial devices (Pelvic Binder™ [PelvicBinderInc.;http://www.pelvicbinder.com/],T-POD® [Pyng Medical; http://www.pyng.com/products/t-pod combat/], and SAM Pelvic Sling® [SAM Medical Products; www.sammedical.com/]) and circumferential sheeting were compared in various combinations in five separate studies.[32–36] All devices tested were found to provide near-anatomic fracture reduction with minimal overreduction. Angular motion was controlled during simulated patient care maneuvers in one study.[33] In general, no significant difference was detected between the various commercial devices and circumferential sheet.

Placement of the binder at the level of the pubic symphysis and greater trochanters was shown to reduce the unstable pelvic fracture most effectively with the least amount of force.[35–37]

Conclusion: There is evidence in cadaver studies that fracture motion is stabilized with a pelvic binder. The binder should be placed at the level of the pubic symphysis/greater trochanters. *Level of evidence: B*

Does a Pelvic Binder Control Bleeding From a Fractured Pelvis?

The primary source of hemorrhage from pelvic fractures is the posterior pelvic venous plexus and bleeding cancellous bone surfaces; however, 10–15% of the time, hemorrhage is arterial and arises from branches of the internal iliac, pudendal, and superior gluteal arteries. Exsanguinating hemorrhage may occur in all fracture patterns, even simple rami fractures, and may be independent of the bony injury pattern to the pelvis altogether.[4]

Conventional teaching indicated that pelvic binders control bleeding by reducing the volume of the pelvis and inducing tamponade. However, the reduction in volume of the true pelvis is much less than expected: a large pubic diastasis of 10 cm corresponds to only a 35% increase in pelvic volume, or 480 cm.[38] Additionally, a tamponade effect may not occur since the retroperitoneum is often disrupted, allowing free bleeding into the peritoneal cavity.[4] Therefore, it is more likely that splinting of pathologic fracture motion to allow clot formation is the mechanism that aids in hemostasis.

Hemorrhage with stable fracture patterns is unlikely to be controlled with a pelvic binder. However, since it is not possible to differentiate a stable from an unstable fracture pattern in the prehospital environment, all suspected pelvic fractures should have a binder applied.

Several clinical studies have attempted to assess the effect of pelvic binder placement on hemorrhage control. A retrospective review of 585 patients with pelvic fractures requiring transfer to a trauma center showed that those who received a pretransfer pelvic binder required fewer blood transfusions and had a shorter length of stay.[39]

In a retrospective study of 183 patients treated with external fixation or pelvic binder after hospital arrival, the binder was associated with lower 24-hour transfusion and shorter length of stay, and with a nonsignificant decrease in mortality (26% versus 37%). The authors noted that the binder could be applied more quickly compared to external fixation.[40]

A retrospective comparison of 192 civilian trauma patients treated with pelvic compression after hospital arrival showed that lethal hemorrhage was higher when a circumferential sheet was used (23%) compared with a binder or C-clamp (4% and 8%) respectively, although the authors acknowledged that sheets may have been used at the more inexperienced trauma centers, while the experienced centers had binders available.[41]

In several case reports, a properly applied binder along with ongoing resuscitation effectively improved hemodynamics for patients with pelvic fracture and hypotension.[42–44] In a case-series of 15 hemodynamically unstable patients with unstable pelvic fractures, hemodynamics were assessed before and immediately after placement of a T-POD® device; mean arterial pressure increased and heart rate declined after the binder was placed.

Conclusion: There is weak clinical evidence that pelvic binder may reduce blood transfusion and lethal hemorrhage compared to other methods. There is likely to have been selection bias in these studies and no studies of prehospital application were identified. Anecdotally, hemodynamics often improve after pelvic binder application. *Level of evidence: B*

Does a Pelvic Binder Improve Survival?

No high-quality evidence was found that documented improved survival associated with the use of pelvic

binders. The results of retrospective studies are mixed. A German-language publication reported 104 severely injured (Injury Severity Score [ISS] >16) patients with isolated pelvic fracture and hemodynamic instability. Those who did receive external pelvic stabilization after hospital arrival had a mortality rate of 19%, while those treated without external stabilization had a 33% mortality rate.[45]

In contrast, a retrospective historical control study in the United States showed that external mechanical compression, when applied after arrival to the hospital, had no effect on mortality, need for angioembolization, or transfusion in a center that emphasized early treatment with angiography.[46]

Of 135 patients with unstable pelvic fractures transferred to a trauma center, three deaths occurred among those who did not receive a pelvic binder before transfer and none occurred among those who did.[39]

Conclusion: There is very weak clinical evidence that pelvic binders may improve survival when applied after hospital arrival. Evidence in regard to survival following prehospital application of pelvic binders is lacking. *Level of evidence: C*

Is There Any Harm in Applying a Pelvic Binder?

In theory, pelvic compression could worsen displacement of certain fracture patterns, particularly lateral compression injuries, or cause injury to internal structures through fracture fragment motion; however, there is no actual clinical evidence that significant harm occurs.

In a series of 115 patients with high-energy Tile B and C pelvic ring injuries,[47] bony alignment of the pelvis improved in 68% after application of a pelvic binder, was unchanged in 11%, and worsened in 11%. The authors noted that in some lateral compression fractures, the radiologic deformity increased with pelvic binder placement; however, any association between a pelvic binder and femoral artery, bladder, or rectal injury was determined to be unlikely.[48]

A clinical series of 16 pelvic fracture patients showed that open book fractures were effectively reduced with a controlled tension pelvic binder, while overreduction of compression type fractures was minimal and no complication observed even with prolonged application (mean 59 hours).[49]

Pressure injury to the skin is a known complication of pelvic binder; such skin break down may interfere with operative fixation of the pelvis.[50–54]

The radiologic signs of open book pelvic fracture may be masked after pelvic binder is applied, and cases of missed injury due to near-perfect bony alignment after pelvic binder placement have been reported.[55]

Conclusion: applying a pelvic binder is unlikely to increase injury or bleeding. Prolonged use or overtightening may cause pressure ulcerations. *Level of evidence: C*

Who Should Receive a Pelvic Binder?

Strategies to identify pelvic fracture in the prehospital environment include identification of risk factors for pelvic fracture and physical examination findings.

