BRIEF ORIGINAL RESEARCH

Contemporary uses of trauma video review: a scoping review

Andrew Quirion[1] · Anton Nikouline[1] · James Jung[2,3] · Brodie Nolan[1,3,4,5]

Abstract

Objectives Trauma resuscitations are sporadic, high-acuity situations and conducting observation in the trauma bay for the purpose of quality improvement is challenging. We aim to review contemporary uses of trauma video review.

Methods Medline and Embase were searched from 1980 to May 2020 for studies involving trauma video review. English studies of adult and paediatric populations were included for study and analysed for uses of trauma video review, outcomes measured and any resulting quality improvement (QI) initiatives.

Results A total of 463 publications were identified with 21 studies meeting eligibility for final inclusion. A majority of studies (11) observed technical skills with analysis of critical procedures, including tracheal intubation and thoracotomy. The remaining studies observed team dynamics and communication. Overall, eight studies resulted in new policies being put in place for trauma resuscitations and six studies utilized trauma video review as an educational tool.

Conclusions This study highlights common uses of trauma video review. The greatest benefit for this new technology is in quality improvement and education. The majority of studies focussed on critical procedures and QI initiatives, such as checklists, protocols and continued education. We recommend adoption of video review systems for ongoing improvement of team dynamics and overall trauma and emergency resuscitation.

Keywords Trauma · Resuscitation · Trauma video review · Observation; scoping review

Résumé

Objectifs Les réanimations traumatiques sont des situations sporadiques à haute acuité et il est difficile de mener des observations dans la salle de traumatologie dans le but d'améliorer la qualité. Notre objectif est de passer en revue les utilisations contemporaines de l'examen vidéo des traumatismes.

Méthodes Des recherches ont été menées dans Medline et Embase de 1980 à mai 2020 pour trouver des études impliquant un examen vidéo de traumatismes. Les études anglaises portant sur des populations adultes et pédiatriques ont été incluses dans l'étude et analysées en fonction des utilisations de l'examen vidéo des traumatismes, des résultats mesurés et de toute initiative d'amélioration de la qualité (AQ) en résultant.

Résultats Un total de 463 publications a été identifié avec 21 études répondant aux critères d'éligibilité pour l'inclusion finale. Une majorité d'études (11) ont observé les compétences techniques avec l'analyse des procédures critiques, notamment l'intubation trachéale et la thoracotomie. Les autres études ont observé la dynamique de l'équipe et la communication.

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Dans l'ensemble, 8 études ont donné lieu à la mise en place de nouvelles politiques pour les réanimations traumatiques et 6 études ont utilisé l'examen de vidéos de traumatismes comme outil éducatif.

Conclusions Cette étude met en évidence les utilisations courantes de l'examen vidéo des traumatismes. Le plus grand avantage de cette nouvelle technologie est l'amélioration de la qualité et l'éducation. La majorité des études se sont concentrées sur les procédures critiques et les initiatives d'AQ, telles que les listes de contrôle, les protocoles et la formation continue. Nous recommandons l'adoption de systèmes de révision vidéo pour l'amélioration continue de la dynamique d'équipe et de la réanimation de traumatologie et d'urgence en général.

Clinician's capsule

What is known about the topic?
Trauma video review is an increasingly utilized method to observe and review trauma resuscitations for quality improvement.

What did this study ask?
How is trauma video review currently being used and what are the focuses and outcomes of review in the literature?

What did this study find?
Trauma video review uses included evaluating procedural performance, measuring protocol compliance, analyzing adverse events, and assessing team dynamics and communication.

Why does this study matter to clinicians?
Clinicians should consider adoption of a trauma video review program for purposes of quality improvement, patient safety and continuing education.

Background

Severely injured patients require rapid, coordinated assessments while simultaneously being resuscitated [1–4]. Trauma care is often provided by an ad hoc team of physicians and allied health providers working together to care for sick patients [5]. There are inherent challenges in assessing team performance, detection of adverse events or measuring quality improvement (QI) initiatives in such a dynamic environment.

