management are not clear. This study evaluated the impact of prehospital trauma care with emergency medical doctors (EMD) on the mortality from severe head injury and determined whether it is associated with longer on-scene times.

Methods. A 36-month prospective study of severely head-injured patients who received ATLS and were transported by EMD to Teaching Hospital, Maribor. We evaluated all patients with severe head injury 3 years before and 3 years after the beginning of the prehospital care with EMD.

Results. See table below.

Patients	ATLS (EMD)	BLS (RN)	*P*
Age	43,5± 18,8	41,4± 16,5	0,86*
Sex (M/F)	30/12	29/9	0,87#
On-scene time (min)	21± 9	19± 8	0,78*
IV line (Y/N)	42/0	15/23	<0,05#
Analgesia, anaesthesia, relaxation (Y/N)	40/2	2/36	<0,05#
Intubation (Y/N)	40/2	4/34	<0,05#
Mechanical ventilation (Y/N)	36/6	0/38	<0,05#
Mortality–first hour (Y/N)	2/40 (5%)	12/26 (35,8%)	<0,05#
Hospital mortality (Y/N)	13/29 (30,9%)	21/17 (55,2%)	<0,05#

* Student's t test; # Chi-square test

Conclusion. ATLS procedures can be performed by emergency medical doctors on severely head-injured patients without significantly prolonged on-scene time. After starting prehospital trauma care employing EMD, there was a decrease in the deaths occurring before hospital admission and a reduction in the severe head injury mortality rate.

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Prehospital End-Tidal Carbon Dioxide and Outcome in Major Trauma

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Learning objectives: *To assess the value of end-tidal carbon dioxide concentration in predicting patient outcome after major trauma.*

Introduction. End-tidal carbon dioxide ($P_{ET}CO_2$) concentration reflects cardiac output when measured at an appropriate minute volume. $P_{ET}CO_2$ levels correlate both with outcome following 45–90 minutes of hospital resuscitation of trauma patients[1] and when measured after 20 minutes of prehospital advanced cardiac life support following non-traumatic cardiac arrest.[2] The predictive value of prehospital $P_{ET}CO_2$ concentration in survival from major trauma has not been examined. We retrospectively examined the predictive value of $P_{ET}CO_2$ and outcome in major trauma following prehospital advanced trauma life support.

Materials and Methods. Records were examined of patients with major blunt trauma treated by a doctor from the Helicopter Emergency Medical Service over a 4-year period (1998–2001). 191 patients were identified with major trauma requiring prehospital intubation at the roadside and in whom prehospital $P_{ET}CO_2$ had been recorded. Patients were ventilated at a minute volume appropriate to their weight (10 ml/kg/min). Initial $P_{ET}CO_2$ and $P_{ET}CO_2$ at 20 minutes after endotracheal intubation was recorded, together with survival to discharge.

Results. Outcome was related to $P_{ET}CO_2$. Mean $P_{ET}CO_2$ at 20 min post-intubation was 4.13 kPa in survivors and 3.51 kPa in non-survivors (95% CI of difference between means from 0.32 to 0.92 kPa). The difference between groups was highly significant (Mann-Whitney U test; $P<0.0001$). A ROC curve (Fig. 1) shows that $P_{ET}CO_2$ at 20 min ($P<0.001$) is a better predictor of outcome than at 0 min ($P=0.02$). Median ISS in survivors was 20.0 and in non-survivors was 41.0.

Discussion. $P_{ET}CO_2$ at 20 min predicts outcome from major trauma. Only 5% patients with $P_{ET}CO_2$ <3.25 kPa survived to discharge. $P_{ET}CO_2$ at 0 min is a poorer predictor, presumably because increased $P_{ET}CO_2$ secondary to airway obstruction is not an indicator of cardiac output.

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Moderated Poster Discussion

"Seat Belt Syndrome" In Children

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The term "seat belt syndrome" was first used by Garrett and Braunstein in 1962 to describe a distinctive pattern of injuries resulting from the use of lap belts in car crashes. The syndrome describes intestinal injury with concomitant spinal injury. We report two children presenting with this pattern of injuries treated in Ullevaal University Hospital.