An analysis of 77 consecutive patients with traumatic lower limb amputation due to a dismounted IED from the United Kingdom Joint Theater Trauma Registry demonstrated a high incidence of pelvic fractures in patients with lower limb amputations: overall, 22% of these casualties had a pelvic fracture; if bilateral above knee amputations were present, 39% had a pelvic fracture.[3] The authors concluded that routine application of pelvic binders was indicated for this injury pattern.

Further analysis of bilateral lower extremity amputations in UK servicemen showed that 14% also had an open pelvic fracture.[56] Of patients who sustained a perineal injury from IED blast, 53% also had a pelvic fracture; the combination of pelvic fracture and perineal injury had a high mortality rate—41%.[57]

A large study assessing the sensitivity of prehospital physical examination for pelvic fracture showed that about one-third of severe pelvic fractures were not suspected in the prehospital environment, with brain injury and low Glasgow Coma Scale (GCS) score independently associated with missed injury. Hypotension and high ISS (≥ 25) decreased the risk of missing a pelvic injury.[58]

The Royal London Hospital published their standard criteria for application of a pelvic binder, which included obvious pelvic disruption, severe trauma with pain in the pelvis, pain in lower back, pain in the hip, pelvic deformity on visual inspection, and unconscious patient with high-energy blunt mechanism.[59] They reported that 25% of all prehospital missed injuries were pelvic fractures (eight pelvic fractures were missed on prehospital assessment, two of which were severe); however, none of the missed pelvic fractures were associated with hypotension. The majority of those that were missed also had distracting injuries to the head or limbs.

The London Faculty of Pre-Hospital Care (FPHC) consensus meeting on prehospital management of pelvic

fractures recommended early and liberal application of pelvic binders in high energy blunt trauma. In the presence of high-energy blunt trauma, the FPHC recommended that a pelvic binder should be used if any one of four risk factors is present: (1) heart rate > 100, (2) systolic blood pressure < 90mmHg, (3) GCS score ≤ 13, or (4) distracting injury and/or pain on pelvic examination.[27]

The Royal London Hospital subsequently reported in a retrospective review that had they used the FPHC criteria, six of eight missed pelvic fractures would have met criteria for a pelvic binder.[59]

Physical examination findings associated with pelvic fracture may include a hematoma above the inguinal ligament, on the proximal thigh, or over the perineum, or ecchymosis of the flank. Additional findings include pelvic pain or instability, neurologic deficits of the lower extremities, blood at the urethral meatus, rectum, or vagina, massive hematuria, high-riding prostate, and unequal leg length.[4,20,21] Pelvic "springing" as a patient assessment technique is a poor predictor of the presence or absence of pelvic fracture and may dislodge adherent clot and further exacerbate hemorrhage, and it is painful to a conscious patient.[60] Physical examination findings are not sensitive for identification of pelvic fracture.[20]

Conclusion: after consideration by the committee, the indications selected for pelvic binder placement include suspected pelvic fracture based on a mechanism of severe blunt force or blast injury with one or more of the following indications:

- Pelvic pain
- Any major lower limb amputation or near amputation
- Physical examination findings suggestive of a pelvic fracture
- Unconsciousness
- Shock

Level of evidence: C

What Is the Best Type of Pelvic Binder?

There are three commercial devices that have been evaluated in clinical and cadaveric studies. The Pelvic Binder™ (NSN 6515-01-618-9137) is a one-size-fits-all, cut-to-fit product with a Velcro fastener and shoelace cinching mechanism (Figure 1). The SAM Pelvic Sling® (NSN 6515-01-509-6866) is made in three standard sizes and contains an "autostop" buckle that limits the amount of compression applied; the device is narrower, leaving more space to access the abdomen or femoral vessels (Figure 2). The belt mechanism is identical to the belt portion of the SAM junctional tourniquet. The medium-size SAM sling fits 96% of adults. The T-POD®

Figure 1 *PelvicBinder™*.

Photograph by Lt Col James Wiedenhoefer.

Figure 2 *SAM Pelvic Sling®*.

Photograph by Lt Col James Wiedenhoefer.

(NSN 6515-01-526-2788) is a one-size-fits-all, cut-to-fit product, with a mechanical advantage pulley lacing system (Figure 3).[32]

Two CoTCCC approved junctional tourniquets (the SAM Junctional Tourniquet and the Junctional Emergency Treatment Tool) can also be used to provide circumferential pelvic compression. When used for this purpose, the inguinal compression devices need not be deployed.

Sheet wrapping techniques vary slightly in various studies and likely in clinical use. In general, this technique involves wrapping a folded sheet around the pelvis and securing the sheet with zip ties or clamps.[33,42] Other improvised pelvic splints have also been described but have not been studied.

Figure 3 *T-POD®.*

Photograph by Lt Col James Wiedenhoefer.

Cadaver Studies

In cadaver studies, the Pelvic Binder™, the SAM Pelvic Sling®, the T-POD®, circumferential sheets, and external fixation have been compared in various combinations.[32-34,61] All of the devices tested did not differ with regard to pelvic ring closure and motion of fracture fragments.

Clinical Studies

In the previously described German Trauma Registry study, the use of sheet wrapping was associated with a significantly higher mortality (23% for sheet versus 4% for binder versus 8% for C-clamp). The authors commented that higher level and busier trauma centers may have been more likely to use a specialized device rather than a sheet, and that it may have been more likely for a sheet to be applied improperly or removed prematurely to facilitate additional interventions. It is therefore not clear from this study whether the use of the sheet is a marker for less-experienced providers or whether the sheet is less effective at controlling hemorrhage.[41]

In an evaluation of application time, ease of use, and user preference in a classroom setting comparing the T-POD and SAM Pelvic Sling, both were correctly applied 100% of the time, the SAM was quicker to apply (18 versus 31 seconds), and 78% of users preferred the T-POD.[62]

A properly applied draw sheet, combined with binding the thighs and ankles loosely together effectively improved hemodynamics in seven patients.[42]

Improvised Pelvic Binder Techniques

It is likely that commercial pelvic binders will achieve more consistent results with less training and should therefore be encouraged to be packed and used whenever the environment and tactical situation allow. Circumferential junctional tourniquets may be used as equivalent to a commercial binder.