Video review has been used in various healthcare settings, such as the operating room and emergency departments for education and QI purposes [6, 7]. It has been used to evaluate both technical skills, such as adherence to procedural steps, and non-technical skills like communication and team function [7, 8]. Trauma video review offers advantages over traditional after-event analysis (such as morbidity and mortality rounds), which are fraught with error from recall bias and often missing important information such as the timeline, incidence and nature of adverse events. Trauma video review has been utilized since the 1980s, however, given advances in technology and increased scrutiny of health privacy laws, it is unclear if this use has changed [5, 9, 10].

The objective of this scoping review was to provide an overview of the uses and applications of trauma video review. The following question was formulated; "What is known from the literature about the uses of video observation during trauma resuscitations at trauma centres?"

Methods

This review followed the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-SCr) (Supplemental Appendix A), and has been registered with the International Prospective Register of Systematic Reviews (PROSPERO) (CRD42020148058). The scoping review was conducted and reported according to PRISMA-SCr guidelines [11, 12]. There were no previous systematic or scoping reviews identified on this topic.

Technical descriptions of the study methods are presented Supplemental Appendix B.

Synthesis of results

For each article included we summarized the year, country, study design, number of enrolled patients, study population, study intervention/exposure, study control, and study outcomes. Additionally, the primary use of trauma video review and any measured outcomes were explored.

Results

Study selection

The literature search identified 463 publications for the screening process. Following screening for both title and abstract, 435 articles were excluded. Full text reviews of 28 studies were performed with 9 studies meeting the inclusion criteria. An additional 12 studies were identified from the references of included studies, resulting in a total of 21 studies included (Fig. 1).

Study characteristics

Table 1 summarizes the study demographics. Eleven studies examined technical skills, four studies examined non-technical skills, three studies examined both and the remaining three studies were surveys of trauma video review. The primary uses and measured outcomes are reported in Table 2.
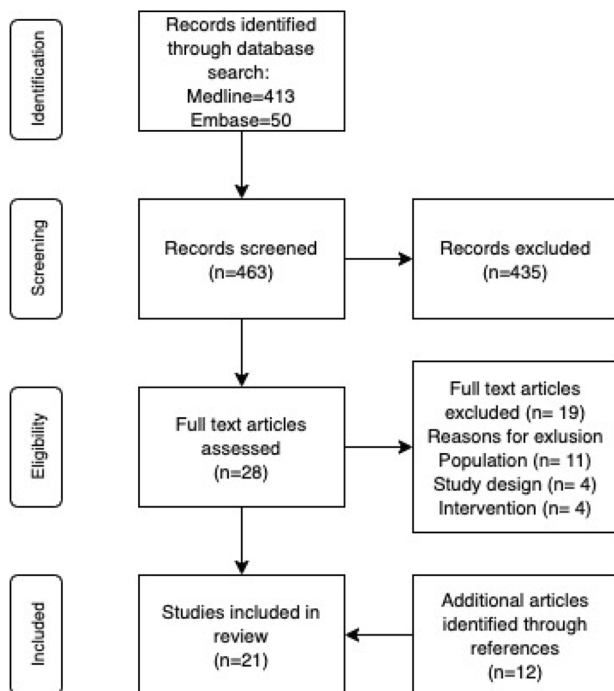

Fig. 1 PRISMA-ScR flow diagram. *PRISMA-ScR* preferred reporting items for systematic review and meta-analysis extension for scoping reviews

Synthesis of results

Trauma video review operational findings

Ten studies utilized continuous video recording of the resuscitation bays. Six studies required activation of a recording system prior to the resuscitation, with one converting to continuous recording during the study. Thirteen studies had ceiling mounted cameras and three studies utilized a camera from the foot of the bed. The majority of studies used a single camera ($n = 8$), while other studies used 2 ($n = 3$) and 3 ($n = 5$).

Assessment of technical skills

Four studies explored outcomes of critical procedures including thoracotomy, cardiopulmonary resuscitation and intubation [13–16]. Four studies analysed compliance with protocols such as advanced trauma life support (ATLS), and full personal protective equipment (PPE) usage [10, 17–19]. The remaining five studies analysed overall trauma resuscitation performance to identify errors and assess team performance [5, 9, 20–23].