Case 1: A 12-year-old boy was transferred to our hospital a few hours after a high-speed car crash. He had been a rear-seat passenger restrained with a lap belt. At the referring hospital a computed tomography (CT) scan showed disruption of the anterior abdominal musculature with herniation of bowel into the subcutaneous space. In addition, a severe diaphragmatic tear with the left kidney displaced in the left thoracic cavity was noted. The vertebral column was incompletely examined initially. After transferral, an abbreviated laparotomy was performed with a second-look operation performed the next day.

Non-viable small bowel and colon were resected, as was the left kidney. The diaphragmatic tear was repaired. Three enterostomies were constructed. A Chance fracture of L2 was diagnosed and treated conservatively. Closures of the enterostomies were performed after 6 weeks and 3 months, respectively. After 8 months, the patient was fully recovered.

Case 2: A 13-year-old girl was involved in a car crash while wearing an adult back-seat lap belt. On admission she complained of abdominal pain and was paraplegic. Physical examination revealed lap belt ecchymosis. An x-ray revealed a burst-fracture of L3. A CT scan showed no sign of intraabdominal injury. The L3 fracture was stabilized operatively. The patient developed abdominal distension a few hours later and was referred to our hospital. Repeated CT scan showed free intraperitoneal fluid and air. Exploration of the abdomen revealed massive contamination with a proximal jejunal perforation and necrosis of the transverse colon. Bowel resections and construction of three enterostomies were performed. The jejunostomy was closed at day 11, the colostomies after 6 weeks. The patient remained permanently paraplegic but otherwise recovered uneventfully.

"Seat belt syndrome" refers to the spectrum of injuries associated with lap belt restraints. Children wearing lap belts are at risk of a "lap belt complex." Both diagnosis and treatment present a challenge. Most important is to remember the typical combination of injury to intestinal organs and spine in these patients.

Traumatic Abdominal Wall Hernia in Children

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Traumatic abdominal wall hernia (TAWH) remains an unusual clinical entity despite the increased incidence of blunt trauma. In children, very few cases have been reported. Recognition of these hernias is of importance since they may be associated with significant intraabdominal injuries, as in the two cases of TAWH in children presented herein.

Case 1: A 12-year-old boy was a rear-seat passenger wearing two-point fixation in a motor vehicle crash. He presented to the local hospital complaining of severe abdominal pain; abdominal ecchymosis was present. A computed tomography (CT) scan revealed a large defect of the lower anterior abdominal wall with herniation of small bowel into the subcutaneous tissue, rupture of the left diaphragm, displacement of the left kidney into the left hemithorax, and bilateral haemothorax. He was transferred to our hospital and immediately after arrival the rupture of the left diaphragm was sutured; the left kidney and parts of small intestine and colon were resected. A second-look laparotomy was performed the next day and additional non-viable bowel segments were resected and three enterostomies were constructed. He had a complicated postoperative course. A Chance fracture of L2 without neurological impairment was treated conservatively. The enterostomies were closed 6 weeks and 3 months after the injury, respectively. He received parenteral nutrition for 5 months. One year after the accident he has regained normal activity with no signs of reccurence of hernia.

Case 2: An 8-year-old boy fell from a tree. He was admitted to an outside hospital, where he presented with abdominal pain and a bulge in the upper left abdominal quadrant. A CT scan revealed a defect in this region, with loops of small bowel in the subcutaneous tissue. A surgical exploration was performed and the hernia was repaired. The following day the patient deteriorated and was transferred to our hospital. At relaparotomy two litres of bile-stained fluid was evacuated and a jejunal perforation near the ligament of Treitz was closed by two layers of interrupted suture. Postoperatively he developed acute respiratory distress syndrome and a hemorrhagic peptic ulcer. Three months later he had regained normal activity with no signs of recurrence of hernia.

