

2018 Combat Medical Care (CMC)

Conference Abstracts

Life in an Underground Syrian Field Hospital

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The United Nations has called the conflict in Syria “the greatest humanitarian tragedy of our times,” and UN officials have said that they are “running out of words” to describe the horrors inside Syria.¹ What started as a peaceful protest in March 2011 has led to 7 years of an escalating conflict in which hundreds of thousands of people have been killed.

The use of chemical weapons and napalm on civilians, the decimation and mass starvation of civilian populations through conventional warfare, the denial of medical care and humanitarian aid, the murder of medics, and the destruction of schools, bakeries, and hospitals—all of these actions have been systematic and deliberate by armed forces.²

A collapsed healthcare system further complicates the situation. Public hospitals and ambulances have been damaged or out of service. Thousands of healthcare personnel have fled the country for their safety, and hundreds have been arrested and tortured.

In some areas, sustained bombardments and intense fighting have transformed civilian and residential neighborhoods into a battlefield. As a result, medical work in these areas has been driven underground where doctors and nurses operate in secret, makeshift, provisional facilities such as caves, farms, and apartment buildings. Massacres and mass casualty events have unfortunately become a daily routine.

This presentation will give a glimpse into what life is like for Syrian medics operating in an underground field hospital under siege in Aleppo where snipers fire at the rooftop and barrel bombs land meters from its doorstep.

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Operation Triton

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Operation Triton was an order from the Norwegian government to the Norwegian Police Force, and its Norwegian National Criminal Investigative Services (NCIS), in the

early spring of 2015. Orders were to support the European Union border control “Frontex”. Due to the large number of migrants crossing the Mediterranean Sea at the time, it was decided to not only focus on border control but also on the ability to perform search and rescue mission. The Royal Norwegian Navy was tasked to support the police run mission, and did so by deploying personnel from the Coast Guard with experience from boarding operations and operations at sea. Force health protection was maintained by deploying personnel from the Royal Norwegian Navy Medical Services. The vessel was a civilian supply ship, reconstructed and adapted to suit the missions need. The crew was therefore roughly 30% police officers, 30% Navy personnel and 30% civilian crew, in order to maintain and run the vessel.

The medical team was later supported by personnel from the Norwegian Armed Forces Joint Medical Services, as the mission was prolonged and one wanted to avoid fatigue among Navy medical personnel.

The medical team was a ROLE 1 Level 2 team, consisting of a doctor, 2 nurses and 1 medical technician. The medical team’s main role was to maintain the health of the crew, the secondary aim was to be able to provide emergency medical aid to migrants who were sick or injured.

In the total operation the Norwegian vessel took on 35 896 migrants. Of these, there were 4719 women; 3985 were children assumed under the age of 16; 34 dead were picked up from other vessels and 65 were found dead or died during SAR actions where the Norwegian vessel was involved directly.

Operation Triton ended 31.12.2017.

A Combat Trauma Hospital Deployed for Humanitarian Response

Colonel B.D. Meunier, MD, FRCPC

On January 12th, 2010, the small Caribbean nation of Haiti suffered a devastating earthquake leading to a broad international humanitarian response. For the first time, the Canadian Armed Forces (CAF) included a deployed combat trauma field hospital, in addition to its Disaster Assistance Response Team (DART). The field hospital was self-sustaining and operated for 6 weeks on the outskirts of Léogâne, a town near the quake epicenter, where estimates placed >80% of the structures destroyed. The lessons learned from this accelerated field hospital deployment for humanitarian response, eight years ago, continue to shape the CAF’s policy and preparedness for domestic and international humanitarian as well as military combat deployments of advanced medical support capabilities.