Assessment of non-technical skills

Two studies focussed on communication through validation of communication assessment tools and identifying features of successful communication [8, 24]. The remaining two studies examined most common leadership strategies and the effect of team size and environment on the completion of ATLS components [25, 26].

Discussion

Assessment of technical skills using trauma video review

Our study demonstrates a number of examples of trauma video review in technical skills assessment and improved overall patient care. Trauma video review was used to analyse performance and benchmark timelines for time-sensitive procedures such as thoracotomy and intubation [13, 14]. Ensuring adequate adherence to protocols by trauma video review helped safeguard against errors in low volume centres and with inexperienced physician trainees. In both cases performance was tracked over time and improved in all studies when trauma video review was used as an educational tool [10, 18, 23]. Additionally, two studies demonstrated that

Table 1 Studies characteristics: direct observations of trauma resuscitation ($n = 21$)

References	Year	Country	Tertiary/rural/urban	Study design	Enrolled patients (n)	Population	Intervention/exposure	Control	Outcome
El-Shafy et al. [8]	2018	USA	Tertiary	Observational	387	Paediatric trauma patients	TTL verbal orders	NA	Time to task completion
Aukstakalnis et al. [21]	2020	Lithuania	Tertiary	Observational	143	Adult trauma patients	All trauma resuscitations	NA	Benchmarking both technical and non-technical skills compared to published data
Chreiman et al. [20]	2017	USA	Tertiary	Observational	145	Trauma patients with no palpable pulse	Vascular access	NA	Success of access attempt
Demoor et al. [24]	2017	USA	Tertiary	Observational	70	All trauma team members	Communication effectiveness using TTCA-24, TEAM, T-NOTECHS	NA	Validation of TTCA-24 tool
DiGiacomo et al. [17]	1997	USA	Tertiary	Observational	66	Adult trauma patients	All trauma activations	NA	Compliance with full barrier protection PPE
Donoghue et al. [13]	2016	USA	Tertiary	Observational	59	Paediatric patients receiving CPR and tracheal intubation	Tracheal intubation	NA	Effect of CPR on tracheal intubation
Dumas et al. [14]	2018	USA	Tertiary	Observational	44	All trauma patients undergoing ED thoracotomy	ED thoracotomy	NA	Time to benchmark ED thoracotomy steps from patient arrival and skin incision
Dumas et al. [31]	2020	USA	Tertiary	Cross-sectional	249	USA trauma centres	Use of TVR	NA	Survey of trauma centres usage and barriers for video review
Ellis et al. [32]	1999	USA	Tertiary	Cross-sectional	220	USA trauma centres	Use of TVR	NA	Survey of trauma centres usage of video review
Hoyt et al. [5]	1988	USA	Tertiary	Observational	2500	Adult trauma patients	Trauma resuscitations with video review education	Trauma resuscitations with no video review	Comparison of time to disposition, wasted time in resuscitation and attention to initial management priorities before and after education
Mackenzie et al. [15]	2007	USA	Tertiary	Observational	50	Adult patients requiring intubation	Tracheal intubation	NA	Implementation of standardized protocol for ensuring endotracheal intubation
Maluso et al. [25]	2016	USA	Tertiary	Observational	170	Adult trauma patients	Trauma evaluation	NA	Team size effect on efficiency of trauma evaluation

Table 1 (continued)

