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## Changing face of trauma and surgical training in a developing country: A literature review

Qamar Riaz, Sabah uddin Saqib, Rehan Nasir Khan, Nadeem Ahmed Siddiqui

### Abstract

Trauma continues to be the major cause of disability and death globally and surgeons are often involved in immediate care. However there has been an exponential decrease in the number of the trained trauma surgeons. The purpose of the current review article is to summarize the published literature pertaining to trauma education in postgraduate surgical training programmes internationally and in a developing country as Pakistan. Several electronic databases like MEDLINE, PubMed, Google scholar and PakMediNet were searched using the keywords 'trauma education' or 'trauma training' AND 'postgraduate medical education', 'surgery residency training', 'surgery residents' and 'surgeons'. The current training in most surgical residency programmes, locally and globally, is suboptimal. Change in trauma management protocols, and decrease in volume of trauma cases results in variable and/ or inadequate exposure and hands-on experience of the surgical trainees in operative and non-operative management of trauma. This warrants collaborative measures for integration of innovative educational interventions at all levels of the surgical educational programmes.

**Keywords:** Traumaeducation, Surgical critical care, Surgery residency training, Communication skills, Trauma surgeon.

### Introduction

Trauma related injuries continue to remain a major cause of morbidity and mortality worldwide, although its distribution, types, causes, severity and therefore prognoses varies across different regions.<sup>1</sup> A wide variety of factors have been identified in the literature that can result in traumatic injuries. These include road traffic accidents (RTAs), falls, poisoning, drowning, suicide bombings and gunshot injuries, domestic violence, abuse and self-inflicted injuries, chemical and fire burns, electrocution, and last but not the least natural disasters.<sup>2</sup> These traumatic injuries range from abdominal and limb

fractures to vascular, thoracic and neuro-spinal injuries. The exact mechanism of injury resulting in traumatic morbidity or mortality, however, varies across countries and is dependent on the local war or peace situation.<sup>1</sup>

The magnitude of trauma related injuries is even more in developing and low income countries including Pakistan. In Pakistan, trauma is the second leading cause of disability, 11th leading cause of premature death, and the fifth leading cause of healthy years of life lost per 1000 people.<sup>2</sup> According to a study, approximately 80-100 patients are presented every day to each trauma facility in Pakistan and rates of death owing to unintentional injury are 50% higher in rural than urban areas.<sup>3</sup> Unfortunately, major emergency departments in Pakistan lack resources, infrastructure and skilled emergency care providers and only a few hospitals have a formal triage system in place.<sup>3</sup> According to a study, approximately 2 million lives could be saved each year if low and middle-income countries (LMICs) had the same level of trauma care as that of the developed world.<sup>4</sup> While trauma care appears to be amongst the most crucial components of the training and education of the health workforce, majority of the published literature on trauma is from the developed countries. Literature from Pakistan is mainly focused towards service component<sup>3,5</sup> with minimal studies exploring the education and training needs.

This review paper focuses on one component of trauma care i.e. role of surgeons as members of the trauma team. The objective of this study is to summarize the published literature pertaining to trauma training and education in surgical residency programmes locally and internationally.

### Search Strategy

MEDLINE, PubMed, Google scholar and PakMediNet (for articles published in local journals) were searched using the keywords 'trauma education' or 'trauma training' AND 'surgery residency training', 'surgery residents' and 'surgeons'. The reference lists of identified papers were also searched for relevant articles. The search was further amplified by manual search of most relevant and accessible journals including but not limited to Journal of trauma and Injury, Injury, Trauma, Emergency Medicine

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journal, Journal of Trauma and Acute Care Surgery and Journal of Surgical Education.

## Results

The current review provides an overview of the published literature pertaining to training and education of postgraduate surgical trainees in trauma and critical care surgery. Additionally this review briefly outlines various components of trauma education, and suggests examples of educational initiatives taken globally that could be replicated or adapted to ensure capacity building of the existing human resource.