Building a Trauma System: The Rambam Medical Center Experience

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Rambam Medical Center is a 900-bed level one trauma center. The Emergency Room at RMC treats 45,000 trauma patients yearly, of whom 3,300 are hospitalized. Organizing a trauma unit is the easy part. Building a trauma team is more difficult. Our team consists of two general surgeons and two nurses. The surgeon is responsible for the trauma patient. It is very difficult to teach physicians and nurses to work as a team, and it took much practice and issuing of specific protocols and standing orders to achieve teamwork. A dedicated physician, preferably a surgeon, should be found to head the trauma unit and build the trauma center. Completion of an A.T.L.S. course is a vital step. A trauma unit has two major components: the admitting area and the team work. Our Trauma Unit consists of three identical bays, each containing a trolley with a monitor and a respirator, and all equipment is within easy reach. Having a well-equipped, well-operating trauma unit does not make a hospital a trauma center. Commitment and dedication do. The commitment must come from the hospital administration. Trauma takes priority, particularly in the operating rooms, intensive care units, and CT unit and in manpower.

The trauma nurse coordinator is the second most important position in the team. She is the crucial link between the patient, family, and multidisciplinary team. Her main task is to build a quality assurance system (QAS). Our QAS consists of a video camera in the admitting area, which records treatment of trauma patients and is reviewed later.

A trauma center does not make a trauma system. A trauma system ensures that all trauma victims receive the best treatment available. Our first task was to embrace the pre-hospital care providers. We began monthly meetings with paramedics, updating their knowledge in trauma and discussing their difficult cases. We also provide written feedback reports on every trauma patient. We developed special transfer documents and send written feedback reports for every patient transferred from other hospitals (700 annually). Our *Quality Assurance in Trauma* Committee meets weekly, while the *Trauma Forum* is a monthly gathering of people involved in trauma treatment, who discuss problems and issue standing orders.

Medial Meniscus Interpositon in a Proximal Tibial Physeal Fracture: A Case Report and Review of the Literature

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Proximal tibial fractures are rare in children. The majority of these injuries are treated conservatively.2 We report a case of minimally displaced proximal tibial fracture in an 11-year-old child. We would have normally treated this fracture conservatively but the presence of massive haemarthrosis and considerable pain made us proceed for examination under anaesthetic/arthroscopy under general anaesthetic. During examination under anaesthetic, no instability could be detected. On screening, the fracture was not reducible. This prompted us to proceed to arthroscopy. At arthroscopy, the medial meniscus was not visualised as expected and this made us wonder whether this could be trapped at the fracture site. A small medial arthrotomy showed the meniscus trapped at the fracture site without any avulsion in the anterior or posterior horns. The fractures easily reduced once the meniscus was levered out. We submit radiographs, intra-operative pictures, and post- reduction pictures of this interesting injury.

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Lack of Change in the Process and Outcome of Trauma Care in England and Wales Since 1994

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Learning objective: *To demonstrate trends in trauma care in England and Wales from 1989 to 2000.*

Study Population: Database of the Trauma Audit and Research Network, which includes hospital patients admitted for 3 days or more–those who died, were transferred, or admitted to intensive care area.

Method: In order to demonstrate trends in outcome, severity adjusted odds of death per year of admission to hospital were calculated for all hospitals (n=99) and 20 hospitals who had participated since 1989 (adjustments are for Injury Severity Score, age, and Revised Trauma Score). The grade of doctor initially seeing the injured patient in Accident and Emergency Department and median pre-hospital times per year of admission were calculated to demonstrate trends in the process of care. Trend analyses were carried out using simple linear regression (odds ratio vs. year.).