Surgical Care of Combat Trauma in the Nigerian Armed Forces

Surgical Care of Combat Trauma in the Nigerian Armed Forces

The decade-long Boko Haram Insurgency in the North Eastern flank of Nigeria has resulted to gross economic loss, infrastructural destruction and loss of lives. The war against this national security threat with attendant deployment of the Armed Forces has brought about near return of peace to the troubled region. However, with deployment and combat come injuries and deaths to Soldiers, Sailors and Airmen. The responsibility to prevent, treat and rehabilitate these wounded warriors lies with the military health system. The entire chain of survival system starting from point of injury to rehabilitation is in incremental fashion according to the echelon of the combat arm being supported. Despite the unconventional tactics and use of improvised explosive devices by the insurgents, troops' survival from resultant horrific wound has remained impressive. Wound debridement and delayed primary closures of wounds were the commonest procedures in the field hospital in this conflict. Better survival is attributed to incremental improvement in the medical process, personnel and infrastructure over the years. Aeromedical evacuation and prompt surgical intervention has played a vital role in the highlighted improved survivability. 419 (98% of total) casualties were evacuated within the period of January 2017 and April 2018 by air component of OPERATION LAFIYA DOLE.

The concerted effort of the Federal Republic of Nigeria in winning the war and mission to boost the morale and care of the traumatized troops led to frequent very important personality visits to the wounded and enhanced rehabilitation. Rehabilitation is geared towards restoration of the wounded to the highest possible functional level, optimal reintegration and return to productive capacity. Visible in the counter-insurgency effort is also enhanced collaboration with allied Armed Forces and civilian health organizations. This mix is improving surgical care of combat trauma and enhancing training and research capacity of the surgical care givers.

Management of the Amok-Assault of Muenster Germany

Surgical Care of Combat Trauma in the Nigerian Armed Forces

Introduction

On April 7th, 2018 a van was deliberately driven into a group of restaurant guests in the historic city-center of Muenster, Germany. The driver committed suicide by gunshot straight after the assault: 25 people were injured, 3 declared dead on scene.

Development

Triage was initiated and resulted in 6 patients in acute life-threatening condition ("red"), 6 severely injured ("yellow") and 13 with minor injuries ("green"). During the start of the rescue-attempt police recognized explosives in the back of the van. Additionally, eye-witnesses reported that two men had fled the incident-scene carrying weapons. The scene was therefore declared unsafe by police and had to be evacuated during the rescue. Patients had to be carried on stretchers or led to a safe area secured by armed police.

Results

All patients received advanced trauma life-support care. Of the 6 patients in life-threatening condition 3 reached the

trauma-centers within 45 minutes after the incident. 3 other patients either needed extrication or anesthesia (severe head-injury). These patients were hospitalized between 70 and 100 minutes after the attack. Autopsy proved all 3 deaths inevitable. One additional patient died 18 days after the incident.

Conclusions

Immediate evacuation of an incident is a major burden for triage, patient-care and transport. Mass-incident equipment is needed at an early state. In this case the explosives found were not equipped with lighting. The reports of additional suspects were proved to be false.

Terror Attacks in Brussels on March 22nd, 2016: The Belgian Experience

J.C. de Schoutheete, E. Mergny, G. Vaes J, Borgers

In 2016, 1,441 attacks were counted for a total of 14,356 fatalities worldwide. In Europe, more specifically, the terror attacks in Nice were the heaviest with 86 dead followed by the ones in Brussels on March 22nd with 32 deceased. In terms of number of injured people on that day, the attacks in Brussels were proportionally not so deadly. In total, there were 324 hospital contacts related to the attacks. Why a so low proportion of fatalities in a country where no trauma system exists yet and knowing that the evacuation of casualties was made difficult by a dysfunctional mobile network as well as by a change of evacuation plan after the second attack in the underground?

At a coordination level, the crisis center first tried quite successfully to turn the mass casualty event into a minor mass casualty event, keeping care containable. Patients were first brought to the nearest hospital, but were then relocated to main hospitals farther away. Furthermore, the military hospital in Brussels was used as a buffer capacity. The first Forward Medical Post (FMP) was moved to the military hospital, which created a new FMP in a safe area.

At an intra-hospital level, not every patient requested a total body computed tomography scanner, which preserved resources. Key-resources like emergency room, intensive care and operating room were built up gradually during the day. Safety measures were also implemented gradually due to the level three terror threat in which the country was at that time.

