dysfunction. Numerous studies have been performed using this model. Another powerful research tool is the genetically engineered mouse. Transgenic and "knockout" mice have been shown to have different physiologic responses compared to wild type mice under a variety of experimental conditions. The purpose of this study was to determine the feasibility of modifying the Noble-Collip drum trauma rat model to accommodate the mouse and thereby provide a model of traumatic shock that would allow future study of the genomic nature of response to injury.

Materials and Methods: Studies were in accordance with the National Institute of Health's Guidelines on the Use of Laboratory Animals and approved by Thomas Jefferson University Institutional Animal Care and Use Committee. Male and female C57Bl6 mice weighing 20–25 g were anesthetized with sodium pentobarbital (60 mg/kg, intraperitoneally) before experimental procedures. A carotid artery was cannulated for determination of arterial blood pressure to confirm occurrence of traumatic shock, according to established procedures. Whole-body trauma was administered in a Noble-Collip drum apparatus with randomly assigned revolutions: 50, 100, or 200 and three randomly assigned rates revolutions per minute (rpm): 60, 80, or 100. All trauma mice underwent autopsy to confirm the presence of gross evidence of traumatic injury (i.e., ischemia, serosanguinous ascites, and vascular engorgement) to splanchnic viscera. Animals were randomly divided into experimental groups consisting of mice subjected either to trauma or to a sham-trauma protocol. Sham-trauma mice were anesthetized, cannulated, and monitored at the same time as trauma mice.

Results: All of the trauma mice met the autopsy criteria for splanchnic trauma. All animals subjected to either 100 rpm or 200 rev died in the drum. None of the trauma mice survived more than 30 minutes after any combination of revolutions or rates. There were no differences based on sex.

Discussion: Wild-type C57Bl6 mice between 20 and 25 grams do not tolerate the same degree or duration of Noble-Collip drum trauma as is observed in rats. Further investigations involving modifications of this well-established model are warranted.

Friday, May 24, 2002

Morning Lectures

Historic Development of Resuscitation and Therapeutic Hypothermia in Cardiac Arrest and Trauma

Peter Safar, Pittsburgh, Pennsylvania, USA

[abstract not available]

Cutting Edge Animal Research: Combination of Small Volume Resuscitation with Anti-Oxidants During Uncontrolled Hemorrhagic Shock Does Not Increase Survival

R. Kentner, Mainz, Germany

[abstract not available]

Free Papers

The Influence of Active Warming on Signal Quality of Pulse Oximetry in Trauma Victims

Frank Lieba, Helmut Strasser Thomas Scheck, Wolfgang Vlach, Alexander Kober Vienna Red Cross „Van Swieten" and the Research Institute of the Vienna Red Cross, Vienna, Austria

Background. Because many trauma victims are intoxicated with alcohol and drugs, they are all prone to the risk of inadequate respiration. Thus, their oxygenation is controlled by noninvasive infrared-based pulse oximetry. As shown in many previous studies, these devices show bad signal quality if the patient is vasoconstricted or if the device itself is exposed to cold ambient temperatures. We tested the hypothesis that active warming of the whole patient and of the sensor during transport improves the quality of pulse oximetry.

Methods. We included trauma patients 19 to 90 years of age in this study. Our study population (n=24) was randomly assigned to two groups (n=12). One group was covered with normal wool blankets, and the other group was covered with a resistive heating blanket (Thermamed, Germany) while being transported to hospital. We recorded core temperature, shivering, skin temperature, vasoconstriction, SpO_2, and haemodynamic parameters.

Results. Before randomization, both groups were comparable in morphometrics, demographics, haemodynamics, SpO_2, and temperature. At arrival at the hospital, the actively warmed patients had significantly warmer core ($P<0.01$) and skin temperatures ($P<0.01$). The warmed patients had no vasoconstriction, while the patients covered with wool blankets were all fully vasoconstricted ($P<0.01$). The pulse oximeter had significantly less "bad signal" alerts of the device in the actively warmed group ($P<0.01$). In the group warmed with a wool blanket, the pulse oximeter could not show any value for more than 30 seconds in significantly more cases than in the actively warmed group ($P=0.04$).