Results: The analysis shows a significant reduction in the severity adjusted odds of death of 3% per year over the 1989–2000 time period ($P<0.001$). During the period 1989–1994, the odds of death declined most steeply (on average 6% per year, $P=0.004$). Between 1994 and 2000, no significant change occurred ($P=0.35$). This pattern was mirrored by the 20 permanent members where the odds of death also declined more steeply over the 1989–1994 period. The percentage of severely injured patients (ISS >15) initially seen by a consultant increased from 10 to 24 from 1989 to 1994 but has decreased to 19% subsequently. Pre-hospital times for severely injured patients have not changed significantly since 1994 (51–45 minutes).

Conclusion: The majority of the case fatality reduction for trauma patients reaching hospital over the 1989–2000 time period occurred prior to 1995, when there was most marked change in the initial care of severely injured patients.

MATADOR–A Virtual Reality Simulator for Emergency Medicine

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Aim of the Project: It has been estimated that one of four deaths among trauma-patients could have been avoided, and most of the fatal mistakes happen in the initial phase. Medical knowledge is together with communication, co-operation, leadership and systematic routines, the key for success. Trauma resuscitation is best taught through direct exposure with hands-on experience. This type of teaching is in Norway limited by the relatively low incidence of serious injury and the consolidation of trauma care to a small number of centres. The aim of the MATADOR-project is therefore to develop a training environment that facilitates multidisciplinary group interaction in the management of acutely traumatised patients.

Material and Methods: MATADOR is an acronym for "Medical Advanced Training in an Artificial Distributed Environment". The simulator have been developed using the DOVRE (Distributed Object-oriented Virtual Reality Environment") platform, a tool for distributing 3 D-graphics, sound, and other multimedia streams over the Internet. The application is distributed i.e. several users can be in different locations and still "meet" in a shared, virtual world, using a standard internet connection. The initial critical period of a severely injured patient is simulated. The participants take the roles of the Surgeon, the Anaesthesiologist, the Emergency Room Nurse and the Nurse Anaesthetist. They are represented in the 3D-environment by *avatars*, human like 3D-figures whose "eyes" are the participant's point of view in the virtual world. The avatars can move freely in the horizontal plane of the virtual environment, which is a model of an emergency room. A distributed field trial will be arranged with 24 medical students, physicians and nurses in Norway and Sweden in April 2002. Aspects of collaborative learning, communication and leadership will be studied.

Results: Results from the field trial will be presented at the TraumaCare2002 conference in May.

Conclusion: MATADOR is a simulator for multidisciplinary training in the initial treatment of multi-traumatized patients. The advantage of the MATADOR prototype lies in the *distributed* form of the simulator; i.e. geographically remote participants can train and collaborate as a *team* in the same virtual emergency room. Advanced 3D-technology creates a clinically realistic environment, increasing the possibility for adopting experience from simulation into real life situations.

Do Car Safety Belts Always Save Life? A Case Report

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Introduction of mandatory safety belt laws significantly increased survival in car crash victims. However, misuse of safety belts may increase the risk of severe injuries. Proper position of driver or passengers is a necessary condition when using safety belts. We present a case of cervical spine injury caused by improper use of safety belts and tilted seat.

At the moment of car crash, when the seat was tilted back and the safety belts were on, the victim was propelled forward, thus "slipping" underneath the waist part of the belt towards the floor of the car. Then, the arm part of the safety belt was blocked at the level of neck, causing damage to spinal ligaments and tear of spinal cord.

Conclusions: Upon car crash, misuse of safety belts and/or improper position of seats may result in equally severe injuries as while driving without safety belts. Only proper position of car seats and appropriate use of safety belts may lead to reduction of car crash-related harm and better survival.

Treatment of Hard Osseous Chest Frame Trauma

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The authors report on their experience with 2023 patients suffering from chest trauma. The patients were treated in the Faculty Surgery Clinic of K.T.Ovnatanyan, Donetsk State Medical University during the years 1991–2001. Three hundred seventy-nine patients (18.7%) had severe chest trauma. Of these 379 patients, 163 (43%) were injured during transportation, while 139 (37%) were injured in work-related incidentes and 77 (20.3%) in domestic incidents.

