Anaesthesia 2015, 70, 893–906

Editorial

ATLS: Archaic Trauma Life Support?

No one could have imagined that when a light aircraft crashed in rural Nebraska in 1976, the nature of global trauma management would be forever altered. James Styner, an orthopaedic surgeon, was piloting the plane in question and the accident resulted in the death of his wife and serious injuries to himself and his four children. The standard of care that he and his family received in the local hospital in the aftermath of the crash so horrified Styner that he decided to establish a new system for the management of major trauma. Lincoln Hospital, Nebraska, had already developed the foundations of the Advanced Cardiac Life Support (ACLS) course and utilising the same pedagogical principles, a course was designed to 'educate rural physicians in a systemic way to treat trauma' [1]. A pilot course was run in Nebraska in 1978, and by 1980, the Advanced Trauma Life Support (ATLS) course had been adopted by the American College of Surgeons and was taught throughout the USA, reaching the UK in 1988. Courses are now run globally, with over one million candidates trained in 60 countries [2].

There is no doubt that the ATLS course principles added some much needed structure to the initial management of multiply injured patients. Before the well-known 'ABCDE' stepwise approach, trauma patients had been managed similarly to general medical patients, with a focus on history and examination before any intervention. This was particularly important in trauma management before the advent of major trauma centres (MTCs), with immediate management provided in multiple different regional hospitals. As a result, care was often provided by junior doctors from a variety of specialties, with varying levels of relevant experience and only infrequently working together as a team. ATLS brought a common language to the management of trauma and highlighted the importance of immediately dealing with life-threatening conditions, as part of a standardised, systematic protocol.

The ATLS manual is now in its ninth edition [3], but over the three decades since its incarnation, trauma management within the UK has changed radically, primarily as a result of the establishment of MTCs [4]. The UK now has a network of hospitals providing expert and predominately consultant-led trauma care on a 24-hour basis. The provision of advanced pre-hospital care is being expanded [5] and the lessons learnt by the military medical services during recent conflicts are being translated into civilian practice [6–8]. In the context of this rapid and continual evolution of trauma care, how relevant is the ATLS course in the 21st century management of major trauma?

Despite the global acceptance that the ATLS management principles appear to represent a gold standard in trauma management, there are few data that suggest ATLS training has meaningfully reduced trauma-related morbidity and mortality in the developed world. A Cochrane meta-analysis [9] examined 2007 citations in order to assess the effect of ATLS training. The authors were unable to identify any randomised control trial with morbidity or mortality as an outcome measure, with the only five relevant studies focusing on acquisition of knowledge and retention of skills. As a result, they concluded that there was no clear evidence of benefit for ATLS training and that future research should be in the form of a sequential, before–after design in a healthcare system where ATLS is not currently in use. A review by the same group on ATLS training for paramedics came to an identical conclusion [10]. Previous work has focused on the impact of ATLS in developing countries [11–14], countries without formal trauma management systems [15, 16], or institutions that admit low numbers of trauma cases [17–19]. In addition, the medical participants recruited in such studies are

Table 1 Trauma management practices in the UK versus those recommended in the Advanced Trauma Life Support (ATLS) manual (9th edition) [3].

