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Video education in open trauma: a program for developing trauma surgical skills

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Abstract

Background Trauma surgery is characterized by high-acuity, low-frequency events. While trauma remains a leading cause of death and disability worldwide, surgical residents experience reduced trauma operative volumes during training. This paper highlights an important innovation for improvement of trauma surgery training: use of camera systems to record high fidelity video footage of open trauma cases.

Methods This paper describes the systematic approach of integrating video camera recording of open trauma surgical cases at the Sotero del Río Hospital in Santiago, Chile. Recording devices include both hand-held and head-mounted action cameras. We describe surgical team roles and responsibilities as well as workflow for patient consent, maintenance and management of recording equipment, and video storage and editing.

Results Our system of open trauma video recording has resulted in the largest video repository of emergent, high-fidelity trauma cases. Our video library contains over 1000 hours of video featuring over 250 independent operations and a broad variety of trauma cases.

Conclusions Successful implementation of an open trauma video recording program requires clearly stated roles and responsibilities, a shift in work culture, and full integration of video recording into a trauma system's existing workflow. Use of the appropriate handheld and head-mounted cameras offers the opportunity to seamlessly collect high quality video footage with minimal impact to the operating team. A large and diverse open trauma video repository allows surgical trainees to review novel cases, attending surgeons to review previous cases, and overall improvement of educational conferences and didactics. Surgical trauma video recording and postoperative review represents a viable, inexpensive, and highly transportable solution to the recent reductions in overall trauma caseloads for surgical trainees across the globe.

Keywords Trauma surgery, Surgical education, Educational technology, Video-assisted learning, Surgical techniques

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Background

Trauma surgery is characterized by high-acuity, low-frequency events. Trauma surgeons must be adept in the management of complex injuries even if they have not encountered those specific injuries in clinical practice. While trauma remains a leading cause of death and disability worldwide, surgical residents experience reduced trauma operative volumes during training [1–3]. This reduction in operative trauma exposure has sparked interest in alternative surgical training methodologies, including video recording of operative cases. Video recording of surgical procedures has long been utilized in laparoscopic, robotic, and elective surgery to improve surgical skills [4, 5]. Similarly, video recording has long been used for education and quality improvement in trauma bay resuscitation using fixed cameras in resuscitation areas [6]. Yet, the regular use of video recording has not transferred to trauma surgery, likely due to the challenges associated with recording high quality video of emergent, open surgical cases. As of January 2020, of the more than 2000 videos in the American College of Surgeons' video library, only 2 feature open trauma cases. In this article, we describe the development of a program to obtain high-quality videos of open trauma surgical cases for the purposes of education and quality improvement, based on the author's participatory experiences creating trauma surgical video content at the Sotero del Rio Hospital.

Methods

Aim

This descriptive study aims to highlight the innovative use of handheld camera devices to improve surgical education at a single trauma center in South America.

Equipment

Recording devices for trauma surgical procedures include both hand-held action cameras and smart glasses. A GoPro Hero4 camera, housed in a waterproof case to prevent damage, is used as the primary camera. The case is capable of rapid Ethylene Oxide sterilization between cases (Fig. 1). In lieu of the waterproof case, a sterile glove or ultrasound probe cover can be used, though poorer image quality should be expected. In addition to the handheld GoPro4, we commonly use a head-mounted fixed camera, such as the PivotHead Durango DUA85A0230. Finally, the primary operating surgeon may wear a GoogleGlass head-mounted camera system, which provides imagery from the perspective of the primary surgeon. In general, head-mounted cameras should be considered when video recording requires multiple angles or multiple surgical sites. The procurement and maintenance of devices and associated technology has been fully funded and supported by the personal resources of surgeons invested in this work.

Recording and workflow

Recording equipment is housed in a specified location in the trauma bay and accessed by the medical student or junior resident prior to the operative case. The medical student or first year resident scrubs into the case with the purpose of obtaining high-quality images of the procedure. The primary camera operator is instructed on proper use of the camera prior to entering the operating room. We have found that explicitly delegating responsibility to a junior team member streamlines efforts, allows the core operative team to focus on patient safety and the technical aspects of the surgery, and provides a sense of purpose and engagement for medical students. Trainee operative experience always takes priority over video recording; junior surgical residents and medical students are only assigned video recording duties if they otherwise



Fig. 1 (A) GoPro Camera Case Sterilized in Ethylene Oxide; (B) GoPro inside sterile ultrasound cover; (C) GoPro Camera in sterilized case, soiled after use