References	Year	Country	Tertiary/rural/urban	Study design	Enrolled patients (*n*)	Population	Intervention/exposure	Control	Outcome
Michaelson et al. [22]	1997	Israel	Tertiary	Observational	1200	Adult and paediatric trauma	All trauma activations	NA	Discussion of types of errors corrected through video review process
Noland et al. [23]	1996	USA	Tertiary	Observational	178	Paediatric trauma patients	All trauma activations	NA	Completion of 8 quality indicators of trauma care
Oakley et al. [19]	2004	Australia	Tertiary	Observational	105	Paediatric trauma patients	All trauma activations	NA	Identification of predetermined errors in ATLS management
Rogers et al. [33]	2010	USA	Tertiary	Cross-sectional	108	USA trauma centres	Use of TVR	NA	Survey of trauma centres usage and procedure for video review
Santora et al. [10]	1996	USA	Tertiary	Observational	73	Adult trauma patients	All trauma activations	NA	Successful completion of 6 time-sensitive components of resuscitation
Townsend et al. [9]	1993	USA	Tertiary	Observational	883	Adult trauma patients	Trauma resuscitations with video review education	Trauma resuscitations with no video review	Time spent in trauma resuscitation
Wurster et al. [18]	2017	USA	Tertiary	Observational	142	Paediatric trauma patients	Level 1 trauma activations	NA	Adherence to ATLS PACT
Xiao et al. [26]	2004	USA	Tertiary	Observational	152	Adult trauma patients	All trauma activations	NA	Identification of leadership functions in care of trauma patients using grounded theory technique
Zhou et al. [16]	2014	China	Tertiary	Observational	66	Adult patients with cardiac arrest receiving CPR	CPR	NA	Effect of medical students on CPR quality

ATLS advanced trauma life support, *CPR* cardiopulmonary resuscitation, *ED* emergency department, *NA* not applicable, *TTL* trauma team leader, *TTCA-24* trauma team communication, *TEAM* Team Emergency Assessment Measure, *T-NOTECHS* Trauma Nontechnical Skills Scale, *TVR* trauma video review, *PACT* Primary Assessment Completion Tool, *PPE* personal protective equipment

Table 2 Reported outcomes and uses of direct observation of trauma resuscitations ($n = 21$)

References	Year	N	Reported outcomes	Initiatives/uses
El-Shafy et al. [8]	2018	387	Frequency of verbal order directability (32.6%), audibility (96.1%), and closed-loop in nature (26.1%). EMS pre-notification, level of activation were also measured with time to task completion recorded for all variables	Emphasis on use of closed-loop communication for trauma team lead training as orders with closed-loop communication occurred 3.6 times more rapidly than open-loop
Aukstakalnis et al. [21]	2020	143	Patient evaluation takes 30% longer than published standards and team leaders were deficient in leadership, communication and decision making portions of T-NOTECHS	Development of a performance improvement system to improve trauma care
Chreiman et al. [20]	2017	145	Peripheral intravenous and intraosseous access attempts were the same in duration in length and more rapid then central venous catheters. Intraosseous had the highest success rate at 95%	Recommending use of intraosseous route as primary line in patients in extremis
Demoor et al. [24]	2017	70	Communication score using T-NOTECHS, TEAM and TTCA-24. TTCA-24 was well correlated with T-NOTECHS ($r = 0.26$, $p = 0.029$) but not TEAM	Validation of TTCA-24 tool through its comparison with T-NOTECHS
DiGiacomo et al. [17]	1997	66	Only 51.5% of trauma resuscitations used full barrier protection PPE with 89.1% of individual workers being compliant. Emergency physicians and nurses were identified as most noncompliant	Used as educational tool for noncompliant populations and tools developed to increase compliance including pre-notification and relief of noncompliant staff from resuscitation
Donoghue et al. [13]	2016	59	Tracheal intubation success rates were greater when CPR was not paused (63% vs 41%). There was no difference found in length of intubation whether CPR was paused or not and 78% of all CPR pauses exceeded 10 s	Recommend tracheal intubation with CPR ongoing
Dumas et al. [14]	2018	44	Frequency of and time to benchmark ED thoracotomy procedures. Median time to milestones in minutes were; right chest decompression 2.11, pericardiotomy 1.35, pericardiotomy 2.35, aortic cross-clamp 3.71. 28/44 (64%) of thoracotomies had one or more milestones omitted	Quality improvement for and education for ED thoracotomy. Video review was also more effective at detecting omitted milestones than electronic medical records
Dumas et al. [31]	2020	249	28% of trauma centres utilized TVR with individual and group education being most common use. Medicolegal concerns and time constraints were biggest barriers to implementation in sites not video recording	Demonstrated demographics of sites using TVR and discordance between perceived medicolegal concern and only 2 sites reporting medicolegal issues
Ellis et al. [32]	1999	220	20% of trauma centres were using TVR and 73% of these were Level 1 trauma centres. Personnel, time and medical staff support were most common problems at centres currently or previously using video review	Identified Level 1 trauma centres with full time trauma coordinators as sites most likely to use TVR. And showed discrepancy between perceived (medicolegal) and actual (personnel) video recording problems
Hoyt et al. [5]	1988	2500	Residents undergoing video resuscitation conferences had a reduction in time to definitive care of 17% compared to 12% for those not participating in conferences. Residents undergoing video review also had less wasted (37% decrease vs 15%) and increased attention to resuscitation priorities (88% vs 56%)	Demonstrated effectiveness of video review as an education tool in comparing residents undergoing video review conferences vs those not participating
Mackenzie et al. [15]	2007	50	Completion of 24 standardized tasks on a tracheal intubation checklist and compared to an unrecognized esophageal intubation. Communication, clinical examination for breath sounds and carbon dioxide confirmation were the missed tasks in the esophageal intubation	Implementation of standardized method of confirming endotracheal tube placement