In 92 (24%) of the patients, the breast bone and ribs were fractured at multiple sites. The clinical course gravity of the mentioned above was determined by the amplitude of flotation and unstable fragments area of the chest. It conditioned the haemodynamic violations expression and the shock gravity, going with the direct heart bruise and other organs and systems damage.

Medical treatment included restoration of breathing, pleura cavity drainage, cardiovascular support, and osseous chest frame stabilization. Intrapleural osteosynthesis was applied in 38 cases when numerous ribs and breast bone fractures were combined with intrathoracic organ damage requiring immediate surgical intervention. Metal osteosynthesis of the ribs were applied in 26 cases, ribs and breast bone combined in 8, and breast bone only in 4 patients. Extrapleural panel fixations of numerous fractures were performed in 42 patients, according to the authors' methods, as shown in the picture (patent Russia 204234). Of 91 patients, 86 patients with fragmental ribs and breast bone got better and 5 (5.5%) died.

Treatment of Traumatic Lesions of the Extrahepatic Bile Tract

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Between January 1982 and December 2001, a series of 18 patients were operated on at our institution for traumatic biliary injuries. The injuries involved the hepatic or choledochal duct in 3 cases and the gallbladder in 16 cases.

The causes of injuries were traffic accidents (n=3), criminal blunt injuries (n=3), non criminal blunt trauma (n=1), stab injuries (n=10) and gunshot injury (n=1). According to Organ Injury Scaling (OIS) there were 3 patients with grade I, 13 patients with grade II gallbladder damage, and 3 patients with grade IV hepatocholedochal injuries. Isolated extrahepatic biliary tract injury was found in two cases (11.1%). Main associated injured organs were liver (n=15, 83.3%), small intestine (n=2, 11.1%), large intestine (n=2, 11.1%), and diaphragm (n=2, 11.1%).

Delay in proper surgical treatment due to video-laparoscopic misdiagnosing of grade II gallbladder injuries and grade IV common bile duct injury was seen in 3 patients (16.6%).

Conventional (14/16) or laparoscopic (2/16) cholecystectomy was performed in all cases of gallbladder injuries. Repair had been performed and a T tube or stent had been left in the main bile duct in 3 patients with bile ducts lesions. There were no postoperative deaths. No complications occurred after cholecystectomy. Postoperative infection occurred in one patient (3.1%) in a case when injury of common hepatic duct was misdiagnosed during laparoscopy. Stent or T tube was removed after an 8-month period and there were no bile duct strictures 2 years postoperatively. None of the patients who underwent immediate or early repair had complications.

Conclusions: 1) Traumatic injuries of the extrahepatic bile tract are rare. 2) Liver is the most frequent associated injured organ. 3) Laparoscopy does not always reveal biliary tract injuries. 4) Cholecystectomy still remains the method of choice in cases of gallbladder traumatic injuries. 5) Non transectional lesions of the extrahepatic bile ducts are managed successfully with primary repair over a T tube.

Early Rehabilitation in the Municipalities Following Multiple Trauma–A Pilot Study

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Introduction: The rehabilitation process after multiple trauma is of essential importance in the perspective of future functioning and quality of life. Return to productivity and participation in community life is the overall goal. The long-term physical and psychosocial consequences of multiple trauma are well documented. Little is known about continued early rehabilitation in the community following primary hospital rehabilitation. The aim of the study was to evaluate whether the problems, goals, and measures described by the rehabilitation professionals were in concordance with the patients' expressed and implicit problems and rehabilitation goals.

Materials and Methods: Sixteen patients with an Injury Severity Score (ISS) (16, and the 7 municipal rehabilitation services and 12 physiotherapists responsible in the rehabilitation were included. The patient population was studied by semi-structured interviews and Short Form 36 quality-of-life instrument (SF-36) 4 weeks and 6 months, respectively, after returning home, whereas the health professionals were interviewed by questionnaires. International Classification of Functioning, Disability and Health (ICF) was used in the text analysis.