**Role of a Surgeon in Trauma Care:** Trauma is time-sensitive. Any delay in resuscitation or definite care, even of a few minutes, may mean the difference between life or death. While all health care providers are actively involved in managing trauma patients, it is the trauma surgeon who makes high stakes decisions, often in quick succession without knowledge of a patient's identity or history. In traumatic injuries, whether blunt or penetrating, role of a trauma surgeon starts as soon as the patient arrives in the emergency room and this is because of the fact that there are several lifesaving procedures required to be performed in crash bay without taking any standard measures in better interest of a victim. These procedures may range from inserting airway surgically when oral endotracheal intubation fails, to emergency room thoracotomy for controlling exsanguinating haemorrhage or performing open cardiac massage in setting of a recent penetrating trauma.<sup>6</sup> Additionally, trauma surgeon is often asked to perform immediate life or limb threatening procedures such as chest decompression after tension pneumothorax, preperitoneal packing or external pelvic fixation in ongoing haemorrhage, or limb fasciotomy for compartment syndrome.<sup>7</sup> Moreover there are several surgical procedures that need to be performed immediately after resuscitation. For example, a trauma surgeon should be well trained in doing emergency burr hole for evacuation of intracranial haematoma. Similarly one should be competent in performing an emergency laparotomy for control of bleeding and contamination and stabilization of extremity fractures.

Beside the key role as team leader and decision making person, the trauma surgeon has to possess excellent communication and administrative skills to keep the situation under control especially in chaotic situations like multiple patients from same family or community with extensive injuries.<sup>8</sup>

The responsibilities of a trauma surgeon continue in post-

operative period as well. Once patient is out of danger, better rehabilitation is also responsibility of a primary trauma surgeon who takes support of ancillary staff and other medical personnel like psychiatrist, home healthcare provider etc. till a victim reaches his/her pre injury health status, which may not be possible in case of irreversible injuries.

**Current status of trauma training:** Literature has identified limitations in general surgery training both at undergraduate and post graduate levels. The undergraduate curriculum is inadequate in terms of trauma management. Many critical concepts are not formally taught and practical experience with many basic procedures is often lacking. A study conducted in 77 countries from different economic strata showed variation in trauma education and experience among medical students, stressing the need to strengthen the trauma care training received by medical students globally.<sup>9</sup>

At post graduate level, trauma surgical training has been identified as the core competency of general surgery residency. However, opportunities to teach trauma-specific surgical skills during surgery residency training have gradually decreased overtime, owing to:

**1. Change in the trauma epidemiology:** Studies have reported changing pattern of trauma over the years and across regions. For example the incidence of penetrating trauma has decreased globally by approximately 60% during this decade, with an increase in RTA and terrorism related injuries.<sup>1,10</sup>

**2. Change in the management of traumatic injuries:** The changes in management modalities have resulted in transformed surgical resident experience with more weightage on non-operative management with a relatively low number of procedures, little experience with diagnostic peritoneal lavage (DPL), and highly variable experience with ultrasound.<sup>11</sup> Replacement of open haemorrhage control procedures with non-surgical radiological balloon occlusion and embolization, has reduced general surgery residents' opportunities to perform emergency open surgical haemorrhage control procedures. The efficacy and resolution of computerized tomographic scanning has led to an entirely new field of non-operative trauma management for blunt trauma affecting major abdominal organs thus reducing the need for exploratory laparotomy. All these changes in management have benefitted the trauma patient and have greatly contributed in reducing the magnitude of trauma related disabilities. But at the same time, they have also significantly reduced the experience of surgical

residents in performing open abdominal surgery and decreased the breadth of experience they require for multiple disease processes.<sup>12</sup>

**3. Change in the volume of trauma cases requiring operative interventions:** Although performance of a specific number of surgical procedures do not guarantee competence of a developing surgeon, certifying and accrediting bodies mandate the minimal requirement of surgical residents' exposure to trauma patients and case mix. Institutes have raised concerns over the volume of operative cases and bedside procedures necessary to ensure trauma related competence in general surgery residents. According to general surgery residents, there has been a dramatic decrease in the number of injured patients requiring general surgical intervention thus reducing their opportunities for exposure and training.<sup>13</sup> The Orthopaedic surgeon is often the first person to be called in cases of accidental trauma, followed by vascular and neurosurgeons. Similarly cases of burns, chemical injury or electrocution, are usually dealt by the plastic surgeons. The general surgeons are only called when abdominal/thoracic or vascular trauma is suspected or in cases of penetrating injury that contribute only to 7-8% of total trauma call patients. Even in centers with majority of blunt trauma, operative procedures in orthopaedics, neurosurgery, plastic surgery, and other specialties involved in the care of trauma patients outnumber general surgical procedures, thus creating an unwanted need to compete with other surgical specialties.<sup>7</sup>