Discussion. Many benefits of keeping trauma victims warm are known, such as reduction of blood loss and improved wound healing. In this study, we could prove that warming trauma patients during transport to hospital strongly improves monitoring quality by optimising the function of the pulse oximetry device.

Videotaping in the Trauma Admitting Area as a Quantitative Tool for Quality Improvement

G. Hyams, M. Michaelson, E. Tal-Or, M. Foox, M. Ebrenfeld, T. Kushnir, L. Levy Rambam Medical Center, Haifa, Israel

Background. Videotaping in the admitting area has been described as an objective tool for quality assurance in the treatment of trauma patients. As part of a Master of Arts thesis project, we tried to build a tool that would allow us to quantitatively judge the treatment of the trauma patient. To this end, we created a questionnaire focusing on two areas, primary treatment according to the ATLS (26 questions) and team work, especially team leadership (15 questions). Time to complete the ABC or total time in the admitting area was recorded. The questionnaires were completed by two physicians and two nurse trauma coordinators for each patient (i.e., 4 questionnaires for each patient, for a total of 180 questionnaires). The final grades were calculated separately for each grader and a mean was calculated. Each of the graders also gave a grade for the treatment as a whole (subjectively). After seeing 30 patients, the worst points were noted. From these, four points were selected for improvement: measurement of end tidal CO_2, reading blood gas results, trauma team waiting for the patient, and the head nurse communicating with the staff during primary treatment. A special program was organized for the teams, correcting these deficiencies, after which another 15 patients were videotaped and graded.

Results. There was good correlation between the objective and subjective grades given by each grader, which validated the questionnaire. In addition, there was no significant difference in the grading by the four team members. There was no significant improvement in the treatment of the last group of patients, as seen by the objective (70.1 and 75.5, $P=0.075$) vs. subjective (75.1 and 80.1, $P=0.61$) grades but there was significant improvement in three of the four points selected. Correlation between subjective and objective grades was found to be significant ($P<0.001$). The difference in the subjective graders was no more than 6.7 (79.9 and 73.2), while the objective difference was 11 (64.1 and 75.1).

Conclusion. Videotaping is a cheap and effective tool for trauma quality control and can also be a quantitative tool.

Endovascular Stent in the Acute Treatment of Blunt Arterial Injury: A Case Report

G.B. Flugsrud, M. Brekke, O. Røise*
Oslo Orthopaedic University Clinic, Ullevål University Hospital, Oslo, Norway
**Department of Cardiovascular Radiology*

Blunt renal arterial injury has been estimated to occur in 1% to 4% of patients with blunt abdominal injuries. Open revascularization has reported success rates of only 20% to 30% and is advised against.[1] A Medline search in 2001 revealed four case reports of endovascular stenting; the results were promising, but follow-up was short.[2]

Case Presentation. The patient, a 42-year-old male, was admitted 30 minutes after being struck by an 1800-kg excavator that tipped over. On admission he was haemodynamically stable with GCS 13. Clinical examination revealed contusions in the left flank. Pelvic X-ray showed a fracture of the left iliac wing, and on abdominal CT scan there was complete absence of contrast uptake in the left kidney. Only a small haematoma was seen adjacent to the left renal artery. ISS was 33. A renal arteriogram showed total occlusion of the left renal artery 2 cm from the aorta. An endovascular stent was introduced, and left renal perfusion restored 3 hours after the injury. Renal scintigram 14 days after the injury showed left renal function to be 20% of right renal function. At outpatient control 3 months post-injury the patient's condition was good, and his blood pressure was 150/90 mmHg. He was not using antihypertensive medication. The next renal scintigram is scheduled at 6 months post-injury and will be presented.

Discussion. Blunt renal artery injury is usually treated non-surgically. Open revascularization shows poor results, and it has been recommended that nephrectomy should be considered only if there are other indications for laparotomy. Re-establishing renal perfusion with endovascular stents may preserve renal function and prevent later renovascular hypertension.