In sum, as terror attacks by coordinated groups become more sophisticated and as more random attacks as well are made simultaneously on soft targets in western countries, using new terror methods of improvised explosive devices radio commanded or vehicle/drone borne or by making dirty bombs, we need to be prepared as good as possible. At a coordination level, the attacks in Brussels have shown that first, the battlefield experience with tactical casualty care and damage control resuscitation is important; second, a secondary FMP and a buffer capacity are paramount; and third, communication is always the Achilles tendon in a mass casualty event. Beside this, March 22nd has also revealed that the intra-hospital dynamic needs to be improved by developing access plans, by learning the pathology to be expected and related training, by making cards to describe staff functions, by elaborating a disaster plan and relevant training with, e.g., some e-learning for all staff of main national hospitals.

Paris – French Strategy Against Terrorism

F. Ramon, R. Roffi, D. Commeau, J. Galant, C. Boutillier du Retail Medical Center of Satory

The recent attacks targeting the European countries led to a substantial evolution of tactical medicine. At GIGN Medical Center, we have been preparing ourselves to such situations for a long time, thanks to our military status and the multiple operations we have carried abroad. We have worked at adapting what we have seen in Afghanistan and Mali to what we could encounter on our territory, because of the evolution of the terrorists' modus operandi. Mass terror attacks, suicide and drone bombings, multiple sites attacks are some of the threats we need to anticipate, because of the panic they usually trigger. The so-called "Fog of War" is typically a time of misunderstanding, where some of the wounded will die because of a lack of care. If we teach our armed forces the first care that can stabilize the wounded until the arrival of the first caregivers, as well as the basics of triage, we can hope to have more survivors. In order to do this, every member of GIGN (and the French army) is trained to Combat Care Lvl 1 (SC1), which includes the use of a tourniquet and safety blanket, and the implementation of extraction and secure position techniques. We have also trained some of them to Combat Care Lvl 2 (SC2), which means they know how to put an intravenous or intra-bone line, how to prepare some drugs, perform a tracheotomy and an exsufflation in case of a tensive pneumothorax. Our operators also have some basics in triage, in order to assist us in directing the wounded according to the seriousness of the injuries. In every squad, we also have a doctor and a nurse, trained to tactical medicine. They know how to use an algorithm similar to TCCC, which we call "SAFE MARCHE RYAN", where the first thing to do is to protect themselves, then to perform the care, beginning with the management of massive bleedings.

In terms of equipment, we have created several medical kits that we carry in backpacks, including a set of tourniquets, Quick Clots, blankets and light stretchers, in order to quickly control any massive bleeding and extract the injured to a rear and safe zone. This evolution of our equipment has been inspired by the massive findings stating that numerous deaths can be avoided when massive bleedings get quickly stabilized.

Our current human and material organization allows us to make an intellectual switch between the tactical squad in charge of the operation and which becomes in a snap a medical team including paramedics, with one to two doctors in charge of the medical crisis management, one to two nurses who can go from a wounded nest to another to assist the SC2, and several SC2 taking care of some wounded nests with the SC1s, helping them providing very basic, emergency care.

Our will is to permanently improve the efficiency of our cares, and we are firmly convinced that international cooperation and exchange between experts is crucial in this domain.

Ground Surgical Team: Development and Realization of a New Deployment Concept

Maj Suzanne See, Maj Elizabeth Anne Hoettels

The dynamic global environment requires the adaptation of medical concepts to optimally meet mission requirements. As the operational picture shifts, the demand for more mobile trauma resuscitation capabilities has increased. Concurrent requirements demand teams that have a small footprint with a limited transportation and logistical requirement. The