The constant need to reduce additional gear requirements has led us to also consider improvised pelvic compression techniques as well.

When properly applied, it has been demonstrated that circumferential sheets are as effective as commercial binders to stabilize pelvic fractures; however, in actual practice, it is likely that there is significant variability among users.

The technique of placing the circumferential sheet as described in studies evaluating this intervention[42,44] involves the combination of manually tightening the sheet to reduce the pelvis and then securing the sheet with clamps or zip ties, generally done with at least two medical personnel. For a single rescuer, it is likely that tension would be lost with this improvised technique due to the need to maintain tension while at the same time securing the sheet (Figure 4).

Figure 4 *Sheet/blanket.*

Photograph by Lt Col James Wiedenhoefer.

Other improvised pelvic compression techniques have been described but have not been formally studied (Figures 5–7). When considering the use of an improvised technique, it is important to ensure that the same principles are rigidly applied in order to achieve similar results: the improvised pelvic binder must be centered at the level of the greater trochanters and pubic symphysis, the device must be applied tightly enough to reduce the fracture without overtightening, the device must be wide enough to distribute pressure evenly, and the thighs or ankles should be bound loosely together

Figure 5 *SAM splint plus tourniquet.*

Photograph by Lt Col James Wiedenhoefer.

Figure 6 *Trousers cut with windlass.*

Photograph by Lt Col James Wiedenhoefer.

(Figure 8). Securing the toes also prevents external rotation of the lower extremities, further stabilizing fracture motion (Figure 9).

Improvised pelvic splints have been described using a combination of SAM splint and CAT tourniquet.[63] This technique uses a familiar tourniquet in combination with a SAM splint, and in the opinion of the authors appears to achieve adequate tension comparable to a commercial device (see Figure 5). This technique, slightly modified, is also taught at the Special Operations Combat Medic Skill Sustainment Course (SOCMSSC).

An additional improvised technique, also taught at SOCMSSC, involves cutting the trouser legs, using the cut ends to encircle the pelvis and a large stick or pole to tighten as a windlass (see Figure 6).

Figure 7 *Cravats.*

Photograph by MSG Daniel Morissette

Figure 8 *Ankles secured.*

Photograph by Lt Col James Wiedenhoefer.

Techniques that include simply tying a cravat around the pelvis or placing linked tourniquets around the pelvis may not achieve adequate tension or may not be wide enough to achieve the expected result, and should be discouraged.

Improvised techniques, in order to be effective, must be thoroughly trained, practiced, and planned in advance.

Conclusion: There is very weak evidence to suggest that a commercial device is more effective in controlling hemorrhage than an improvised sheet. *Level of evidence: C.* There is no evidence that any commercial compression device is better than another. *Level of evidence: B.* Other improvised pelvic binders have not been studied.

Overall recommendation

There is consistent evidence in cadaver studies that unstable pelvic fractures are reduced and stabilized by pelvic binder placement. There is clinical evidence supporting pelvic binder placement to reduce hemorrhage, although evidence of improved survival is overall weak

Figure 9 *Toes secured to prevent external rotation.*

Photograph by Lt Col James Wiedenhoefer.

and fraught with biases. There is also clinical evidence demonstrating that hemodynamics improve after application of a pelvic binder in hemodynamically unstable patients with severe pelvic fracture. There is no indication of substantial harm, beyond the risk of pressure injury to the skin, associated with pelvic binder use.

A pelvic binder should be converted to external or internal fixation as soon as conditions allow, or removed if found to be unneeded once imaging is obtained. If definitive care is delayed beyond approximately 8–12 hours, the need for a binder should be reassessed and the binder loosened if the patient remains hemodynamically stable.

The CoTCCC recommends the use of pelvic binders for all cases of suspected pelvic fracture. A commercial device is recommended for consistency and ease of training, however improvised compression is acceptable if a suitable commercial device is not available.

Where Does Pelvic Binder Fit Into Priorities?

Prehospital medical interventions are prioritized according to the M-A-R-C-H mnemonic (Massive hemorrhage, Airway, Respiration, Circulation, Head/Hypothermia).

A pelvic binder should be considered in the control of hemorrhage during the "circulation" stage, after control of massive external hemorrhage and addressing airway or respiratory compromise, and before reassessment of tourniquets and intravenous access.

When possible, the pelvis should be immobilized before moving the patient. Care Under Fire precludes pelvic immobilization.

Training

A pelvic binder should be applied for cases of suspected pelvic fracture:

– Severe blunt force or blast injury with one or more of the following indications:

  - Pelvic pain
  - Any major lower limb amputation or near amputation
  - Physical examination findings suggestive of a pelvic fracture
  - Unconsciousness
  - Shock

The above criteria capture high-risk blast injury patients, those with physical examination concerning for pelvic fracture, those with a compromised physical exam due to unconsciousness, and hemodynamically unstable blunt trauma patients.

A pelvic binder provides the greatest degree of stabilization when applied at the level of the greater trochanters rather than at the level of the anterior superior iliac spine.[33] Improper placement, however, is common—in one study as many as 40% of pelvic binders were placed too high resulting in inadequate reduction of pubic symphysis diastasis.[64] Ideally, the binder should be placed next to the skin rather than over clothing to allow more accurate positioning and prevent the need to remove the device on arrival to the hospital. In tactical situations, it may not be advisable to remove the clothing; however, the pockets should be emptied and gear removed from the belt before placing a pelvic binder.

If a pelvic fracture is suspected, logrolling and unnecessary movement of the patient should be avoided. If possible, the pelvic binder should be placed before moving the patient. Ideally, the patient should be lifted gently onto the litter by two or more people, or a scoop litter used if available. In a tactical environment, a rigid litter may not be available; however, excess motion should still be avoided when moving the patient to the litter. Since logrolling is a common technique used to place casualties onto a litter, avoidance of such motion in cases of suspected pelvic fracture requires particular training emphasis.

The binder should be passed under the thighs and slid up to the level of the greater trochanters, carefully lifting from behind the back and thighs if needed. If the binder is passed beneath the lumbar spine and slid down, the technique is more likely to result in malpositioning the binder above the greater trochanters and decreased effectiveness of the binder.[64] If the technique of sliding down from the lumbar spine is used, particular attention must be given to proper positioning over the greater trochanters.