References

1. Peterson NE. Genitourinary trauma. In Feliciano DV, Moore EE, Mattox KL, editors. Trauma, 3rd ed. Stamford, Connecticut: Appleton & Lange; 1996, pp 661-93.
2. Bruce LM, Croce MA, Santaniello JM, Miller PR, Lyden SP, Fabian TC. Blunt renal artery injury: incidence, diagnosis, and management. Am Surg 2001; 67(6):550-6.

Laryngoscopic View Obtained During Rapid Sequence Intubation (RSI) in the Emergency Department

A.J. Oglesby, C.A. Graham†, D. Beard‡, and D.W. McKeown§,*
Department of A&E Medicine, Royal Infirmary of Edinburgh, Scotland; Department of A&E Medicine, Southern General Hospital, Glasgow, Scotland†; Scottish Trauma Audit Group, Royal Infirmary of Edinburgh, Scotland‡; Department of Anaesthesia, Royal Infirmary of Edinburgh, Scotland§*

Objective. To document the views obtained at laryngoscopy during RSI in the emergency department by anaesthetists and emergency physicians, taking into account the medical seniority of the intubator.

Methods. Data were collected prospectively on every intubation attempt in seven urban Scottish emergency departments for two calendar years commencing 11 January 1999. Data included patient's age, sex, indication for intubation, grade and specialty of intubator, laryngoscopic grade (Cormack-Lehane), number of intubation attempts, and complications. Analysis was performed using SPSS™ v9.0.

Results. 1713 patients were entered into the study and 735 patients were classified as having a RSI. Grade of intubation was documented in 91% (671/735). 68.0% of the intubations were classified as Cormack-Lehane grade I, 23.3% grade II, 6.1% grade III, and 2.4% grade IV. Anaesthetists had a significantly higher percentage of "good views" (defined as grade I & II) than emergency physicians (see table).

First attempt specialty			
EM PHYS	ANAES	TOTAL	
Good view	316 (89.3%)	2968 (94.0%)	614 (91.5%) ($P=0.039$)
Poor view	38 (10.7%)	19 (6.0%)	57 (8.5%)
Total	354 (100.0%)	317 (100.0%)	671 (100.0%)

Consultants, specialist registrars, senior house officers, and staff grade doctors obtained similar percentages of "good views" on laryngoscopy (92%), but experienced senior house officers (SHO III) obtained good views in only 88% of cases.

Conclusions. Anaesthetists obtain better laryngoscopic views than emergency physicians during RSI. The chance of obtaining a good view does not appear to be related to operator grade in either specialty. It may be related to anaesthetists having increased relevant training as well as familiarity and confidence with the Cormack-Lehane grading system, although other factors may be involved.

Emergency Intubations by Anaesthetists and Emergency Physicians

D.W McKeown, A.J. Oglesby, D. Beard, C.E. Robertson
Royal Infirmary of Edinburgh and Scottish Trauma Audit Group, Edinburgh, Scotland

Introduction. Early and effective management of the airway is essential in the care of the critically ill patient. Advanced airway interventions may be performed by anaesthetists or suitably trained emergency physicians (EPs) depending on local policies. This study reports on the practice in the emergency department (ED) of a large, urban teaching hospital.

Materials and Methods. This is a prospective, observational study. A proforma was completed for every patient in whom endotracheal intubation was attempted in the ED between 11.01.99 and 05.10.01.

Results. Data were collected on 857 patients. RSI was performed in 434 patients. 252 patients were in non-traumatic cardiac arrest. There were 3 children under 13 years and 41 prehospital intubations performed by EPs. 171 patients were given other combinations of drugs but did not satisfy the criteria for RSI.

Discussion. In this hospital it is common for EP with training and experience to perform advanced airway management, including RSI. The complication rate in the RSI group was higher for EPs. The views and initial intubation success rates of EPs in RSI are similar to those in non-traumatic cardiac arrests, where airway control is almost exclusively undertaken by EPs. A cooperative policy has been developed between Anaesthesia/Critical Care and Accident and Emergency Medicine to increase the training and experience of EPs in airway management.