Intervention	ATLS guidelines	UK trauma practice
Tranexamic acid administration	Not mentioned	1 g load as soon as possible, with 1 g subsequently over 8 h [27]
Damage control resuscitation	Initial bolus of 1-2 litres of warmed crystalloid and response assessed. Packed red cells and blood products in those with class-3 or -4 shock, i.e. only those who are transient or non-responders to a crystalloid bolus	Variations on models developed by the military, with the early use of packed red cells, coagulation factors and platelets in predefined ratios, restricted intravenous fluid administration and permissive hypotension [8, 28]
Coagulation monitoring	Use of coagulation factors should be guided by prothrombin time, partial thromboplastin time and platelet count. No mention of point-of-care testing	Plasma-based tests recognised as being unlikely to be helpful in the early management of acute traumatic coagulopathy [29]. Viscoelastic point-of-care testing preferable [28] and utilised by many centres
$PaCO_2$ in traumatic brain injury	Target 'around' 4.67 kPa, but acceptable range of 4.67-6 kPa	$PaCO_2$ of 4.5-5.0 kPa as per Association of Anaesthetists of Great Britain and Ireland recommendations [30]
Springing of pelvis to test stability	Can be performed once in the absence of shock or an obvious pelvic fracture	Due to the low probability of gaining useful information and risk of clot disruption and bleeding, clinical assessment is not recommended, with radiological investigations preferred [31]
Evaluation of abdominal trauma	Focused assessment sonography in trauma (FAST) or diagnostic perinoneal lavage (DPL) preferred to computed tomography (CT)	Whole-body CT is the initial investigation of choice in polytrauma cases [32]

often either doctors in training or medical students [20, 21]. There are no data examining the value of ATLS training within a highly evolved, consultant-delivered trauma management system, making it difficult to assess the value of ATLS in current UK trauma management.

The expectation that any educational course could meaningfully reduce morbidity and mortality may be somewhat unrealistic. The heterogeneous nature of trauma patients' injury patterns and demographics, and the variation in management systems and protocols in admitting hospitals, are likely to have such confounding effects on outcomes that it would be impossible to assess the effect of ATLS training in isolation. Advocates of ATLS training will point out that the course primarily aims to improve knowledge and skills relevant to trauma care and to a degree, this has been demonstrated. A systematic review in 2014 concluded that ATLS teaching resulted in initial improvements in candidates' knowledge and technical and non-technical skills [22], and although cognitive and skill levels decline over time [23, 24], this can be partially attenuated by regular clinical exposure to trauma cases [25, 26].

The educational benefits of ATLS, however, are only going to be realised outside the confines of the course if the knowledge and skills obtained are relevant and applicable to clinical practice; it is this aspect of ATLS that I believe limits its usefulness in the management of UK trauma. ATLS was designed to teach the *single-handed* rural practitioner, who infrequently manages trauma, a systemic approach to management. This is the reason for the strict sequential ABCDE approach, rather than the multisystem assessment by several clinicians that is typical in UK resuscitation rooms. In addition, the principles and skills taught do not reflect management of polytrauma within UK MTCs. There are numerous differences between the most recent ATLS guidelines, published in 2012 [3], and standard UK clinical trauma care (Table 1). Most notable, perhaps, is the inclusion of diagnostic peritoneal lavage; this investigation has been superseded by the use of CT, which has become a standard of care in the initial management of trauma, even in the pres-

ence of haemodynamic instability [33].

The challenge of how to keep course content up-to-date in the face of rapidly evolving clinical practice is not limited to ATLS [34]. However, despite revision of the manual on a 4-5 year cycle, ATLS has perpetuated several theories that have been included in numerous publications and lectures despite evidence to the contrary. The so-called 'golden hour' and triphasic distribution of trauma deaths do not appear to exist as a clinical phenomenon [35, 36], and the ATLS classification of shock is not applicable to real-world patients [37, 38]. The fixed, didactic nature of ATLS management principles compounds these problems. Each UK MTC has developed its own protocols for trauma management, based upon the local population, pre-hospital care services, incidence of type of trauma (blunt vs penetrating) and the availability of in-hospital specialties. For example, an injury that is managed surgically in one centre may be treated using interventional radiology in another. Similarly, some MTCs will administer targeted blood component therapy using point-of-care testing, whereas others will use traditional laboratory tests or predetermined ratios of coagulation factors and red cells. The common theme is the tailoring of the clinical management to the resources and skill mix available within that institution and few (if indeed any) will still be using ATLS principles as the basis for trauma care. Despite this, ATLS certification remains a requirement for the completion of specialist training in emergency medicine and most surgical specialties, in addition to appearing as either an essential or a desirable criterion for many consultant posts involving trauma care.