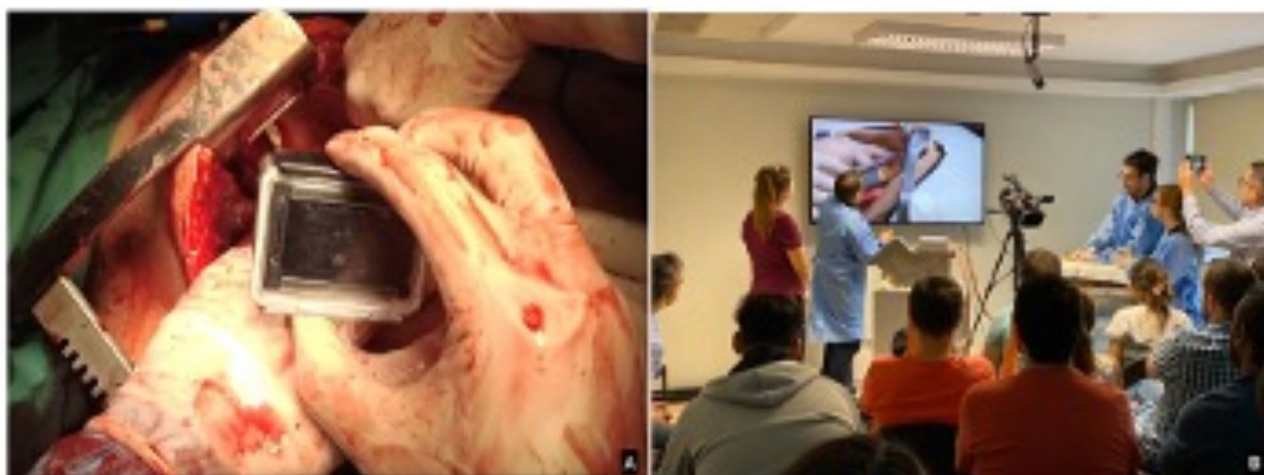


Fig. 2 (A) Video recording with GoPro in sterile case. (B) Use of trauma video at an interactive clinical meeting

would not be directly assisting in the operation. As a result, at our institution, the video program has not detracted from hands-on surgical training. When initiating a trauma video workflow, surgeons should consider how many and the seniority of trainees typically available during these rare cases and assign duties accordingly. Once recorded, video is downloaded immediately after the case onto a designated encrypted laptop. The video is edited to remove any identifiable patient information and unwanted video content. Often, the editing surgeon or other educator may include specific audio content (i.e. voice-over) during the editing process to highlight critical steps of the procedure. Typically, editing, voice-over, and final preparation of a single case video takes 45 minutes to a few hours, but this varies significantly based on the length and complexity of the case.

Sotero del Rio has also added video recording onto its standard hospital intake forms. Given the emergent nature of trauma procedures, this allows the team to focus on preparing for the operative procedure rather than the video consent process. During the postoperative period, patient consent or consent from an appropriate healthcare proxy is explicitly obtained prior to storage in the video library. Importantly, all videos are de-identified with all patient faces, tattoos, etc., blurred out or removed during the editorial process. Patients do not have access to these videos. The consent form signed by patients explicitly states that all images captured will be used exclusively for educational purposes. This routine consent process limits the chances of video content resulting in or informing legal action. While we did not experience major barriers working with our hospital's privacy office for internal use of video recordings for education, wider dissemination of our repository via a public streaming platform (such as YouTube or Vimeo) would require a more extensive approval process. Surgeons and

educators interested in launching similar video libraries should consult their institution's legal office and understand all local legal requirements. In addition, approval of a formal consent process and video repository dissemination plan with the appropriate institutional privacy office should be pursued upon initiating a trauma video program to prevent lengthy delays.

Results

This is, to our knowledge, the largest sophisticated, high-fidelity video repository of emergent trauma cases. Since 2017, we have recorded over 1000 hours of video featuring over 250 independent operations and trauma resuscitations. Video content has included over 100 cases of cardiac, thoracic and pulmonary lesions, 9 cases of pancreatic trauma, and 18 cases of peripheral vascular disease. Trauma video collected at Sotero del Rio has been used in morbidity and mortality meetings, in educational content for surgical residents and medical students, and in direct review by attending surgeons for self-improvement (Fig. 2). See Additional file 1 for an example video from a traumatic superior vena cava injury surgery.

Discussion

Recent trends in surgical training, including work hour restrictions, sub-specialization, and the increasing role of non-operative management, have reduced overall case exposure for surgical trainees. These trends have disproportionately impacted trauma caseloads due to operative trauma's inherently high acuity and low frequency. After adoption of the 80-hour workweek, general surgery residents across the United States have experienced declines in operative caseloads for thoracic, abdominal, solid organ, and extremity-vascular trauma [2]. Reduction in operative trauma exposure during training extends beyond the United States, with a recent study in Canada

finding variable and limited exposure to both operative and nonoperative trauma care across ten general surgery training programs [7]. Although most trauma caseload exposure occurs while on-call, both legal and physical limitations restrict trainees from further expanding on-call time during residency and fellowship training. In light of this reduction in trauma exposure for surgical trainees, adoption of adjunctive forms of trauma education has become increasingly important. Surgical video recording provides an effective platform for surgical education by providing a step-by-step guide to a procedure with accompanying real tissue visualization from the perspective of the operating surgeon. Through video education, trainees receive exposure to both common and rare surgical procedures without additional call.

