EDITORIAL

TRAINING FOR WAR: TEACHING AND SKILL-RETENTION FOR THE DEPLOYED SURGICAL TEAM

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In Afghanistan and Iraq in 2008 the daily surgical workload can be enormous with the surgical case-mix involving skills out with those of the normal NHS Consultant [1-8]. The historical priorities of the Defence Medical Education and Training Agency (DMETA) - now the Joint Medical Command (JMC) have been of elective secondary care provision to the pre-deployment military force. This imperative may not now be compatible with the acquisition and maintenance of the necessary deployed trauma skills for asymmetric war. Table 1 outlines the suggested skills that the deployed team should possess [9]. It is probably impossible now for a single surgeon to possess every surgical skill required: Two surgeons are a minimum requirement but three may now be optimal. The question remains however as to how best to train our surgeons for the application of these skill sets, given that they may be breast surgeons no longer on a general surgical on-call rota or a hand or plastic surgeon. Surgical training courses such as the Definitive Surgical Trauma Skills Course (DSTS) run by the Royal College of Surgeons of England are vital. These are now seen as an almost mandatory part of pre-deployment training, but it is unclear whether these two to three day intensive courses are effective – and if they are, for how long the skill sets are retained.

Between 2003 and 2006, 38 surgical teams from 21 hospitals have participated in a total of ten 'Damage Control Surgery' courses in Norway. Surgeons, anaesthetists and operating room nurses from each hospital performed as single teams throughout the interactive lectures and operative sessions. Although surgical skills were taught, there was also considerable emphasis on communication, collaboration and team-based problem solving. Ninety nine percent of participants reported a dramatic increase in their proficiency with damage control techniques, particularly the vital military skills of extra-peritoneal pelvic packing and emergency thoracotomy; 94% felt that this team-based approach was crucial to improving patient outcomes. Importantly, a later telephone survey revealed twelve cases of lifesaving damage control surgeries in a rural setting, subsequently performed by course participants. Taking overall course costs into consideration, this equated to $15,075 per life saved [10].

Motor skill learning principles are founded mostly in the domains of psychology and athletics. There is good evidence that 'distributed practice' – that is practice interspersed with periods of rest leads to both better acquisition and retention of skill when compared to 'massed practice' – that is practice delivered in a continuous block with little or no rest in between [11]. In tests in animal vascular labs, surgical trainees improved immediately in both learning groups with identical time spent on the learning process. Retention testing at one-month showed the massed group produced significantly worse results in all domains (global rating, checklist score, final product analysis and most worryingly – operating theatre competency). In the 'massed group' who performed an aortic anastomosis, 3/19 tore the vessel beyond repair and were unable to complete the anastomosis, whereas the entire 'distributed group' completed the task. This difference although not statistically significant, has obvious clinical implications.

The reason is probably due to 'Consolidation of Learning' [11]. Two phases occur during the learning of a new skill or behaviour – within the session and afterwards. In each phase, different brain regions become activated, each considered necessary for relative permanent retention of that skill. Distributed practice multiplies this cycle. It also allows for repeated cognitive preparation and mental rehearsal. These are both considered key factors in the performance of surgical procedures. Having to retrieve from memory (multiple times) key aspects of any skill, more deeply encodes that particular skill into memory. Top-up courses are therefore necessary when the learnt skill is not used routinely.

Hardwiring of skills, that is permanent competent skill retention is often claimed to eliminate skill-fade, manifest as a flawed personal belief that even if a long period has ensued between performing a motor task and repeating it , that this skill is usefully retained. There is little evidence to support this, and aviation regulations strongly reject this supposition. A recent report from the Canadian Air Force showed that there was a relatively strong relationship between decreasing flying hours and what were euphemistically called 'increasing personnel-related cause-factor rates' [12]. This was especially worrying as C-130 transport aircraft pilots were among those most specifically implicated in near/accident causation. This decrease in proficiency became most apparent after 1996 when it was clear that flying hours had fallen below a certain ('safe') critical skill retention threshold.