Next, the ankles or feet should be loosely strapped or taped together. This will help control external rotation

of the lower extremities that is commonly seen in patients with displaced pelvic fractures and reduce the forces acting through the hip joint that contribute to pelvic deformity.[42] If there is an amputation, the thighs should be bound together.[3]

Pelvic compression may be effectively accomplished with a commercial device, a sheet or other cloth material such as the trouser legs secured with zip ties, or possibly other combinations of improvised devices (ex. *Wilderness Medicine* guide to pelvic splints).[63]

Application techniques are different for each of the three currently available commercial devices; therefore, medical personnel must be trained on the specific device to be used. If an improvised device is used, it must be incorporated into training. Improvised compression with sheet/clothing is best applied by two personnel—one to pull the cloth tightly and another to secure it.

In addition, currently available circumferential junctional tourniquets (SAM Junctional Tourniquet or Junctional Emergency Treatment Tool) are also effective pelvic compression devices.[65] Routine use of junctional tourniquets for any suspected pelvic fracture, however, will significantly increase cost.

Pneumatic Antishock Garment (PASG)

The use of PASG has previously been included in the TACEVAC phase of the TCCC guidelines for stabilizing pelvic fractures and controlling pelvic and abdominal bleeding. In recent guideline changes, the addition of junctional tourniquets as well as pelvic binders has replaced the use of PASG for this purpose. Concern for potential harm with lack of proven benefit related to the use of PASG,[66] as well as the contraindications of thoracic and brain injuries, have led us to recommend removal of the PASG from the TCCC guidelines.

PROPOSED CHANGE TO THE TCCC GUIDELINES

Current wording
Care Under Fire
N/A

Tactical Field Care

4. Bleeding
   a. Assess for unrecognized hemorrhage and control all sources of bleeding. If not already done, use a CoTCCC-recommended limb tourniquet to control life-threatening external hemorrhage that is anatomically amenable to tourniquet use or for any traumatic amputation. Apply directly to the skin 2–3 inches above the wound. If bleeding is not controlled with the first tourniquet, apply a second tourniquet side-by-side with the first.
   b. For compressible hemorrhage not amenable to limb tourniquet use or as an adjunct to tourniquet removal, use Combat Gauze™ as the CoTCCC hemostatic dressing of choice.

      Alternative hemostatic adjuncts:
      – Celox Gauze or
      – ChitoGauze or
      – XStat™ (Best for deep, narrow-tract junctional wounds)

      Hemostatic dressings should be applied with at least 3 minutes of direct pressure (optional for XStat™). Each dressing works differently, so if one fails to control bleeding, it may be removed and a fresh dressing of the same type or a different type applied.

      If the bleeding site is amenable to use of a junctional tourniquet, immediately apply a CoTCCC-recommended junctional tourniquet. Do not delay in the application of the junctional tourniquet once it is ready for use. Apply hemostatic dressings with direct pressure if a junctional tourniquet is not available or while the junctional tourniquet is being readied for use.
   c. Reassess prior tourniquet application. Expose the wound and determine if a tourniquet is needed. If it is, replace any limb tourniquet placed over the uniform with one applied directly to the skin 2–3 inches above wound. Ensure that bleeding is stopped. When possible, a distal pulse should be checked. If bleeding persists or a distal pulse is still present, consider additional tightening of the tourniquet or the use of a second tourniquet side-by-side with the first to eliminate both bleeding and the distal pulse.
   d. Limb tourniquets and junctional tourniquets should be converted to hemostatic or pressure dressings as soon as possible if three criteria are met: the casualty is not in shock; it is possible to monitor the wound closely for bleeding; and the tourniquet is not being used to control bleeding from an amputated extremity. Every effort should be made to convert tourniquets in less than 2 hours if bleeding can be controlled with other means. Do not remove a tourniquet that has been in place more than 6 hours unless close monitoring and lab capability are available.
   e. Expose and clearly mark all tourniquet sites with the time of tourniquet application. Use an indelible marker.

TACEVAC Care

3. Bleeding
   a. Assess for unrecognized hemorrhage and control all sources of bleeding. If not already done, use a CoTCCC-recommended limb tourniquet to control life-threatening external hemorrhage that is anatomically amenable to tourniquet use or for any traumatic amputation. Apply directly to the skin 2–3 inches above the wound. If bleeding is not controlled with the first tourniquet, apply a second tourniquet side-by-side with the first.
   b. For compressible hemorrhage not amenable to limb tourniquet use or as an adjunct to tourniquet removal, use Combat Gauze™ as the CoTCCC hemostatic dressing of choice.

Alternative hemostatic adjuncts:
– Celox Gauze or
– ChitoGauze or
– XStat™ (Best for deep, narrow-tract junctional wounds)

Hemostatic dressings should be applied with at least 3 minutes of direct pressure (optional for XStat™). Each dressing works differently, so if one fails to control bleeding, it may be removed and a fresh dressing of the same type or a different type applied.

If the bleeding site is amenable to use of a junctional tourniquet, immediately apply a CoTCCC-recommended junctional tourniquet. Do not delay in the application of the junctional tourniquet once it is ready for use. Apply hemostatic dressings with direct pressure if a junctional tourniquet is not available or while the junctional tourniquet is being readied for use.

c. Reassess prior tourniquet application. Expose the wound and determine if a tourniquet is needed. If it is, replace any limb tourniquet placed over the uniform with one applied directly to the skin 2–3 inches above wound. Ensure that bleeding is stopped. When possible, a distal pulse should be checked. If bleeding persists or a distal pulse is still present, consider additional tightening of the tourniquet or the use of a second tourniquet side-by-side with the first to eliminate both bleeding and the distal pulse.

d. Limb tourniquets and junctional tourniquets should be converted to hemostatic or pressure dressings as soon as possible if three criteria are met: the casualty is not in shock; it is possible to monitor the wound closely for bleeding; and the tourniquet is not being used to control bleeding from an amputated extremity. Every effort should be made to convert tourniquets in less than 2 hours if bleeding can be controlled with other means. Do not remove a tourniquet that has been in place more than 6 hours unless close monitoring and lab capability are available.

e. Expose and clearly mark all tourniquet sites with the time of tourniquet application. Use an indelible marker

Proposed New Wording
Care Under Fire
N/A

Tactical Field Care

(Proposed New material in red text)

4. Bleeding
   a. Assess for unrecognized hemorrhage and control all sources of bleeding. If not already done, use a CoTCCC-recommended limb tourniquet to control life-threatening external hemorrhage that is anatomically amenable to tourniquet use or for any traumatic amputation. Apply directly to the skin 2–3 inches above the wound. If bleeding is not controlled with the first tourniquet, apply a second tourniquet side-by-side with the first.
   b. For compressible **(external)** hemorrhage not amenable to limb tourniquet use or as an adjunct to tourniquet removal, use Combat Gauze™ as the CoTCCC hemostatic dressing of choice.