**4. Restrictions on work-hours for residents:** The Accreditation Council for Graduate Medical Education (ACGME) implemented the 80-hour work hour policy for residents. This restriction has also adversely impacted the surgical residents' education and experience in surgical critical care (SCC) and trauma.<sup>6</sup>

**5. Undefined curriculum for trauma surgery:** The current operative list for which "the graduate must be competent to independently perform these procedures" includes multiple trauma operations: surgical airway; surgical exploration of penetrating neck injuries; resuscitative thoracotomy; trauma laparotomy including exploration of retroperitoneal haematomas; and damage control surgery for massive intra-abdominal haemorrhage or multiple intra-abdominal injuries". Additionally the graduating surgeon must be able to take the role of trauma team leader.<sup>15</sup> There are no specific ACGME requirements for rotations in SCC, trauma, and burn in a general surgery residency programme and the experience of general surgery residents in these core rotations have been reported to be greatly variable across centers and regions.<sup>16</sup> Studies have reported no or

minimal experience of recent surgery graduates entering fellowship programmes in non-operative management of severe poly-trauma cases, performing trauma laparotomy independently, or fulfilling the role of trauma team leader (TTL).<sup>14</sup>

**6. Declining interest in trauma as a discipline:** Decreasing operative opportunities in trauma care has negatively affected career satisfaction among trauma surgeons, thus resulted in declining interest of the surgical trainees' in pursuing trauma as career. According to a study majority of the residents perceived trauma surgery as unappealing mainly due to lifestyle, poor reimbursement, and limited operating room exposure.<sup>16</sup>

#### Trauma training in Pakistan:

In Pakistan trauma care is in infancy and trauma training is minimal. At undergraduate level medical students are exposed to trauma patients during their surgical clerkships, but there is no structured curriculum in trauma.<sup>17</sup> At postgraduate level, trauma related experience is very opportunistic; surgery residents learn about trauma, on the job during on calls in emergency rooms, and this varies across programmes because of variability in volume, case mix and expertise of the attending/ trauma surgeon available. Although College of Physicians and Surgeons of Pakistan (CPSP) has been accredited by the American College of Surgeons to administer the Advanced Trauma Life Support (ATLS) program, it has not yet been made mandatory for all surgery residents across the country.<sup>18</sup> Few institutes although offer a 2 year fellowship in trauma but these are unfortunately not recognized by the CPSP.

### Recommendations

#### Components of a Trauma Curriculum:

Ideally the curriculum of trauma education especially to surgical residents should address all those essential skills which they are expected to exhibit while managing trauma patient. These include acquisition of adequate knowledge about principals of trauma management, and proficiency in necessary skill set to perform lifesaving interventions. Furthermore good communication skills, administrative capability, professionalism, team work, leadership qualities, ethical considerations and exhibition of empathy are other crucial aspects for a trauma surgeon. Once these essential competencies to become good trauma surgeons are identified, curriculum should be designed in a way that by the end of surgical training, resident must acquire all these necessary set of skills to be called a safe trauma surgeon.

**At Undergraduate Level:** Studies suggest that teaching about a trauma patient should start at undergraduate level. Trauma Evaluation and Management (TEAM), is a low cost course designed by American College of Surgeons for young inspiring medical students as alternative to ATLS.<sup>19</sup> It provides basic insight into trauma, and is now a mandatory exercise for medical students who are about to graduate at various medical schools in US.

**At Internship Level:** A house surgeon must be a basic life support (BLS) provider and should play active role in perioperative management and documentation of trauma patients.

**During first 2 years of Surgical Residency:** Although much have already theoretically learned at student and internship level regarding basics of trauma and its implication, better understanding of trauma comes during surgical residency training. Advance trauma life support course (ATLS) by American college of surgeons is now included in most residency curricula for junior surgical residents.<sup>18</sup> Moreover encounter with trauma patients on activation of trauma rush call provides an enhanced insight into traumatic injuries.

**At Senior Level:** Senior resident or a chief resident are the backbone of any trauma team, and in these last years of their surgical training they should have attained the art and science of estimating traumatic injuries, and performing immediate resuscitation and stabilization.