Surgeon volume, and by direct inference – task repetition, should then be a viable marker of proficiency when matched against operative mortality. A study of 474,108 patients undergoing one of eight major cardiovascular procedures or cancer resections between 1998 and 1999 showed a clear and highly significant inverse relation between volume and mortality [13], but the numbers of procedures involved do not need to be high. For pancreatic cancer resection, low volume was defined as <11 procedures per year and high volume was >11 per year; however the difference in the adjusted odds ratio for operative death was highly significant between the groups: A 3.61 times higher chance of death when operated on by a low volume surgeon. This effect was seen regardless of the surgical volume of the hospital in which the surgery took place. Surgeon volume is similarly important in trauma where the odds ratio of dying when taken to a Level II Trauma Centre are 1.14 times

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higher than when compared to a Level I Centre and 1.17 times higher when compared to a Level III centre – a highly significant effect [14].

It is therefore necessary to accept that we must reinforce those skills that are outside the NHS remit and comfort zone of our deploying surgeons. We cannot accept on-deployment learning curves. We do not have the volume of penetrating trauma or blast injury in the United Kingdom to rely on day-to-day experience to gain and retain these skills. Currently only one-third of UK general surgical consultants feel adequately prepared to manage acute cardiothoracic injuries. The median number of trauma laparotomies undertaken annually by a UK consultant is 2 for blunt injury and 1 for penetrating injury. Of current UK Specialist Registrars, 21% have not performed a splenectomy for trauma and 44% have no experience of packing for liver trauma [15]. Longer-term attachments to overseas trauma centres are needed and must include the whole deploying team; surgeon, anaesthetist, scrub nurse and operating department practitioners so they train together. Some training can take place within a simulation environment (Hospex), but after this initial training on junctional, pelvic and torso trauma management, repeated refresher courses will be necessary fulfilling the tenets of distributed practice. Specialist Registrars will need to be deployed to Afghanistan and Iraq as part of their formal surgical training continuum without loss of training recognition.

In summary, isolated military surgeons practising in austere circumstances will encounter multiply injured patients with high-energy-transfer fragment, projectile and blast wounds requiring an assortment of damage control and definitive operative competencies unparalleled in civilian practice. These demanding surgical interventions are best delivered by well-trained, NHS current, trauma-competent, consultant-led surgical teams. Ensuring that our military surgical teams continue to be adequately trained remains a priority for our surgical trainers, the Academic Department of Military Surgery and may present a funding dilemma for JMC.

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A suggested Surgical Team Skill Set
Aortic cross-clamping during resuscitative laparotomy (Thoracic or abdominal)
Simple ligation of any major vessel tear
Liver laceration packing
Small intestinal perforation stapling
Colonic perforation control with terylene tape
Arterial injuries shunted/ligated + fasciotomy/cooling
Venous injury ligation or repair
Bladder ruptures catheterized and drained
Pancreatic bed leaks multiply drained
Peritoneal soilage copiously irrigated and contained
Abdomen temporarily and/or rapidly closed
Visceral compartment syndrome treated with plastic sheet or iv-fluid bag closure (Bogota Bag)
Rapid emergency thoracotomy
Non-anatomically stapled lung resection
Pulmonary tractotomy
Circum-hilar rotation for lung haemorrhage control
En-masse lobectomy
Skin staple closure of cardiac wounds
En-masse closure of chest wall muscles
Patch closure of thoracic wounds (using an iv fluid bag)
Intracranial bleeding - emergent arrest and control
Adequate early exposure via 4-into-1 burr hole technique
Intracranial haematoma evacuation/limitation of contamination
CNS superficial bone/metal fragment removal
CNS infection control using early antibiotic therapy
CNS infection prevention with primary dural and scalp closure
Post-surgical swelling control with decompressive craniectomy
Femoral fracture control with rapid unilateral frame external fixation or Thomas splint
Unstable pelvic ring # - pelvic binding or external fixation +/- pelvic packing
Junctional zone bleed control with urinary catheter tamponade
Articular fracture temporization with bridging external fixator
Rapid Amputation - decision making and performance
Fracture reduction with approximate alignment
Pin site skin tenting prevention with wide skin incisions
Soft tissue damage - rapid primary debridement with physiological control
Contamination minimized by high-volume fluid lavage
Musculoskeletal infection control using early appropriate antibiotics
Compartment syndrome prevention - wide area fasciotomy
Soft tissue coverage temporary dressing
Primary wound management with vacuum drainage packs ('Vac')

Table 1. A suggested Surgical Team Skill Set