Air Force Mobile Field Surgical Team was the first-generation conventional force concept capable to forward deploy surgical and critical care capabilities. The six-person Ground Surgical Team (GST) was developed as the next-generation concept, evolving to provide an even smaller footprint in more austere locations. The modular configuration of the GST can provide damage control surgery for 3 patients with a 12-hour critical care holding capability within the first increment and flex to a total of 10 damage control procedures with the entire 1500 pounds (682 kilograms) of supplies. Along with the development of this new capability came the development of a new training pipeline. Pulling from the experiences of subject-matter experts, a 3-week training program was developed combining didactics, medical simulation, and a week-long field exercise. The first GST deployed in May 2017 with a hand-picked team of veteran deployers. As with any new platform, there were implementation challenges in both logistics and a steady need for socialization of the concept. However, opportunities for the team during the 90-day deployment allowed for concept validation, creation of operationally tailored configurations, and advancement of the training platform and logistical requirements for future GST deployments.

Belgian Special Operations Surgical Team: Experiences From Casualty Collection Points in Iraq

J.C. de Schoutheete, F. Waroquier, L. De Cupere, M. O'Connor, K. Van Cleynenbreugel, J.C. Ceccaldi, B. Vanderheyden

Bringing surgery to a Casualty Collection Point (CCP) near the frontline is a new concept that only a few western nations are doing. The NATO AJP-4.10 (B) does not describe this but it is currently discussed and it will be implemented in the next NATO AJP-4.10 (C).

At the beginning of the battle for Mosul in 2016, only Special Operations Force (SOF) Medics were involved at CCP's but gradually, because the frontline was pushed west farther away from the Role 2, surgical teams were asked to treat patients at these locations. The idea was to bridge the conventional medical capacity by putting a forward surgical element, performing triage and medical stabilization as soon as possible, or surgical stabilization if required, before further evacuation to a Role 2 medical treatment facility. This CCP system worked in parallel with the medical facilities provided by the Iraqi Ministry of Health and by different Non-Governmental Organizations. However, most of the patients seen at a CCP were evacuated after stabilization to these entities.

Belgium sent a Special Operations Surgical Team (SOST) to CCPs during 6 months in 2017. A Belgian SOST consists in six people: an anesthesiologist, a surgeon, an anesthesiology nurse, an operation room nurse, an operation room technician and a SOF medic. They were located 10 to 20 minutes (evacuation time) from the frontline with the first checkpoint one minute away. The evacuation time to the next local medical treatment facility and to the coalition Role 2 was between 5 and 60 minutes and 30 to 40 minutes respectively. The Belgian SOST did not have a laboratory or x-ray capacities at their disposal but they were equipped with an ultrasound device, a sterilization device and whole blood capability. The SOST saw more than 500 patients, from which about 10% required a surgical treatment. They treated a broad spectrum of patients, from which a six-month-old baby. In addition, they successfully performed three retrograde endovascular balloon occlusions of the aorta.

So, at these times when it becomes increasingly more difficult to deploy a Role 2 close to combat zones, the experience of the Belgian SOST has shown that medical and surgical treatments can be provided with good results in pre-hospital at CCP-level.

Starlite Aviation Group – International Milmedevac

Fiona McCarthy

Operations

Starlite Aviation Group is a diverse aviation company, offering a wide range of helicopter and fixed wing services. Boasting an impressive portfolio, having operated in 25 countries and 5 continents in some of the harshest environments in aviation, we are a solution driven organization focusing on providing mission ready aircraft for multi-task configurations on a global basis. Starlite prides itself as experts at taking on complex assignments in remote locations and focusing on fast deployment.

Medical

Dedicated intensive care equipped aircraft has become one of Starlite's primary areas of focus providing medically equipped helicopter and fixed wing aircraft on a 24/7 basis. The success of Starlite in this area is attributed to our all-encompassing service which provides aircraft, maintenance, medical equipment and consumables and fully operational, experienced teams for complex assignments in the most remote areas.

Flight Crew

Starlite's aircrew are made up of a select group of pilots with a wide range of flying experience ranging from, Medevac operations, general utility flying, high altitude cargo sling work, offshore and ship service flying, rescue and disaster relief, as well as night, Night Vision Systems and Instrument Flight operations.