Results: The SF-36 scores were significantly below Norwegian normative data on 7 out of 8 subscales. Main focus in the patients' goals (107) was on health and functioning (36) (impairments/activities) and on participation in work, education, and social life (52). Information from the municipal health services was limited. Few problems were described, and the measures taken consisted of technical aids and personal assistance. The physiotherapists' main focus throughout the entire process was on impairments and basic movement activities. Few goals comprised more complex activities like self-care or general life activities such as work, education, or leisure. Psychosocial problems and pain were underreported from the health professionals. None of the measures taken concerned work or education directly.

Discussion: The discrepancy between the patients' needs and goals and the health professional's focus and measures can be explained by the lack of knowledge about the long-term consequences of multiple trauma by the municipal health professionals and by insufficient functioning of the municipal rehabilitation services concerning rehabilitation as a coordinated multidisciplinary and participation oriented process in a biopsychosocial perspective. Ensuring the information flow from the primary hospital to the municipal health services could improve the conditions for a more optimal rehabilitation process.

Key Words: multiple trauma, rehabilitation, ICF.

CT Findings of Tracheal Injury

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Introduction: It is easy to detect a major tracheal injury resulting in respiratory distress but difficult to detect a minor tracheal injury exactly. We can easily suspect a respiratory tract injury from subcutaneous emphysema, deep cervical (prevertebral) emphysema in plane neck x-ray examination, or mediastinal emphysema in plane chest x-ray examination. A minor tracheal injury often brings significant respiratory crisis in patients suported by ventilator. Bronchoscopy often misses the existence of the upper tracheal injury, particularly in intubated patients. The aim of this study was to clarify the usefulness of CT image findings for diagnosis of the tracheal injury.

Materials and Methods: CT findings of patients with blunt neck or chest trauma having cervical emphysema (subcutaneous emphysema, deep cervical emphysema) were examined by neck and chest CT images. The irregularity of the tracheal wall, bulky emphysema, and low density area (LDA) around the trachea in CT images were evaluated. These findings were compared with the bronchoscopic findings and their clinical course. We believe that subcutaneous emphysema of patients with a tracheal injury might be worsened by positive pressure ventilation.

Results: Fourteen cases were examined. The irregularity of the tracheal wall was pointed out in 10 cases and an irregular LDA around the trachea in 5 cases. Three cases were diagnosed as a tracheal injury by bronchoscopy and by their clinical course. CT images of all 3 cases with tracheal injury showed irregularity of the tracheal wall and bulky emphysema close to the irregular LDA. CT images of 11 other cases showed an irregular LDA without emphysema close to it (n=2), irregularity of the tracheal wall without irregular LDA (n=7), and no irregularity of the tracheal wall and LDA (n=2), and their subcutaneous and deep cervical emphysema rapidly improved without any other sign of the tracheal injury. These 11 cases did not need any treatment for tracheal injury.

Conclusion: CT imaging is useful for the detection of tracheal injury in patients with blunt neck and chest trauma having subcutaneous and deep cervical emphysema.

Key Words: tracheal injury, CT scan.

Interdisciplinary Competence Development in Treatment of Trauma Patients Using Simulation

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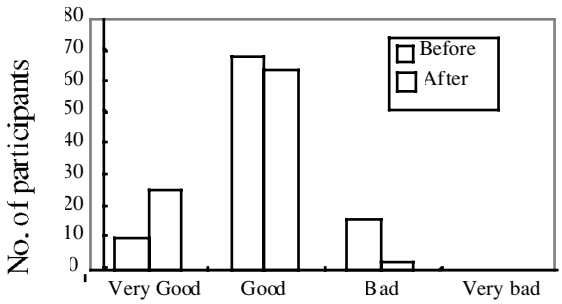
Introduction: The treatment of multitraumatised patients demands a coordinated effort of the trauma team. This requires knowledge of both aspects of treatment and leadership, communication, and co-operation. ATLS(principles are sought integrated in combination with the concept of simulation with vital parameters shown on monitors.