Alternative hemostatic adjuncts:
– Celox Gauze or
– ChitoGauze or
– XStat™ (Best for deep, narrow-tract junctional wounds)

Hemostatic dressings should be applied with at least 3 minutes of direct pressure (optional for XStat™). Each dressing works differently, so if one fails to control bleeding, it may be removed and a fresh dressing of the same type or a different type applied.

If the bleeding site is amenable to use of a junctional tourniquet, immediately apply a CoTCCC-recommended junctional tourniquet. Do not delay in the application of the junctional tourniquet once it is ready for use. Apply hemostatic dressings with direct pressure if a junctional tourniquet is not available or while the junctional tourniquet is being readied for use.

c. A pelvic binder should be applied for cases of suspected pelvic fracture:
– Severe blunt force or blast injury with one or more of the following indications:
- **Pelvic pain**
- **Any major lower limb amputation or near amputation**
- **Physical exam findings suggestive of a pelvic fracture**
- **Unconsciousness**
- **Shock**

d. Reassess prior tourniquet application. Expose the wound and determine if a tourniquet is needed. If it is, replace any limb tourniquet placed over the uniform with one applied directly to the skin 2–3 inches above wound. Ensure that bleeding is stopped. When possible, a distal pulse should be checked. If bleeding persists or a distal pulse is still present, consider additional tightening of the tourniquet or the use of a second tourniquet side-by-side with the first to eliminate both bleeding and the distal pulse.

e. Limb tourniquets and junctional tourniquets should be converted to hemostatic or pressure dressings as soon as possible if three criteria are met: the casualty is not in shock; it is possible to monitor the wound closely for bleeding; and the tourniquet is not being used to control bleeding from an amputated extremity. Every effort should be made to convert tourniquets in less than 2 hours if bleeding can be controlled with other means. Do not remove a tourniquet that has been in place more than 6 hours unless close monitoring and lab capability are available.

f. Expose and clearly mark all tourniquet sites with the time of tourniquet application. Use an indelible marker.

TACEVAC Care

3. Bleeding
   a. Assess for unrecognized hemorrhage and control all sources of bleeding. If not already done, use a CoTCCC-recommended limb tourniquet to control life-threatening external hemorrhage that is anatomically amenable to tourniquet use or for any traumatic amputation. Apply directly to the skin 2–3 inches above the wound. If bleeding is not controlled with the first tourniquet, apply a second tourniquet side-by-side with the first.

b. For compressible (external) hemorrhage not amenable to limb tourniquet use or as an adjunct to tourniquet removal, use Combat Gauze™ as the CoTCCC hemostatic dressing of choice.

   Alternative hemostatic adjuncts:
   – Celox Gauze or
   – ChitoGauze or
   – XStat™ (Best for deep, narrow-tract junctional wounds)

   Hemostatic dressings should be applied with at least 3 minutes of direct pressure (optional for XStat™). Each dressing works differently, so if one fails to control bleeding, it may be removed and a fresh dressing of the same type or a different type applied.

   If the bleeding site is amenable to use of a junctional tourniquet, immediately apply a CoTCCC-recommended junctional tourniquet. Do not delay in the application of the junctional tourniquet once it is ready for use. Apply hemostatic dressings with direct pressure if a junctional tourniquet is not available or while the junctional tourniquet is being readied for use.

c. **A pelvic binder should be applied for cases of suspected pelvic fracture:**
   – Severe blunt force or blast injury with one or more of the following indications:
   - **Pelvic pain**
   - **Any major lower limb amputation or near amputation**
   - **Physical exam findings suggestive of a pelvic fracture**
   - **Unconsciousness**
   - **Shock**

d. Reassess prior tourniquet application. Expose the wound and determine if a tourniquet is needed. If it is, replace any limb tourniquet placed over the uniform with one applied directly to the skin 2–3 inches above wound. Ensure that bleeding is stopped. When possible, a distal pulse should be checked. If bleeding persists or a distal pulse is still present, consider additional tightening of the tourniquet or the use of a second tourniquet side-by-side with the first to eliminate both bleeding and the distal pulse.

e. Limb tourniquets and junctional tourniquets should be converted to hemostatic or pressure dressings as soon as possible if three criteria are met: the casualty is not in shock; it is possible to monitor the wound closely for bleeding; and the tourniquet is not being used to control bleeding from an amputated extremity. Every effort should be made to convert tourniquets in less than 2 hours if bleeding can be controlled with other means. Do not remove a tourniquet that has been in place more than 6 hours unless close monitoring and lab capability are available.

f. Expose and clearly mark all tourniquet sites with the time of tourniquet application. Use an indelible marker

Remove from guidelines:

TACEVAC Care

17. The Pneumatic Antishock Garment (PASG) may be useful for stabilizing pelvic fractures and controlling pelvic and abdominal bleeding. Application and extended use must be carefully monitored. The PASG is contraindicated for casualties with thoracic or brain injuries.

Level of evidence: (Tricoci)

The levels of evidence used by the American College of Cardiology and the American Heart Association were outlined by Tricoci in 2009:

– Level A: Evidence from multiple randomized trials or meta-analyses.
– Level B: Evidence from a single randomized trial or nonrandomized studies.
– Level C: Expert opinion, case studies, or standards of care.