Medical Personnel

Starlite provides highly qualified registered medical practitioners and advanced life support paramedics specialising in pre-hospital emergency care and extensive experience in trauma, cardiology, surgery, anaesthetics and aviation medicine. Starlite are committed to ensure a high level of quality of the medical service provided with the focus being on a seamless transition to provide uninterrupted medical evacuation including the transfer of ventilated intensive care patients to various hospitals while maintaining treatment if required.

Night Vision Systems

Starlite obtained the first ever official approval for Night Vision Systems from the European Aviation Safety Agency (EASA) and South African Civil Aviation Authority (SACAA) as a civilian air transport operator.

The night vision systems are used purely in a civilian role to enhance the safety of operations throughout the spectrum of our operations. In utilizing NVS in the civilian sector for the past 12 years predominantly with military experienced flight crew, we have gained a vast amount of experience in the safe practice of this system. NVS is extremely beneficial where time is crucial and any delay in dispatching a flight would add additional risk to a positive outcome of the situation which is often the case in emergency medical scenarios.

Starlite is a results oriented rotor wing and fixed wing operator who places priority on safety, availability and cost efficiency.

Starlite's goal is to deliver a top-quality, client specific service to achieve a cost-effective solution.

Starlite's strength lies in our previous experience operating rotor wing and fixed wing aircraft in hostile environments with full intensive care capabilities which has provided us with the knowledge of anticipated maintenance issues and the various layers of safety applied to operations in harsh operating environments.

Surgeon Experience in Afghanistan and Iraq: Improving Outcomes in Low Resource and Austere Surgery

LCdr Sanita Atwal Dr, Department of National Defence (Canada)

The challenge of providing medical and surgical care in military operations is multi-layered, depending on the type of operation, the responses required, the medical rules of engagement, and the underlying circumstances upon which these are overlaid.

Combat surgical care focuses on providing appropriate stabilization, resuscitation, and damage control procedures for injured soldiers, with the anticipated course being their evacuation rearward, through established levels of care, with speedy repatriation so that definitive care can then be accomplished. Conflict ops may also involve caring for injured local soldiers and civilians; other military responses include efforts of humanitarian or disaster relief.

Humanitarian emergencies complicate standard conflict (trauma) care, and natural disasters, famine, and disease outbreaks are characterized by the collapse of infrastructure and basic health services. Emergencies are superimposed on longstanding needs, and on extreme poverty. Over 95% of the world's refugees and displaced persons are in low or middle income countries, and disproportionately represented are the countries with high maternal, newborn and child mortality rates.

The special considerations are (1) care of more vulnerable populations, such as women, children, and the elderly, (2) lack of standard equipment and medications, (3) the need to alter surgical strategies, perhaps using older or more radical techniques, (4) the need to provide definitive solutions for local patients, (5) the need to be cognizant of the local resources, and the ability of the local organisations to care for complex patients, and (6) these considerations need to be balanced with the absolute requirement for ethical treatment.

We have the opportunity to enhance our clinical capabilities to tailor our medical response and to achieve the best outcomes for low-income, high-risk populations. Civilian medical databases (MEDLINE) and published literature from multiple humanitarian organisations (EM-DAT, ICRC, UNHCR, WHO, Oxfam, World Vision, UN Dept of Peacekeeping Operations, World Bank, Global Humanitarian Assistance, CDC, MSF, Canadian Global Surgery, Canadian Network for International Surgery), as well as available military databases (JTTR) can be systematically reviewed to detail the most common surgical issues treated and procedures required.

Once the most common problems are identified, a data-collection tool adapted from those extant, or formulated based on these can be used to form a prospective dataset to identify our own most commonly encountered global/conflict surgical problems, and most beneficial/lifesaving interventions.

Collating and reporting annually will allow us to formulate a training plan directed to these specific needs, to teach the relevant core surgical skills (already identified by civilian humanitarian organisations) and to facilitate ongoing re-evaluation, modification and enhancement of these competencies, tailoring them to new urgent needs.

Morbidity and mortality data can then be reviewed, with clinical responses to appropriate surgical interventions.