Table 2 (continued)

References	Year	N	Reported outcomes	Initiatives/uses
Maluso et al. [25]	2016	170	Number of team members, presence of attending surgeon and presence of engaged leader were correlated with 20 tasks based off ATLS protocols. There was a positive correlation between number of team members and completion of all tasks except assessment of breath sounds which had a negative correlation. No correlation was found between task completion and the other variables	Only team size was correlated with task completion. Further research is recommended to study optimal team size
Michaelson et al. [22]	1997	1200	Method of chest tube insertion, effective team performance, troubleshooting ET tubes and awareness of length of trauma resuscitation were issues identified and improved with video review	Video used to identify and improve issues with trauma resuscitations and implemented as quality improvement method
Noland et al. [23]	1996	178	Use of universal precautions was improved from 14% to 64% through the study period. All other quality indicators performed at 89% of higher. However only 50% of resuscitations were adequately recorded	Improved use of universal precautions in trauma resuscitations and developed plans to expand trauma program with room dedicated to video recording
Oakley et al. [19]	2004	105	Delay in oxygen administration (67%), incomplete circulatory examination (65%) and incomplete secondary examination (79%) were the most common identified errors in video review	Demonstrated superiority of video review to chart review and implemented as quality improvement method.
Rogers et al. [33]	2010	108	20% of trauma centres currently using TVR. 51% of sites reported technical issues using video review. All sites used TVR for resident education and 38% used video for quality improvement	Demonstrated demographics of sites using TVR. Technical issues are most common problem with video and resident education is most common use
Santora et al. [10]	1996	73	Comparison of team function over a 13 month period with video review showed improvement only in leadership (pre-briefing, direct and clear orders, control and minimization of waste). Also identified 7 system deficiencies in trauma resuscitation	Showed significant improvement in resident leadership skills following trauma video review program and corrected multiple system deficiencies
Townsend et al. [9]	1993	883	Time in resuscitation room was decreased following implementation of trauma video review education process from 97.5 to 88.6 minutes with no difference in mortality. Additionally multiple individual and process errors were identified	Individual and process errors identified and improved as well as reduced time required to manage patients in resuscitation room with video review
Wurster et al. [18]	2017	142	Following initiation of video review acceptable scores on PACT tool were seen in 37%, 66% and 91% at 3, 6 and 12 months post implementation from a baseline of 9%	Implementation and assessment of ATLS PACT tool
Xiao et al. [26]	2004	152	Identified 6 leadership conditions (strategic planning, reporting plans, critiquing plans, coaching, maintaining awareness and information requests) in trauma resuscitations	Validation of grounded theory approach to assess poorly defined phenomena and well suited for video review
Zhou et al. [16]	2014	66	There was no observed difference in chest compression rate, intubation time, rate of ROSC or survival to discharge in the student groups. The student groups did have a higher rate of BVM but a lower total hands off time than non-student groups	Assessment of student CPR quality and further observation of students. Recommends student involvement in CPR but observation for interventions such a ventilation rate