Using the taxonomy above, the level of evidence for each statement below is shown:

– *Circumferential pelvic compression devices stabilize pelvic fractures: Level B*
– *Circumferential pelvic compression devices help to control bleeding from a fractured pelvis: Level B*
– *Circumferential pelvic compression devices improve survival in individuals with pelvic fractures: Level C*
– *Circumferential pelvic compression devices are unlikely to cause further injury when applied to individuals with suspected pelvic fractures: Level C*
– *Circumferential pelvic compression devices should be applied for individuals with suspected pelvic fracture as a result of blast injury with lower extremity amputation or with blunt trauma and any of the following:*
  – *Shock*
  – *Pelvic pain*
  – *Compromised exam (GCS ≤ 13 or distracting injury) Level C*
– *There is no clearly superior device among the three currently available circumferential pelvic compression devices: Level B*

Recommendations for Further Research and Development

1. The Joint Trauma System performance improvement process should be used to identify all future casualties on whom circumferential pelvic compression devices are used and how they performed.
2. Clinical study to evaluate outcomes of prehospital pelvic binder use, both military and civilian.
3. Retrospective review of casualties who would have been good candidates for circumferential pelvic compression devices but for whom these devices were not used.
4. Evaluation of improvised pelvic binders in comparison to commercial devices with particular interest in binders constructed using materials commonly available in combat aid bags.
5. Develop a relevant animal model for pelvic fracture hemorrhage and assess the effect of pelvic binder placement on survival.

References

1. **Mamczak CN, Elster EA.** Complex dismounted IED blast injuries: the initial management of bilateral lower extremity amputations with and without pelvic and perineal involvement. *J Surg Orthop Adv*. 2012;21:8–14.
2. **Ramasamy A, Evans S, Kendrew JM, et al.** The open blast pelvis; the significant burden of management. *J Bone Joint Surg*. 2012;94B:829–835.
3. **Cross AM, Davis C, Penn-Barwell J, et al.** The incidence of pelvic fractures with traumatic lower limb amputation in modern warfare due to improvised explosive devices. *J R Navy Med Serv*. 2014;100.2:152–156.
4. **White CE, Hsu JR, Holcomb JB**. Haemodynamically unstable pelvic fractures. *Injury*. 2009;40:1023–1030.
5. **Bailey JR, Stinner DJ, Blackbourne LH, et al.** Combat-related pelvis fractures in nonsurvivors. *J Trauma* 2011;71:S58–S61.
6. **Davis JM, Stinner DJ, Bailey JR, et al.** Factors associated with mortality in combat-related pelvic fractures. *J Am Acad Orthop Surg*. 2012;20(suppl 1):S7–S12.
7. **Mossadegh S, Tai N, Midwinter M, et al.** Improvised explosive device related pelvi-perineal trauma: anatomic injuries and surgical management. *J Trauma Acute Care Surg*. 2012; 73:S24–S31.
8. **Wong JML, Bucknill A**. Fractures of the pelvic ring. *Injury*. 2015.
9. **Littlejohn L, Bennett BL, Drew B.** Application of current hemorrhage control techniques for backcountry care: part 2, hemostatic dressings and other adjuncts. *Wilderness Environ Med*. 2015;26:246–254.
10. **Trainham L, Rizzolo D, Diwan A, et al.** Emergency management of high-energy pelvic trauma. *JAAPA*. 2015;28:28–33.
11. **Mauffrey C, Cuellar DO 3rd, Pieracci F, et al.** Strategies for the management of haemorrhage following pelvic fractures and associated trauma-induced coagulopathy. *Bone Joint J*. 2014;96-B:1143–1154.
12. **Langford JR, Burgess AR, Liporace FA, et al.** Pelvic fractures: part 1. Evaluation, classification, and resuscitation. *J Am Acad Orthop Surg*. 2013;21:448–457.
13. **Chesser TJS, Cross AM, Ward AJ.** The use of pelvic binders in the emergent management of potential pelvic trauma. *Injury*. 2012;43:667–669.
14. **Guthrie HC, Owens RW, Bircher MD**. Fractures of the pelvis. *J Bone Joint Surg Br*. 2010;92:1481–1488.
15. **Flint L, Cryer HG**. Pelvic fracture: the last 50 years. *J Trauma*. 2010;69:483–488.
16. **Rommens PM, Hofmann A, Hessmann MH.** Management of acute hemorrhage in pelvic trauma: an overview. *Eur J Trauma Emerg Surg*. 2010;36(2):91–99.
17. **Jeske H, Larndorfer R, Krappinger D, et al.** Management of hemorrhage in severe pelvic injuries. *J Trauma*. 2010;68: 415–420.
18. **Hak DJ, Smith WR, Suzuki T.** Management of hemorrhage in life-threatening pelvic fracture. 2009;17:447–457.
19. **Geeraerts T, Chhor V, Cheisson G, et al.** Clinical review: initial management of blunt pelvic trauma patients with haemodynamic instability. *Crit Care*. 2007;11:204–213.
20. **Lee C, Porter K.** The prehospital management of pelvic fractures. *Emerg Med J*. 2007;24:130–133.
21. **Durkin A, Sagi HC, Durham R, et al.** Contemporary management of pelvic fractures. *Am J Surg*. 2006;192:211–223.
22. **Mohanty K, Musso D, Powell JN, et al.** Emergent management of pelvic ring injuries: an update. *Can J Surg*. 2005:48:49–56.
23. **Friese G, LaMay G**. Emergency stabilization of unstable pelvic fractures. *Emerg Med Serv*. 2005;34:65, 67–71.
24. **Biffl WL, Smith WR, Moore EE, et al.** Evolution of a multidisciplinary clinical pathway for the management of unstable patients with pelvic fractures. *Ann Surg*. 2001;233:843–50.
25. **American College of Surgeons**. *Advanced trauma life support for doctors*. 9th ed. Chicago, IL: American College of Surgeons; 2012.
26. **Magnone S, Coccolini G, Manfredi R, et al.** Management of hemodynamically unstable pelvic trauma: results of the first Italian consensus conference. *World J Emerg Surg*. 2014; 9:18.
27. **Scott I, Porter K, Laire C, et al**. The prehospital management of pelvic fractures: initial consensus statement. *Emerg Med J*. 2013;30:1070–1072.
28. **Cullinane DC, Schiller HJ, Zielinski MD, et al.** Eastern Association for the Surgery of Trauma practice management guidelines for hemorrhage in pelvic fracture—update and systemic review. *J Trauma*. 2011;71:1850–1868.
29. **Heetveld MJ, Harris I, Schlaphoff G, et al**. Guidelines for the management of haemodynamically unstable pelvic fracture patients. *ANZ J Surg*. 2004;74:520–529.
30. **Joint Trauma System.** Clinical practice guideline, pelvic fracture care, 2 Apr 2012. http://www.usaisr.amedd.army.mil/cpgs .html. Accessed 24 Apr 2016.
31. **UK Ministry of Defense.** Clinical guidelines for operations. https://www.gov.uk/government/publications/jsp-999-clinical -guidelines-for-operations. Accessed 24 Apr 2016.
32. **Knops SP, Schep NWL, Spoor CW, et al.** Comparison of three different pelvic circumferential compression devices: a biomechanical cadaver study. *J Bone Joint Surg Am*. 2011;93: 230–240.
33. **Prasarn ML, Conrad B, Small J, et al.** Comparison of circumferential pelvic sheeting versus the T-POD on unstable pelvic injuries: a cadaveric study of stability. *Injury*. 2013;44: 1756–1759.
34. **DeAngelis NA, Wixted JJ, Drew J, et al.** Use of the trauma pelvic orthotic device (T-POD) for provisional stabilization of anterior-posterior compression type pelvic fractures: a cadaveric study. *Injury*. 2008;39:903–906.
35. **Bottlang M, Simpson T, Sigg J, et al.** Noninvasive reduction of open-book pelvic fractures by circumferential compression. *J Orthop Trauma*. 2002;16:367–373.
36. **Prasarn ML, Small J, Conrad B, et al.** Does application position of the T-POD affect stability of pelvic fractures? *J Orthop Trauma*. 2013;27:262–266.
37. **Bottlang M, Krieg JC, Mohr M, et al.** Emergent management of pelvic ring fractures with use of circumferential compression. *J Bone Joint Surg*. 2002;84:43–47.
38. **Stover MD, Summers HC, Ghanayem AJ, et al.** Three-dimensional analysis of pelvic volume in an unstable pelvic fracture. *J Trauma*. 2006;61:905–908.
39. **Fu CY, Wu YT, Liao CH, et al.** Pelvic circumferential compression devices benefit patients with pelvic fractures who need transfers. *Am J Emerg Med*. 2013;31:1432–1436.
40. **Croce MA, Magnotti LJ, Savage SA, et al**. Emergent pelvic fixation in patients with exsanguinating pelvic fractures. *J Am Coll Surg*. 2007;204:935–939.
41. **Pizanis A, Pohlemann T, Burkhardt M, et al.** Emergency stabilization of the pelvic ring: clinical comparison between three different techniques. *Injury*. 2013;44:1760–1764.
42. **Nunn T, Cosker TDA, Bose D, et al.** Immediate application of improvised pelvic binder as first step in extended resuscitation from life-threatening hypovolaemic shock in conscious patients with unstable pelvic injuries. *Injury*. 2007;38: 125–128.
43. **Qureshi A, McGee A, Cooper JP, et al.** Reduction of the posterior pelvic ring by non-invasive stabilization: a report of two cases. *Emerg Med J*. 2005;22:885–886.
44. **Routt MLC, Falicov A, Woodhouse E, et al.** Circumferential pelvic antishock sheeting: a temporary resuscitation aid. *J Orthop Trauma*. 2002;16:45–48.