Method: We conducted two training courses with a total of 8 trauma teams (104 participants). The training was by nature interdisciplinary, as handling of these patients involved doctors, nurses, secretaries, hospital porters, x-ray staff, and staff from other specialties. The training took place in the emergency department trauma theatre. The simulations were videotaped for debriefing. A moulaged paramedic was made up as a patient. The training was conducted as a project granted from Copenhagen County.

Results: Figure 1 shows that knowledge was "shifted" from before to after the training.

Conclusion: The training was extremely well received by the participants. Most expressed the need for such regular training. The local trauma manual was well functioning. Training should be conducted every 6 months to ensure that new staff is integrated into the trauma teams.



Theoretical knowledge before and after the training according to the evaluation from the participants.

Characteristics of Open Pelvic and Acetabular Fractures

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Introduction: While pelvic injuries are common, open fractures are rare and are reported to occur in approximately 3% of all pelvic fractures. Open pelvic fractures are associated with a high mortality rate, often due to haemorrhage in the acute phase, later due to sepsis and multiple organ failure. We looked at the characteristics of 30 open pelvic fractures in patients admitted to our hospital.

Patients and Methods: The study was conducted as a prospective registration of patients with open pelvic fractures admitted to our level I trauma hospital during a 7-year period (Feb. 1995 to Feb. 2002). During this time, approximately 160 pelvic fractures were treated annually. Thirty fractures were open, constituting approximately 2.6% of all pelvic fractures. We studied the clinical and radiological parameters of these fractures.

Results: The patients' mean age was 30 years (range 8–86 years). Nine were females, 21 were males. All patients were exposed to high-energy traumas; 18 in traffic-, 7 in industrial-, 4 in sports-, and one in fall-related injuries. The average hospital stay was 26 days (range 1–83). The pelvic fractures were classified according to Association for the Study of Internal Fixation (AO [Arbeitsgemeinschaft für Osteosynthesefragen]) as 8 type A-fractures (stable), 10 type B (partially stable), and 11 type C (unstable) fractures. One patient had an isolated acetabular fracture, whereas associated acetabular fractures occurred in 7 patients. Four patients exsanguinated and died primarily (16%). Ten of the 30 patients had anorectal injuries (30%), 13 urogenital injuries (43%), and 5 degloving injuries (17%). Twenty-six had other associated injuries (87%). The patients required on average 38 blood units (SAG) during hospitalisation. Profuse initial haemorrhage necessitated primary treatment with extraperitoneal packing or embolisation in 13 of all patients (43%). Debridement and irrigation were performed in all patients who survived the first hours. Twenty-two fractures necessitated definite orthopaedic stabilisation, whereas 13 patients underwent diverting colostomy to prevent contamination. None of the patients who survived the first hours died during hospital stay.

Discussion: Pelvic fractures that communicate with an open wound are rare, but they are associated with high incidence of associated injuries and high mortality rates. Aggressive early control of haemorrhage, debridement, and diverting colostomy to prevent continued colonisation may have improved survival in these patients. The prognosis is good for those patients who, provided adequate primary treatment, survive the first hours of the initial haemorrhagic phase.

Traumatic Liver Injuries in Stockholm County–A Population-Based Study

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Introduction: The aim of this study was to investigate the incidence of traumatic liver injuries in the Stockholm County of 1.75 million inhabitants in 1996–1997.

Methods: Data on adults were retrieved from The National Board of Forensic Medicine (NBFM) for forensic autopsy reports and from The Public Health and Medical Services Committee Register (PHMSCR) for patients treated at Stockholm County's Emergency Hospitals.

Results: The traumatic liver injury incidence for 1996–1997 was 3.0/100000 per year. Seventy-seven cases (19 females and 58 males) were ascertained through the NBFM registry. The median age was 47 years. Penetrating trauma as the cause of liver injury was observed in 8% of the cases. In 42% of the cases were the right hepatic lobe injured, 9% of patients had injury on the left hepatic lobe, 38% had injury of both lobes. Liver injuries were graded[1] as follows: grade I, 8%; grade II, 13%; grade III, 27%; grade IV, 20%; grade V, 21%; and grade VI, 25%.

