



Important learning points arising from the focused issue dedicated to the Terror and Disaster Surgical Care (TDSC®) course on mass casualty incident management

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Abstract

The Terror and Disaster Surgical Care (TDSC®) course on mass casualty incident management was formulated in Germany by military medical personnel, who have been deployed to conflict areas, but also work in hospitals open for the lay public. In this manuscript we discuss different concepts and ideas taught in this course as these are described in a focused issue recently published in the *European Journal of Trauma and Emergency Surgery*. We provide reinforcement for some of the ideas conveyed. We provide alternative views for others. Injuries following explosions are different from blunt and penetrating trauma and at times demand a different approach. There are probably several ways to manage a mass casualty incident depending on the setup of the organization. An open discussion on the topics presented in the manuscripts included in the focused issue on military and disaster surgery should enrich everyone.

Keywords TDSC® · Mass casualty incident · Blast · Terrorism

The last focused issue dedicated to the topic of disaster and military surgery published in the *European Journal of Trauma and Emergency Surgery* was devoted to different aspects of the Terror and Disaster Surgical Care (TDSC®) course. This course was formulated in Germany and has been offered since 2017. The need for the TDSC® course arose with increasing exposure of the German society during the last years to terror threats and actual terror attacks [1]. The course founders include instructors who are military medical personnel who divide their time between military deployments to conflict areas and work as specialists in their respective fields in military level 1 trauma centers in Germany that are open to the lay public. Involved in the development of this course were specialists from the civilian sector and various professional societies from different fields: surgery, anesthesia, burn medicine and CRBN. Thus, the

strength of this course is that the course instructors are both experienced working in the public health system in Germany and in combat-related injuries commonly experienced in mass casualty incidents (MCIs) but rarely experienced in the civil trauma scenario.

Germany has a population of over 80 million people and the trauma network caring for this population is comprised of over five hundred trauma-certified German hospitals [2]. The German Trauma Society (DGU) has implemented several policies in order to improve trauma care in Germany. These include the formation of regional trauma networks and the publication of the White Paper [3]. With the first edition published in 2006 and updated editions published in 2012 and 2019, the White Paper specifies the standards of trauma care in Germany [4].

Establishment of TDSC® course is part of the DGU's effort to improve trauma care in case of a mass casualty incident (MCI). The course was developed in order to provide participants with medical knowledge necessary to manage such events [5]. Participation of trauma leaders in the TDSC® course will be a White Paper requisite for public hospitals to become accredited as a trauma center starting in 2020.

In this manuscript we wish to emphasize the important learning points raised by the authors in the six manuscripts

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included in the focused issue. We also wish to emphasize those points that in our opinion are controversial. There are probably several ways to manage a mass casualty incident depending on the setup of the organization. Testing the different solutions under extreme circumstances may be the only way to know if the plan is feasible or not, before the major event actually strikes.

The learning points to remember and those that need re-evaluation are the following:

1. Wurmb et al. explain that proper response to MCIs involves not only medical teams, but police and other rescue teams, who need to work “hand in hand” with each other to enable an optimal result [1]. This is true in the scene as is true once the victims arrive to the hospital, where different sectors and specialties attend the injured victims. Wurmb et al. also emphasize that a coordinated response demands first and foremost definition of common goals. These goals serve as a lighthouse guiding all providers with a common language and a similar set of top priorities. Only once acceptable goals are defined, should different sectors responding to an MCI develop their specific mission strategies and tactics [6]. The main problem, however, are ambiguous messages prone to misinterpretation presented by leaders as common goals. Most casualties do not suffer from life threatening injuries. Messages such as “greatest good for the greatest number” and “the survival of the greatest possible number of casualties” do not focus on the minority with life-threatening injuries that are potentially reversible. These messages should be replaced with others that clearly state the conservation of resources in favor of those few in dire straits.
 2. The TDSC® approach to casualty care is translated into four sequential steps: categorizing, prioritizing, coordinating, and implementing [7]. Through these four steps, the TDSC® approach not only defines the site and the team responsible for implementation, they also describe the objectives of each step, the possible choices and the tools. Through the categorizing-prioritizing-coordinating-implementing, the TDSC® presents a comprehensive framework for the treatment of patients.
 3. Bieler et al. and Bieler et al. explain that patients with life-threatening uncontrolled bleeding should be immediately transferred to nearby hospitals for surgery [5, 8]. The authors identify uncontrolled bleeding (non-compressible torso hemorrhage) as the major pathology that leads to reversible mortality. While this may be true in patients suffering from penetrating trauma (either gunshot-wounds or penetrating metal fragments from bombs), it may be untrue in patients who were exposed to pure blast rather than penetrating trauma.
- In this latter group of patients, the major pathology leading to death is hypoxia, which is reversible with positive pressure ventilation and other measures such as drainage of the frequent accompanying pneumothoraxes. Having said that, as the authors emphasize, the overall majority of hemodynamically unstable severely injured patients, even following explosions, will be bleeders from penetrating trauma rather than hypoxic from blast lung injury. Commonly added metal fragments such as nails, bolts, metal pellets to the bombs, transforms the mechanism of trauma. As hypothesized by Mellor and Cooper, most of those exposed to the blast wave will die from the penetrating metal fragments [9]. Thus, very few survivors will manifest blast lung injury if indeed metal fragments are added to the bomb [10]. Patient history is very difficult to elicit in real time and evaluation is usually dependent on primary survey. Though in a previous publication one of the authors (IA) emphasized looking for blast and if this is ruled out, consider penetrating than blunt trauma as the cause of injury, we are aware that with the increasing use of metal fragments, pure blast lung injury as a cause of instability is uncommon and the pathology leading to instability is usually penetrating or blunt [11].
4. Bieler et al. explain what ought to be done, and what ought not to be done in injuries with extensive soft tissue damage [8]. The authors advocate the exploration and debridement of necrotic tissue as soon as possible. Irrigation should be thorough but care should be taken to avoid further damage. Removal of all embedded foreign bodies should be postponed in order to reduce operating times and minimize further soft tissue damage. As a rule, the wounds should not be closed primarily. However, the authors also recommend the promotion of granulation tissue formation with negative-pressure wound therapy. Our experience with soft tissue injuries following treatment of combat-related weapons is to promote hemostasis and debridement of necrotic tissue. Once these have been achieved, some of us attempt reconstruction by delayed primary closure of the wound [12]. Waiting till granulation tissue is formed is not always required.
 5. According to the Bieler et al. acute post-traumatic lung injury (ARDS) or blast lung can occur, sometimes after a delay of several days [8]. The authors offer no data and do not provide a direct reference for this. In our experience, hypoxia and/or hemothysis from blast lung injury manifest either immediately in most of the patients, or within 1–2 h in a minority of the patients suffering from this pathology. There is one historical account that blast lung injury manifested itself in one patient only following several days from exposure to

- an explosion [13]. Many years ago, one of the authors of this manuscript (IA) tried to make contact with the authors of the aforementioned manuscript in order to receive more information concerning this patient, without any success. Our experience with hundreds of patients following explosion injury is that this observation is rare at best, if not unfounded [11, 14].
6. Friemert et al. explain that following explosions the victims present with obvious injuries and that bleeding that lead to life-threatening injuries are easily identifiable [15]. In our opinion, while this comment may be true for gunshot wound injuries, it may be less true following explosions. Victims of explosion commonly suffer from multiple penetrating skin wounds. However, most if not all of these penetrate only superficially and do not cause life-threatening injuries. In stable patients, differentiating between superficial wounds and deeply penetrating wounds with internal injury will be difficult at first. Imaging is almost always necessary to rule out penetration [16]. The problem arises in patients who are hemodynamically unstable and imaging is, therefore, restricted to eFAST. In these patients, correctly identifying the trajectory of the penetrating missile leading to instability is far from being straightforward.
 7. Friemert et al. also suggest a strategy that starts with proper distribution of patients to not overwhelm any one hospital, and to avoid sending patients to hospitals that lack the capacity to treat them [15]. While this may be possible in daily situations, where EMS need to transport individual patients, is there data that supports the same is possible following major incidents? Other than the dual attacks in Boston in 2013 and in Brussels in 2016, where patients were effectively divided between many hospitals, most literature to date reveals that patient distribution between admitting hospitals was unequal, and few hospitals admitted the majority of the patients, both in numbers and severity [14, 17–21]. Hospitals should prepare contingency plans to accommodate for different numbers of patients that may be admitted following a MCI.
 8. Friemert et al. also describe how a terrorist attack may target the hospital and they suggest that appropriate precautions should be taken [15]. There is abundant literature of hospitals being either primary or secondary soft targets for terrorism [22]. If a terrorist attack has taken place and victims are being transported to hospitals, indeed, precautionary measures should be employed.
 9. According to Friemert et al., “a key element is a triage area that should be established to keep the chaos out of the hospital” [15]. This concept has been explored in several mass casualty incidents [14, 17, 23]. We question the validity of this strategy in all circumstances. Where, location-wise, should this site be set up in relationship to the hospital and the site (or sites) of attacks? Who should be in charge of setting up this site? How quickly can it be set up, especially in non-office hours? How do we set up security of this site, when all available power is used to secure the attack site and lock-down the hospitals? While many of the terrorist attacks occurred at day time during working days, many other attacks occurred during non-office hours, and even at night when the amount of manpower is limited [21, 24, 25]. This includes the terror attack in Berlin’s Christmas market, which occurred at 20:02 PM [1, 7]. Furthermore, the objectives set for this site contradict objectives defined for security and on-site triage explained in Bieler’s manuscript [8]. Setting up a second triage site outside from the hospital to avoid influx of mildly injured patients into the hospital will lead to unwarranted delays in treatment of the hemodynamically decompensated patients.
 10. The medical director of the MCI (termed in the manuscripts as the EOMC or ZONK) must make rapid decisions and in particular decisions on life-saving surgical procedures, prioritizing diagnostic, medical and surgical procedures. Though critically injured patients need the most attention, according to Friemert et al. the EOMC is responsible for managing all treatment areas [15]. The authors describe here the most important conflict an EOMC may have—where to place him/herself, with T1 patients or with all patients? While the authors’ final verdict is that the EOMC should be allowed to manage all the patients, this position can only be legitimized if problems with triage are anticipated. In their plan, the authors place a lot of emphasis on proper triage before the patients are brought into the hospital. Allowing the EOMC to rotate through T2 and T3 patients (the latter being the overwhelming majority of patients), may be a waste of surgical expertise in a time period when this resource is lacking.
 11. In the five manuscripts describing the TDSC®, the strategy termed tactical abbreviated surgical care (TASC) is presented in which limitations of care of the individual patient is tailored to a situation, where the resources for medical care and in particular surgical capacities are scarce [5, 7, 8, 15, 26]. Under these circumstances, the patients undergo only those surgical procedures and other treatments that are necessary to ensure their survival. According to the authors, the TASC approach can save not only in diagnostic resources in the pre-surgical setting but also on surgical capacities and intensive care resources. The TASC concept should be an essential part of the EOMC’s strategy to cope with discrepancies between avail-