45. **Esmer E, Esmer E, Derst P, et al.** Influence of external pelvic stabilization on hemodynamically unstable pelvic fractures. *Unfallchirug*. Published online 16 Dec 2015.
46. **Ghaemmaghami V, Sperry J, Gunst M, et al.** Effects of early use of external pelvic compression on transfusion requirements and mortality in pelvic fractures. *Am J Surg*. 2007;194: 720–723; discussion 723.
47. **Tile M.** Acute pelvic fractures: 1. Causation and classification. *J Am Acad Orthop Surg*. 1996;4:143–151.
48. **Toth L, King KL, McGrath B, et al.** Efficacy and safety of emergency non-invasive pelvic ring stabilization. *Injury*. 2012; 43:1330–1334.
49. **Kreig JC, Mohr M, Ellis TJ, et al.** Emergent stabilization of pelvic ring injuries by controlled circumferential compression: a clinical trial. *J Trauma*. 2005;59:659–664.
50. **Knops SP, van Riel MPJM, Goossens RHM, et al.** Measurements of the exerted pressure by pelvic circumferential compression devices. *Open Orthop J*. 2010;4:101–106.
51. **Knops SP, Van Lieshout EMM, Spanjersberg WR, et al.** Randomised clinical trial comparing pressure characteristics of pelvic circumferential compression devices in healthy volunteers. *Injury*. 2011;42:1020–1026.
52. **Jowett AJL, Bowyer GW.** Pressure characteristics of pelvic binders. *Injury*. 2007;38:118–121.
53. **Prasarn ML, Horodyski M, Schneider PS, et al.** Comparison of skin pressure measurements with the use of circumferential compression devices on pelvic ring injuries. *Injury*. 2016;47: 717–720.
54. **Schaller TM, Sims S, Maxian T.** Skin breakdown following circumferential pelvic antishock sheeting: a case report. *J Orthop Trauma*. 2005;19:661–665.
55. **Fletcher J, Yerimah G, Datta G.** The false security of pelvic binders: 2 cases of missed injuries due to anatomical reduction. *J Orthop Case Rep*. 2016;6:44–47.
56. **Penn-Barwell JG, Bennett PM, Fries CA, et al.** Acute bilateral leg amputation following combat injury in UK servicemen. *Injury*. 2014;45:1105–1110.
57. **Mossadegh S, Tai N, Midwinter M, et al.** Improvised explosive device related pelvi-perineal trauma: anatomic injuries and surgical management. *J Trauma Acute Care Surg*. 2012; 73:S24–S31.
58. **Lustenberger T, Walcher F, Lefering R, et al.** The reliability of the pre-hospital physical examination of the pelvis: a retrospective, multicenter study. *World J Surg*. 2016 Jul 26 (Epub).
59. **Yong E, Vasireddy A, Pavitt A, et al.** Pre-hospital pelvic girdle injury: improving diagnostic accuracy in a physician-led trauma service. *Injury*. 2016;47:383–388.
60. **Grant PT.** The diagnosis of pelvic fractures by "springing." *Arch Emerg Med*. 1990;7:178–182.
61. **Prasarn ML, Horodyski MB, Conrad B, et al.** Comparison of external fixation versus the trauma pelvic orthotic device on unstable pelvic injuries: a cadaveric study of stability. *J Trauma Acute Care Surg*. 2012;72:1671–1675.
62. **Bryson DJ, Davidson R, Mackenzie R.** Pelvic circumferential compression devices (PCCDs): a best evidence equipment review. *Eur J Trauma Emerg Surg*. 2012;38:439–442.
63. **Hodnick R.** A guide to pelvic splints. http://wilderness medicinemagazine.com/1120/Pelvic-Splints-Guide. Accessed 12 Jun 2016.
64. **Bonner TJ, Eardley WGP, Newell N, et al.** placement of a pelvic binder improves reduction of unstable fractures of the pelvic ring. *J Bone Joint Surg Br*. 2011;93B, 1524–1528.
65. **Gary JL, Kumaravel M, Gates K, et al.** Imaging comparison of pelvic ring disruption and injury reduction with use of the junctional emergency treatment tool for preinjury and postinjury pelvic dimensions: a cadaveric study with computed tomography. *J Spec Oper Med*. 2014;14(4):30–34.
66. **Lateef F, Kelvin T.** Military anti-shock garment: historical relic or a device with unrealized potential? *J Emerg Trauma Shock*. 2008;1(2):63–69.