Twenty-eight cases (9 female and 19 male) were ascertained through the PHMSCR. The median age was 34 years. Eleven percent of the patients had penetrating trauma and 89% blunt trauma. In 54% of the cases the right hepatic lobe was injured, 11% of the patients had injury of the left hepatic lobe, 11% of both hepatic lobes, and 4% of patients had a central injury. Liver injuries were graded as follows: grade II, 46%; grade III, 14%, grade IV, 18%; grade V, 7%. The overall non-liver-injury related mortality of the hospital cases was 7%.

Discussion: To our knowledge no prior population-based liver trauma incidence studies have been published. Blunt trauma is the dominating trauma mechanism in Stockholm County in our material (91%). The dominating injury site was the right hepatic lobe. Grade II and III are the prevailing injury scores in our population.

Reference

1. Moore EE, Shackford SR, Pachter HL, et al: Organ injury scaling: spleen, liver and kidney. *J Trauma* 1989; 9:1664.

Missed Injuries in ICU Trauma Patients

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Aims: To analyse the frequency and quality of missed injuries in ICU trauma patients.

Methods: 273 consecutive trauma patients (177 men), mean age 35.7 (SD 19), range 1-92 years, ICU of the University Hospital of Lund, were investigated, including 6 months follow-up.

Results: 164/1098 injuries (14.9 %) in 107 patients (39 %) were not detected primarily. Most frequent missed lesions of the total number were thoracic 39/191 (mostly costae fractures), non-cerebral head lesions 27/121 (fractures dominating), abdominal 26/115 (spleen injuries dominating), pelvic fractures 8/40, cerebral injuries 15/144, extremities 22/252 (mostly fractures), and spinal cord 11/82.

The frequency of missed diagnoses was higher ($P<0.001$) with higher ISS: 0–25 points, 29 %; 26–50, 53%; and 51–75, 55%. The number of patients with missed injuries was more frequent ($P<0.001$) with more intense trauma: low-energy, 8%; medium-energy, 24%, and high-energy, 46%. Of 81 non-communicable patients, 52% suffered from missed injuries compared with 34% of the communicable ($P<0.01$). The highest frequency of patients with missed injuries involved accidents with cars (51%), fall from high altitude (44 %), motorcycles (41%), pedestrian hit by car (30 %), and bicycles (29%).

Seven percent of the injuries were diagnosed en-passant without any initial suspicion. In 128 cases, a trauma-CT (helical scanning) was performed, but in 32% injuries were not detected. 145 patients did not have a trauma-CT and in 29 % lesions were later found, which reasonably a CT-scan would have diagnosed. In 9 patients missed injuries were diagnosed during follow-up. Two cases were operated on, one with a subdural hematoma and one with an ankle ligament rupture. In 4/19 deceased patients, missed injuries probably contributed to the deaths.

The time at the ICU for patients with diagnosed injuries was in mean 2.2 days (SD 3.4) vs 3.9 (SD 4.6) ($P<0.001$) for those with missed injuries. The total hospitalisation time was in mean 17.8 days (SD 37.0) for diagnosed patients vs 28.2 (SD 53.4) ($P<0.05$) for those with missed lesions.

Conclusions: Despite that this trauma patient cohort required ICU hospitalisation, 15% of the injuries were primarily missed in 39% of the patients. Missed lesions were more frequent in patients with higher ISS, those with high-energy trauma, and those who were not communicable. These patients need repeated, careful examinations to reveal initially non-diagnosed injuries.

Noble-Collip Drum Trauma Model Revisited in the Mouse

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Introduction: Noble-Collip drum trauma in anesthetized rats is a well-described model of traumatic shock, characterized by marked microcirculatory perturbation and endothelial

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

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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

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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

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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

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

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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.