ATLS advanced trauma life support, *CPR* cardiopulmonary resuscitation, *ET* endotracheal, *PACT* Primary Assessment Completion Tool, *PPE* perosnal protective equiment, *T-NOTECHS* Trauma Nontechnical Skills Scale, *TEAM* Team Emergency Assessment Measure, *TTCA-24* Trauma Team Communication Assessment, *TVR* trauma video review

residents who underwent trauma video review education outperformed their counterparts over time based on trauma performance [5, 8]. Trauma video review has shown to be more effective than chart review at detecting management errors [14, 19]. Trauma video review has improved morbidity and mortality rounds as it captures the environment and team dynamics to provide a superior learning experience [14, 19, 27, 28]. Compliance with PPE was shown to be improved with video review implementation and this is likely to be a prominent feature in trauma and emergency care moving forward in the COVID era and beyond [17].

Assessment of non-technical skills

Six studies examined non-technical skills in trauma resuscitation and primarily focussed on communication, team dynamics and leadership qualities. These studies focussed on optimal team size for trauma resuscitation and found that closed-loop communication was the only factor which led to orders being completed more rapidly [8, 25]. Trauma video review allowed for multiple aspects of communication and team dynamics to be assessed, which can be difficult in real time [21, 26]. Santora et al. [10], showed that resident leadership qualities including pre-briefing, clear and direct orders, and control of resuscitation were significantly improved over their study period with trauma video review. With the increasing need for effective medical education this may be a powerful tool to acquire expertise in resuscitation and team management that may be applicable to other emergency resuscitations [29].

Trauma video review and quality improvement

A trauma video review program can overcome the limitations of after-action reviews and provide reliable video data to better understand latent safety threats and adverse events. For example, in the case of delay to blood product administration, trauma video review can provide an accurate record of times compared to the current standard of nursing documentation. It can also provide specific causes such as the request for blood not being heard, a lack of staff available or blood products arriving unannounced. A more thorough understanding with video review can provide actionable information. Trauma video review can also provide a reliable method to track specific quality metrics, such as whether the trauma team was assembled prior to patient arrival or time to blood product administration. Some trauma video review programs also allow any team member to flag a resuscitation for review anonymously, allowing all team members to have a voice and promoting a culture of safety in trauma [30].

Limitations to trauma video review

Although trauma video review is a useful tool and positively perceived by centres using it, it is not without limitations and is not yet widely used in trauma care [31–33]. Medicolegal concerns are often cited as a barrier to implementation of a trauma video review program; however amongst centres using it there were very low rates of actual medicolegal issues [31, 34–37]. Implementation of trauma video review programs must be done in coordination with hospital legal and privacy departments to ensure compliance with local privacy regulations. Adequate staffing, processes and time required to acquire, record and review documented resuscitations are also cited as challenges [31–33]. Additionally, the cost of installation of cameras and audio recording devices, downtime required to install this equipment, logistical issues surrounding storage of data and ongoing resources required for review and analysis may be prohibitive to some hospitals in the implementation of a video review system [15, 32].

Study limitations

The heterogeneity of included studies limits the discussion to a broader summary and prevents focal conclusions from being synthesized. In addition, the abundance of studies observing technical skills may create significant bias versus studies that looked at non-technical skills wherein the latter may produce fewer positive results thus receiving fewer publications [38].

Conclusion

This scoping review demonstrated that trauma video review can be a useful tool in assessing technical and non-technical skills that are otherwise difficult to measure using traditional observational data. Current uses of trauma video review include improving clinical skills, developing protocols/checklists, provider education and improving team dynamics. Trauma video review has demonstrated its greatest benefit within the realms of medical education and quality improvement, and should be considered for implementation in Canadian trauma programs as well as general emergency departments.

Declarations

Conflict of interest The authors declare that they have no conflict of interest statement.

Meetings presented None.

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