**Fellowships in Trauma and Critical Care:** Development of Fellowships in Trauma/Critical care or Acute Care Surgery, based on the foundation of general surgery, have been suggested as a means to imparting all skills necessary in definite management of trauma patients along with critical care thus addressing the issue of shortage of trauma surgeons.<sup>20</sup>

**Continuing Medical Education (CME):** Continuing medical education and/or continuing professional development have proved effective in imparting knowledge and skills in health care professionals and are a common means for addressing the gaps. Trauma symposium, workshops, courses and outreach programmes in community gives a platform for a trauma surgeon in continuous medical education and research.<sup>21</sup> These not only improve clinical knowledge thus improving outcomes in trauma patients but also benefit participants' host institutions in terms of infrastructure and human resource development.<sup>22</sup>

### **Possible solutions for the forthcoming challenge:**

The increasing need for skilled emergency surgical providers, coupled with decreasing experience in emergency surgery among trainees, has resulted in identification of various strategies that can be used as alternative for teaching trauma to surgery residents. Some of these have been discussed below.

**Technology:** With advances in medical education, technology has become the mainstay for teaching and learning of clinical and soft skills globally. In use in trauma education ranges from video review with debriefing for teaching team competencies and improving team function in simulated trauma resuscitation<sup>23</sup> to novel computer-based programmes and games for improving surgery residents' knowledge of anatomy, surgical incisions, exposures, and technique.<sup>24</sup> Teleconferencing with experienced surgeons in collaborating institutes and medical centres worldwide is yet another means by which technology can be used for real time guidance and capacity building of the local residents and surgeons.<sup>25</sup>

Simulation based trauma scenarios of increasing difficulty such as "Surgery for Abdomino-thoracic Violence (SAVE)" has been shown to be effective in improving diagnostic and experiential skills to effectively recognize and manage potentially life-threatening and complex penetrating injuries.<sup>26,27</sup> In addition to teaching the technical skills, simulation have also been well established as a strategy to develop leadership, team information sharing, communication, and decision-making skills, and enhancing relational and cultural aspects of trauma care. The advanced human patient simulators have been shown to significantly improve teamwork and clinical performance of multidisciplinary trauma teams and ability of surgical residents to assume the role of team leaders in the trauma resuscitation rooms.<sup>28</sup> A team-based trauma course with immersion in a realistic environment has been suggested for improving team performance in trauma resuscitation.<sup>29</sup> A trauma curriculum incorporating simulation shows promise in developing crisis management skills that are essential for evaluation of critically injured patients for both undergraduate and postgraduate students.<sup>30</sup>

**Workshops and Short courses:** While didactic sessions have long been used to teach principles and guidelines of trauma management, hands-on workshops using human and animal tissues and/or cadavers are effective in teaching surgical exposure of anatomic structures that, when injured, may pose a threat to life or limb.<sup>22</sup> Combined live tissue and simulation-based training has been shown to add value to the teaching and learning

activities related to trauma.<sup>31</sup>

Short courses ranging from 1-2 days to a week also play an effective role in enhancing the knowledge and skills for trauma management. An intensive one-day interdisciplinary boot camp for interns significantly improved basic trauma knowledge, and self-reported confidence in leadership and role delegation, team work, and performance of primary and secondary surveys.<sup>32</sup> Some postgraduate programmes have also mandated certain courses or rotations in trauma units or national trauma centers as an essential part of the basic surgical training promoting trauma and Acute Care Surgery, TEAM and ATLS being few of them.<sup>19</sup>

### Collaboration and Interprofessional Education:

Literature also suggests multi-professional and inter-professional education to teach the knowledge and skills to perform specific role tasks as members of a team, as well as the interactions and processes rooted within these tasks in a team.<sup>33</sup> National and international collaborations with high volume trauma centers can play a vital role in training of the health professionals in traumatic injury management and trauma team dynamics.<sup>34</sup> International rotations at high volume surgery and trauma centers have been identified as a valuable tool to supplement operative and educational experience of the residents and fellows in acute care, trauma and SCC (PDs).<sup>35</sup> These trained fellows and trauma surgeons can then serve as master trainers to develop human resource locally, especially at primary care set ups. Collaborations like these have been shown to be sustainable and effective in establishing centers of excellence and developing or restructuring trauma care systems, thus reducing trauma related mortality and morbidity in low and middle income countries.<sup>34</sup>

### Conclusion

This review paper has identified the deficiencies in the trauma related training and education in postgraduate surgical education and the factors responsible, and has suggested different strategies used in different developed and developing countries that could be replicated as such or after contextual adaptations to address this issue. The estimated increase in the burden of the trauma related injuries in coming years warrants a multifactorial concerted effort to equip our surgeons with the essentials of knowledge and skills required to adequately manage trauma cases thus reducing resultant mortality and morbidity.

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