So how should we teach the management of major trauma, given the challenges posed by a heterogeneous population and injury pattern and the variation in specialist skills amongst MTCs? I would argue that the central facet of optimal trauma care is teamwork. Teams perform better than individuals working in isolation, especially when a task is time-critical, requires a variety of skills, and demands decisions based on judgment and experience [39]; this is the very nature of trauma management. However, effective teamwork cannot be achieved by simply bringing a group of trained individuals together: a team of experts does not make an expert team [40]. Ensuring all members of a trauma team are ATLS certified will not guarantee that the team performs at a high level. Teams require training in both task completion and teamworking. The latter aspect primarily involves non-technical aspects of care and necessitates the development of skills in leadership, communication, adaptability and goal alignment [41]. Such training improves processes and can result in an improvement in delivered clinical care [42]. The introduction of trauma teams may reduce mortality, especially in those most severely injured [43]. Multiprofessional team training has not, however, been associated with reductions in mortality or morbidity, although improved team efficiency has been demonstrated, with reductions in the time needed for tracheal intubation and transfer to CT [44].

The most effective way of providing trauma team training has yet to be determined, with video analysis and high-fidelity simulation having been used successfully [45]. Simulation offers the advantage of allowing the entire multiprofessional team to participate in scenarios that can be tailored to their institution's unique population and management protocols. This individualised training and opportunity for deliberate practice must be more cost-effective than routine attendance at ATLS courses, to be taught management principles that will subsequently never be used. More recent courses, e.g. the Anaesthesia Trauma and Critical Care Course (see http://www.atacc.co.uk/) and European Trauma Course (see http://www.europeantrauma.com/), place greater emphasis on the importance of management principles and teamworking than on dogmatic treatment strategies.

So what direction should trauma training take in the future? I would suggest the following:

1 Treat ATLS as a 'basic' trauma course, with attendance limited to junior medical staff with no trauma experience. Candidates will learn the common language and vocabulary of trauma management, which will be of benefit when they subsequently attend trauma calls in clinical practice. In the developing world, where resources and personnel are

limited, ATLS will continue to have a role.

2 Stop routine recertification of ATLS for individuals experienced in trauma management. Given the high cost of these courses (~£600 (€825; $918) for certification and £350 (€482; $535) for recertification) this practice will account for a significant proportion of an individual's annual study leave budget. This time and money would be better invested in developing enhanced leadership, communication and teamworking skills.
3 In line with the Royal College of Anaesthetists, remove ATLS certification as a prerequisite for the completion of training in surgery and emergency medicine. Instead, focus on ensuring adequate experience in the management of major trauma.
4 Similarly, for consultant posts that include trauma management, remove ATLS certification as an appointment criterion. Evidence of experience in trauma management, alongside formal training in leadership and/or human factors, would be of greater relevance.
5 Require regular team-training sessions for MTC staff, either by video review or utilising simulation, ideally within the team's usual working environment. This would allow training to be institution-specific, with the potential to refine protocols and undertake focused debriefs of recent cases.

When introduced almost 40 years ago, ATLS represented the cutting edge of trauma management; unfortunately, the course has failed to evolve at a pace that allows it to be relevant to the care delivered in modern MTCs. This course without doubt revolutionised trauma care, but it should now be reserved for use in isolated rural centres or environments where trauma is managed infrequently and with limited resources. The King is dead, long live the King!

Competing interests

No external funding and no competing interests declared.

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doi:10.1111/anae.13166

Editorial

Training and assessment of non-technical skills in the operating theatre: where next?

The importance of human factors and non-technical skills in the management of emergencies was initially recognised by the aviation industry as a result of retrospective analysis of catastrophic accidents [1]. The concept that major errors resulted from poor non-technical skills rather than the lack of techni-