Rapid Sequence Intubation for Trauma Patients in Scotland

C.A. Graham, D. Beard, J. Henry, D.W. McKeown
Scottish Trauma Audit Group, Royal Infirmary of Edinburgh, Scotland

Objective. Rapid sequence intubation (RSI) is now accepted as the technique of choice for securing the airway in trauma patients who require intubation in the emergency department (ED). This can be performed by an anaesthetist, an intensive care doctor, or a suitably trained and experienced emergency physician (EP). We aimed to identify any differences between anaesthetists and emergency physicians with regard to RSI in trauma patients in Scotland.

Methods. Prospective, multi-centre observational study of RSI in the EDs of seven urban Scottish teaching hospitals which contribute data to the Scottish Trauma Audit Group (STAG) an ongoing national audit of trauma care. Data were collected prospectively on every intubation attempt for two calendar years commencing 11 January 1999. Data included patient's age, sex, indication for intubation, grade and specialty of intubator, laryngoscopic grade, number of intubation attempts, and complications. STAG data (RTS, ISS, operative details, length of stay in ITU) were collected as part of the routine audit in each centre. The datasets were merged and analysed.

Results. 201 STAG patients were identified who had RSI. Patients who were intubated by emergency physicians had a higher Injury Severity Score (median 26 v 25, Mann-Whitney of rankings $P=0.024$) and a lower Revised Trauma Score (median 5.03 v 5.97, Mann-Whitney of rankings $p=0.006$) than those intubated by anaesthetists. Trauma patients in the EP group were more likely to be intubated within 15 minutes (50.6% v 18.9%, $P<0.001$, Chi square). Mortality was 33.7% in the EP group and 27% in the anaesthesia group ($P=0.385$). Although there was no difference in the proportion of Grade I & II views at laryngoscopy between the two groups ($P=0.110$), anaesthetists had a significantly higher first attempt success rate than emergency physicians (89.2% v 74.2%, $P=0.010$, Chi square). There was no difference in observed complications (10 patients in the EP group and 12 patients in the anaesthesia group, $P=1.0$, Chi square).

Conclusion. Trauma patients undergoing RSI performed by emergency physicians in this study were more severely injured, had more physiological derangement, and had a similar mortality compared with those intubated by anaesthetists. In addition, a higher proportion was intubated within 15 minutes. Anaesthetists have higher first attempt success rates for intubation.

— Session 2A —

Utstein Symposium on Patient Safety, Simulation, and Medical Education in Trauma and Critical Care (Part II)

Part C. Simulation in Medical Education

Why Use Simulation in Medical Education?

John Schaefer, Pittsburgh, Pennsylvania, USA

[abstract not available]

How the Use of Medical Simulators Can Improve Airway Management

Michael Seltz Kristensen
Department of Anaesthesia and Intensive Care, Centre of Head and Orthopaedics, Rigshospitalet, Copenhagen University Hospital, Copenhagen, Denmark

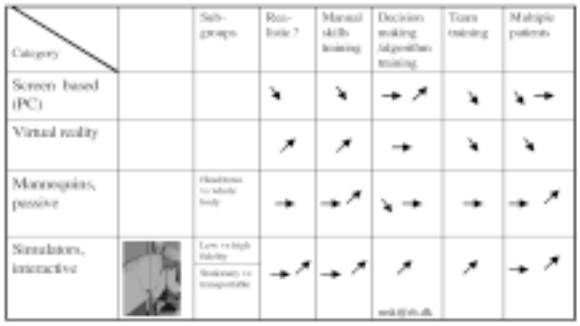
Learning objective: *To explore the distinct strengths and weaknesses of various airway simulators.*

What is the documented effect of training on airway simulators?

