Tele-mentored damage-control and emergency trauma surgery: A feasibility study using live-tissue models

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ABSTRACT

Background: Damage-control and emergency surgical procedures in trauma have the potential to save lives. They may occasionally not be performed due to clinician inexperience or lack of comfort and knowledge.

Methods: Canadian Armed Forces (CAF) non-surgeon Medical Officers (MOs) participated in a live tissue training exercise. They received tele-mentoring assistance using a secure video-conferencing application on a smartphone/tablet platform. Feasibility of tele-mentored surgery was studied by measuring their effectiveness at completing a set series of tasks in this pilot study. Additionally, their comfort and willingness to perform studied procedures was gauged using pre- and post-study surveys.

Results: With no pre-procedural teaching, participants were able to complete surgical airway, chest tube insertion and resuscitative thoracotomy with 100% effectiveness with no noted complications. Comfort level and willingness to perform these procedures were improved with tele-mentoring. Participants felt that tele-mentored surgery would benefit their performance of resuscitative thoracotomy most.

Conclusion: The use of tele-mentored surgery to assist non-surgeon clinicians in the performance of damage-control and emergency surgical procedures is feasible. More study is required to validate its effectiveness.

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1. Background

Damage control and emergency surgical procedures for trauma are potential lifesaving maneuvers that often are not completed due to first responder or primary care provider’s lack of knowledge, experience or comfort. Tele-mentored surgical skills have been examined in several settings and demonstrated encouraging results.1,2 We sought to examine the feasibility of tele-mentoring non-surgeon operators in effectively performing some of the lifesaving interventions as described by Gerhardt et al.3 such as surgical airway and chest tube insertion. Given the possible correlation between injury-to-procedure time and survival4,5 in emergency thoracotomy, this procedure was also included in the study. We also examined whether tele-mentoring improved non-surgeon confidence and increased willingness to perform these tasks in an otherwise unsupported setting.

2. Methods

Tele-mentored damage-control and emergency trauma skills were studied using a porcine live tissue (LT) model. Ethics approval was obtained through our institutional Ethics Review Board and all animal research protocols were followed in accordance with our research center standing orders. Participants were drawn from a pool of candidates on the Canadian Armed Forces (CAF) Advanced Military Trauma Resuscitation Program (AMTRP) course. AMTRP candidates consist of several military clinicians, including non-surgeon medical officers (MOs). Only non-surgeon MOs were asked to be participants given the limited number of live tissue models. Participants received no pre-study training in order to closely mimic an emergency situation that requires performing an unfamiliar procedure or one that may have suffered the effects of
skill fade due to a prolonged interval since last practiced. They were briefed on the nature of the study on arrival at the lab, provided informed consent, then performed the described procedures with tele-mentored assistance. This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

The mentoring surgeon (PD) and operators communicated using iPad2 tablets running Reacts Lite™, a secure videoconferencing app (v.2.4.5.10, Innovative Imaging Technologies, Inc., Montreal, QC). This allowed the mentor real-time supervision capability and the ability to guide the procedure using verbal instructions along with a virtual pointer overlaid on the surgical field. The mentors and the mentees had no pre-existing relationship.

2.1. Participants

Two of our participants were FRCP (5-year training program) emergency physicians while the other two were general practitioner/family physicians, one with the one-year emergency medicine designation; technical difficulties (no signal was available in his portion of the laboratory) were experienced with the latter and he was therefore unable to participate. He was not included in the survey as he was not able to appreciate the effects of tele-mentoring. One physician assistant was also present for one of the MO’s procedures. He was in a strictly observational role and therefore did not complete the surveys.

2.2. Data collection

Three of the authors (PD, NG, MH) determined a set of criteria for all tele-mentored tasks. Certain of the criteria were considered critical and are described in Table 1. Scoring was recorded as a pass/fail grade based on a percentage of 50% or greater and all critical criterion being completed. Participants also conducted a pre- and post-procedure survey to gauge confidence and willingness to perform these tasks independently or with tele-mentoring using a Likert-score questionnaire. The questionnaire was created de novo by the corresponding author (PD). Specific questions included confidence and willingness to perform the procedure prior to participating in the study. Following the study and in order to gauge the participants’ perceived benefit of tele-mentoring, we asked their willingness to perform the procedures with and without tele-mentoring, as well as globally how beneficial they felt tele-mentoring was in this situation.

3. Results

3.1. Effective completion of tasks

After completion of each task, specimens were examined by PD to evaluate success of the procedure. All three observed participants completed their respective tasks successfully, meeting 100% of designated criteria, including all those deemed critical. These results are listed in Table 2. No complications were observed.

3.2. Comfort and willingness survey

Participants (MOs) were asked to complete a series of Likert scale surveys to gauge the perceived benefit of tele-mentoring in these tasks. Pooled data is listed in Table 3. Notably, there is modest improvement in their comfort level pre- and post-study. This could be a result of simply completing one procedure in a live-tissue lab. There appears to be more pronounced improvement in willingness to perform a resuscitative thoracotomy with tele-mentoring, likely due to the degree of difficulty and rarity of this procedure. Less benefit in terms of comfort and willingness were noted with surgical airway and chest tube insertion. Despite these results, all participants rated the benefit of tele-mentoring very highly with the mean score being 5/5 for all three procedures.

4. Discussion

CAF non-surgeon medical officers frequently deploy to remote locations. They may be employed as primary care providers working independently or within a larger facility with surgical resources. During deployed operations in Afghanistan and Iraq, resuscitative thoracotomy showed most beneficial in patients losing vital signs within the emergency department or following admission to hospital. One could extrapolate that the critical factor was time from loss of vital signs to intervention, and that pushing the procedural capability forward could increase survival. Chest tube insertion and surgical airway are skills taught on ATLS but can easily be associated with diminished knowledge and confidence if not frequently used. Trained surgeons represent a finite resource that is difficult to pre-position everywhere and it is impossible to predict the need for surgical intervention, particularly in low-volume environments such as low-intensity combat zones or rural settings. Non-surgeon clinicians tele-mentored by surgeons might be able to bridge the gap in emergent situations where transfer to a higher-level center cannot be done sufficiently quickly.

Moving this concept outside the military arena, tele-mentored surgery may lend itself to many applications. Firstly, it could be used in a similar fashion to that which was conceptualized in this study, assisting remote and rural non-surgical clinicians perform life-saving tasks. Additionally, it could be considered for surgeon-to-surgeon mentoring, such as for a junior surgeon within a ‘transit-to-surgeon’ program, a rural or remote surgeon faced with a complex emergency surgical case that is beyond his or her current scope of practice or even to proctor cases as a surgeon is working.

<table>
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<th>Participant</th>
<th>ED thoracotomy</th>
<th>Surgical Airway</th>
<th>Chest tube insertion</th>
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