able resources and patients' needs. Unlike the damage control principal, where the individual patient's physiologic reserves dictate the procedure, in the case of the MCI, the logistic reserves of the providers dictate the treatment. While we agree with the TASC as a concept, we ask ourselves whether in most MCIs, was TASC a real necessity? We ask whether TASC should be automatically employed or should it be employed only in certain circumstances? We think every system should calculate its capacities. Since capacities within any institution fluctuate depending on the weekday and time of the day, the worst case scenario should be considered such as a MCI occurring at the late evening and on weekends [27]. The number of incoming victims, available workforce and logistic constraints should dictate whether TASC is to be employed or not, and for how much time.

12. Franke et al. briefly discuss whether an increased number of negative exploratory laparotomies and thoracotomies can be justified in a situation characterized by limited resources [7]. In our opinion, these should be avoided. Stable patients categorized as severely injured (T1) should be retriaged and worked up with CT if needed. A positive eFAST should be carefully interpreted in hemodynamically stable patients [28]. Unstable patients should be evaluated for uncontrolled torso bleeding with eFAST. If a source of bleeding from the chest has been ruled out by chest tubes, a negative eFAST should be followed by a diagnostic peritoneal lavage [29]. If instability cannot be explained by either abdominal or thoracic bleeding, other pathologies leading to instability should be explored depending on the assumed mechanism of trauma. Negative explorations should be avoided, not because surgical capacities in the initial phases of an MCI may be scarce [7]. These should be avoided, since they are associated with morbidity and even mortality [30].
13. The tactic used by the TDSC® course includes lectures and four simulation “games” [26]. We usually use the term “simulations”, “exercises”, and “drills” to describe role-playing methods when educating MCI management. We wish to applaud the authors for choosing the word “game” instead of the former more commonly used options. As described by Achatz et al., games not only help us integrate knowledge, interact with other individuals (gamers), but they also help integrate emotions into the learning process. All these generate motivation essential for the learning process.

In conclusion, we all strive to save as many patients with life-threatening injuries as possible. This is the universal objective that is endorsed by all and the authors of the six manuscripts that are included in this focused issue. Whether

specific tactics described by the authors are applicable to all, should be individually tested by anyone wishing to adopt these tactics for their individual setting. These tests should take into consideration local capacities (and incapacities) of the emergency medical services, restrictions imposed by the hospitals setup, and most important, the fact that major incidents may happen during non-office hours when capacity is significantly diminished. We wish to congratulate the authors of the TDSC® course. We may not agree on everything. Nevertheless, an open discussion on topics presented in the manuscripts included in this focused issue should enrich everyone.

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Compliance with ethical standards

Conflict of interest Itamar Ashkenazi and Per Ortenwall are faculty members of the Medical Response to Major Incidents (MRMI) course that teaches students how to manage a mass casualty incident. The ideas conveyed by the authors are their own and do not represent what is taught in the MRMI course. Furthermore, both Itamar Ashkenazi and Per Ortenwall peer-reviewed some of the manuscripts that were eventually published in the focused issue on disaster and military surgery in August 2020. Other than that, the authors have no other conflicts of interest or competing interests to disclose.

Ethics approval This manuscript is a review discussing six articles describing the TDSC® course recently accepted for publication in the European Journal of Trauma and Emergency Surgery. The manuscript does not describe a study involving human subjects and as such does not need authorization by a Research Ethics Committee.

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