1) In many publications, the parameter reported is the participants' own subjective finding that simulator training is useful, including the observation from expert participants that they gained insight in their own performance under stress.
2) Better airway management-performance on the simulator itself. Certain skills (for example, face mask ventilation, placement endotracheal tube, laryngeal mask airway, Combitube, and retrograde intubation) can be learned on simple airway mannequins. The performance of the skills are afterwards evaluated on the same mannequin. Mannequins are also used to study the feasibility of already known procedures in unusual surroundings, for example, weightlessness.
3) Better airway management performance in patients. When combining simulator training and didactic training, emergency medicine technicians were taught endotracheal intubation and the performances evaluated both in the simulator and in real emergency patients. The EMTs were able to learn endotracheal intubation but the failure rate in the clinical setting was unacceptably high. A virtual reality (VR) simulator for bronchoscopy has been validated against the performances of novices and intermediate and expert bronchoscopists. The simulator was able to distinguish the performances by these three groups. After this validation, new trainees were randomised to train either on the VR simulator or have conventional training. After the training, the first group performed best both on the simulator and on their first real patients.
4) No studies were found that were able to show decreased morbidity or mortality as an effect of training on airway simulators.

The different types of medical simulators relevant for airway management can be divided into the categories shown in the table. The strengths and weaknesses of the different categories are indicated.

Airway Simulators by Category, Stengths and Weaknesses.



Airway simulators are convenient for many airway-training purposes; for some purposes they can even be essential:

1) Recognition and management of rare life threatening situations, where both skill and knowledge are necessary, can only be trained using some kind of simulation. An obvious example is the "cannot intubate/cannot ventilate" situation.
2) Some airway management skills may be used so rarely that simulation is necessary to acquire and maintain them. This could be the case for skills such as cricothyroidotomy, retrograde intubation, and placement of a Combitube.

Pitfalls. Airway simulators are strong learning tools and thus have the potential for encouraging inappropriate behaviour in the trainees. If, for example, a simulator scenario is misconstructed in such a way that the simulated patient is saved by means of an inappropriate technique, this technique may become the trainees' response in a real-life situation. This illustrates the need for an expert to guide the simulator session or at least for debriefing afterwards. Judging clinical competence from performance on simulators may give an overoptimistic estimate of real-life performance.[1]

Drawbacks. Some forms of airway simulator training are extremely demanding concerning manpower because of the need for instructors, technicians, and even actors. Airway pathology is often badly presented in the simulators. The realism of most simulators is not evaluated. Most simulators don't bleed, don't get oedema, and don't move while coughing.

What Can We Learn from the Military Use of Training Simulators?

Howard Champion, Bethesda, Maryland, USA

[abstract not available]

Defining and Assessing Professional Competence Using Debriefing and Simulation

Ulrik Juul Christensen, Copenhagen, Denmark

[abstract not available]

Video Analysis to Develop Best Trauma Practices

Colin F. Mackenzie, MBChB, FRCA, FCCM
Professor, Director, the Charles McC. Mathias, Jr., National Study Center for Trauma and Emergency Medical Systems, University of Maryland School of Medicine, Baltimore, Maryland

Learning objective: *To discuss results of video recordings of trauma resuscitation and to describe the utility of such analysis for improvement of trauma team performance and trauma care working environments.*

Latent system failures and non-optimum team performance have an adverse effect on trauma patient outcome. Video recording in trauma centers can determine best practices for trauma patient safety and team training.

Methods. Video recordings of tracheal intubation and chest tube insertion were obtained from ceiling-mounted cameras in a trauma resuscitation unit. Video analysis used a task analysis template and aggregated data across multiple performances of the same task at two levels of task urgency. In addition, comparison was made of three types of self-reports of trauma team performance deficiencies with events identified through video analysis. Critical incident analysis was used to review two unusual video recordings.

Results. More high-priority tasks were omitted in emergency than elective tracheal intubation. Video analysis of chest tube insertion identified failures of adequate skin preparation, small peri-incision drapes, and lack of universal precautions as major sources of contamination. None of the performance deficiencies identified by video analysis were in the quality assurance reports, 2 of 28 were on the anesthesia record, and 5 were noted in a research questionnaire. Video records of individual critical incidents identified team coordination failures and need for training.

Discussion. Video provides a permanent source document that can be reviewed by multiple analysts. Multiple uses of video recording are reported to improve ergonomic, behavioral, and safety performance of teams in dynamic workplaces such as trauma resuscitation. Prototypical task sequences with the assistance of a core group of trauma care experts can allow extraction of quantitative data from video recordings.

Conclusion. Video recording and task analysis can be used to promote best practice performance in dynamic, risky, and complex medical work places such as a trauma center.