Trauma residents and fellows at Sotero del Rio benefit from this large video repository during Morbidity and Mortality (M&M) and educational conferences. Through informal satisfaction surveys, trainees report benefiting significantly from this resource. The quality of our educational conferences has improved, and trainees cite a positive impact on their personalized surgical skills by reviewing challenging cases and infrequent scenarios. To date, we only have this subjective data to report on educational improvement. Future research is needed to objectively measure growth of resident surgical skills and decision making. Currently, videos are only utilized during regularly occurring M&M conferences. Trainees do not access nor search the database outside of this scheduled time. However, our planned future efforts include expanding this use case to allow for review during personal time. Next steps include providing open access to the video repository for trainees and digitally formatting the video library in a way that is logically categorized by case type and easily searchable. Given that the video program is lead and monitored by busy trauma surgeons who volunteer their time, expansion of the project has been slow. We will consider hiring an employee (research assistant) or recruiting a medical student or other trainee to lead project expansion. Ultimately, personalized video-based curricula targeting individual learning needs and complementing real-world case exposure should be established to maximize impact on trainee education.

The development of our large trauma surgical video repository at Sotero del Rio differs from previously described trauma video collection efforts in a number of key ways. First, the video recording process has become integral to both the trauma workflow and the culture. Video recording consent has been integrated into hospital intake forms. Surgeon-to-surgeon sign off at morning report includes details about video recordings from the previous shift and any additional instructions for video download and storage. Medical students and junior residents are provided instructions for equipment handling

and roles and responsibilities during initial integration into the team. Second, most trauma video recording in the United States has historically relied on fixed, wall-mounted cameras. Fixed recording yields video content that is often poorly focused and poorly centered. Further, fixed cameras are often obscured by movement of personnel throughout the field of view. By using hand-held and head-mounted action cameras, we have avoided these limitations. Importantly, surgeons committed to this work have dedicated significant portions of their academic and research time to editing the audiovisual materials. We are hopeful that this proof-of-concept report will encourage departments and other institutions around the world to financially and logistically support invested surgeons.

This study and the described trauma video program are not without limitations. While we have subjective feedback from surgical trainees regarding the utility of the video repository, we have no objective data to support its effectiveness. This is a single institution study at a trauma center in Santiago, Chile and therefore the generalizability of the program may be limited. That said, we believe the general principles of building a trauma video repository apply broadly to trauma centers worldwide. Our current collection includes just over 250 unique procedures. Next steps should include formal survey collection and objective measurement of surgical skill improvement, continued growth of the video repository content, widening of access to the collection for trainees, and eventually, implementation across different surgical training programs.

Conclusions

In this study, we describe the creation of a large video library of open trauma surgical cases featuring sophisticated, high-quality video. Video recording of trauma operative procedures shows promise as an adjunctive training methodology for trauma surgical trainees. In addition to their value for high-quality educational conferences, these videos have been critical to surgeon-to-surgeon descriptions of intraoperative findings, for surgeon self-critique, and for quality improvement processes. Key innovations in our video recording process include the use of hand-held and head-mounted cameras from multiple points-of-view, integration of the video recording process into daily surgical team workflow, and delegation of recording responsibility to junior members of the surgical team. Future efforts will focus on increased organization and access to the video library for our surgical trainees and objective measurement of improvement in surgical knowledge and skills resulting from adoption of video-based education.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12909-025-06863-y>.

Supplementary Material 1

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None.

Author contributions

Conceptualization; Data curation; Investigation; Methodology; Project administration– JPR, AZ, MRB, PO, NRFormal analysis; Roles/Writing (original draft); Writing (review and editing)– MRB, GPB, IA, NPR.

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Data availability

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Declarations

Ethics approval and consent to participate

This project was submitted to the Sotero del Rio Hospital Ethics Committee. The committee requested that the Trauma Surgery team at the Sotero del Rio hospital sign a standard waiver for consent form per the Ethics Committee policy. This form was provided to each patient who had clinical video recorded in lieu of a formal consent form. This document is provided in this submission.

Consent for publication

Patient video added to this manuscript as supplemental material was appropriately consented in accordance with institutional policies at the Sotero del Rio Hospital per the above description and as dictated by the Sotero del Rio Ethics Committee.

Competing interests

The authors declare no competing interests.

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