Col Shackelford, USAF, is a trauma surgeon, currently serving as the chief of Performance Improvement, Joint Trauma System, San Antonio, Texas. She is a member of the Committee on TCCC and has previously deployed as the director of the Joint Theater Trauma System.

Dr Hammesfahr is currently the medical director of the Center for Orthopaedics and Sports Medicine and is an orthopedic surgeon. Formerly the chairman of the Curriculum and Examination Board for US Special Operations Command, he has been extensively involved in developing medical protocols and interoperability training for USSOCOM. He is actively involved in teaching TCCC and Tactical Emergency Casualty Care to civilian Special Operations Teams and serves as the medical director for Tactical Emergency Medical Service teams in Georgia.

MSG Morissette, USA, is a Special Operations Advanced Tactical Paramedic, currently serving as the senior enlisted medical advisor at Special Operations Command South, Homestead, Florida. He is a member of the Committee on TCCC and has previously deployed to the CENTCOM AO as a medic.

MSG (Ret) Montgomery, USA, is a retired Ranger Medic/ Special Operations Combat Medic, having served as the senior enlisted medical advisor at USSOCOM and the regimental senior medic of the 75th Ranger Regiment for a combined 25 years. He is currently the operational medicine liaison for the Joint Trauma System and a member of the Committee on TCCC.

Mr Kerr is the primary instructor for the Special Operations Combat Medical Skills Sustainment Course. He previously served as an 18D ODA medic for multiple deployments to Afghanistan.

CPT Broussard, USA, is the current battalion physician assistant of 3rd battalion, 75th Ranger Regiment. Since 2001, he has been deployed nine times and has experience providing prehospital care to casualties in Iraq, Afghanistan, Korea, and the Baltic States.

CAPT (Ret) Bennett, USA, is a physiologist and prehospital care subject matter expert who served on faculty and as the vice chairman (1994-2001), Department of Military and Emergency Medicine, Uniformed Services University. He served as the commanding officer, Field Medical Service School, Marine Corps Camp Pendleton, California, and the commanding officer, Naval School of the Health Sciences, Portsmouth, Virginia. Since 2002, Dr Bennett continues to serve the CoTCCC as a subject matter expert. He is the immediate past president of the Wilderness Medical Society.

Col (Ret) Dorlac, USAF, is a trauma surgeon and currently the trauma medical director at Medical Center of the Rockies, Loveland, Colorado. He was the trauma medical director at Landstuhl Regional Medical Center in Germany (2004–2007), a prior member of the TCCC, and the prior trauma consultant to the USAF surgeon general. He has deployed to both Iraq and Afghanistan and is a prior director of the Joint Theater Trauma System.

CAPT Bree, UK Royal Navy, is an anesthesiologist in the military since 1985. He has deployed multiple times to Iraq, Afghanistan, Sierra Leone, and the Balkans. He has a particular interest in pediatric trauma in combat zones. He recently served for 3 years as the UK liaison officer to the US military for all medical matters, is currently working in Plymouth, England, and is due to deploy to the Middle East next year.

CAPT (Ret) Butler, USN, was a Navy SEAL platoon commander before becoming a physician. He is an ophthalmologist and a Navy undersea medical officer with more than 20 years of experience providing medical support to Special Operations Forces. Dr Butler has served as the command surgeon for the U.S. Special Operations Command. He is currently the chairman of the Department of Defense's Committee on TCCC and Chief of Prehospital Trauma Care at the Joint Trauma System.

KEYWORDS: *pelvic binder; prehospital guidelines; TCCC guidelines*

The Special Operations Medical Association's Official Journal

JSOM

JOURNAL *of* SPECIAL OPERATIONS MEDICINE™

Spring 2017
Volume 17, Edition 1

THE JOURNAL FOR OPERATIONAL MEDICINE AND TACTICAL CASUALTY CARE

Inside this Issue:

- Case Report: REBOA in CCC Setting
- Case Report: Paraphimosis Reduction in an Austere Environment
- Case Report: Exertional Heat Injury
- Case Report: Balloon Occlusion of the Aorta
- In Brief: New Ultrasound Transmission Gel
- Tourniquet After Environmental Exposure
- Tourniquet Effectiveness Monitoring
- Pediatric Trauma in an Austere Environment
- Key Orthopedic and Extremity Injury Articles
- Visual Estimation of Blood Loss
- Potential of Battlefield REBOA
- Ongoing Series: Clinical Corner, Human Performance Optimization, Infectious Diseases, Injury Prevention, Law Enforcement & Tactical Medicine, Prolonged Field Care, SOFsono Ultrasound Series, Special Talk, Book Review, From the NATO Surgeon, TCCC Updates, TacMed Updates, *and more!*

Dedicated to the Indomitable Spirit and Sacrifices of the SOF Medic

A Peer-Reviewed Journal That Brings Together the Global Interests of Special Operations' First Responders