Finally, a long-term data review program will allow transition from individual/group responses to a broader application to guide medical and surgical response planning and resource allocation in the face of a wide variety of wartime and humanitarian crisis situations.

Research on Trauma Induced Coagulopathy

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Introduction: Trauma is the leading cause of death in patients under the age of 45 worldwide. Most of these deaths due to trauma are caused by major bleeding. A complication of major bleeding and increasing factor of mortality is the trauma induced coagulopathy (TIC) (1,2). Not only in civilian, but especially in combat situations major hemorrhage is one of the main reasons why soldiers are killed in action (KIA). Due to this, various prehospital transfusion concepts were introduced in civilian and military prehospital trauma care procedures of multiple countries. But until now there are neither sufficient tools available to identify patients out-of-hospital (OOH) who could profit from administration of a blood product because the best method for detection of TIC is the thrombelastometry (3), nor which would be the best blood product to use in prehospital trauma care. In 2015 we conducted the PREDICT-Study (Prehospital Evaluation and Detection of Induced Coagulopathy in Trauma-Study) (4).

Methods: Beginning in August 2015 we included trauma patients who were treated by the team of HEMS Christoph 22, Ulm/Germany. Out-of-hospital and again in the emergency room (ER) we drew blood for thrombelastometry (TEM) with Rotem® for evaluating CT, CFT, CF, A10, MCF in Intem, Extem, Fibtem and Aptem, as well as plasmatic coagulation parameters (aPTT, INR, Quick), blood count and blood gas analysis. In addition to this we collected over 70 parameters per patient like trauma mechanism, injuries, administered fluids, vital signs, blood product transfusion in the first 24 hours, etc. The Study is registered under DRKS00009559 (German Registry of Clinical Trials) and has a positive vote of the ethic committee of the University of Ulm (346/14).

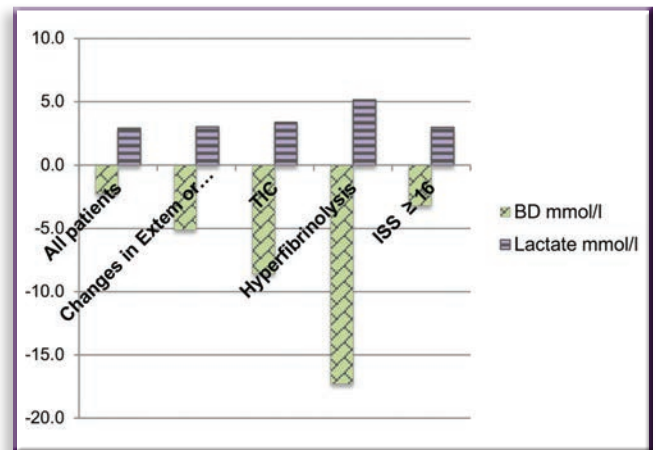
Preliminary Results: From August 2015 to February 2017 130 patients were included. Of 82 patients we had complete OOH data at Feb 2017. The mean ISS of all 82 patients was 19.7 and the NISS 24.6. In 30.5 % of the patients there were pathological findings in Extem and/or Fibtem, 13.4 % had a TIC with abnormalities in Extem and Fibtem and 4.9 % of all 82 patients had already on scene a hyperfibrinolysis. In addition to changes in Extem and Aptem in the OOH blood probe we found in the patients with TIC a significant correlation with base deficit in Wilcoxon's two pair test ($p=0.0356$), but

no significance in correlation with prehospital lactate levels ($p=0.8102$). The group of patients with TIC and hyperfibrinolysis was at the time of preliminary data evaluation too small to do sufficient statistics.

TABLE 1 P-value of base deficit and lactate in Wilcoxon's two-sample test (4)

p-value	Changes in Extem or Fibtem	TIC	Hyperfibrinolysis	ISS \geq 16
Patients	25	11	4	46
BD	0.0135	0.0356	—	0.1096
Lactate	0.4432	0.8102	—	0.3453

TABLE 2 On-scene base deficit and lactate values of all patients and different subgroups (4)



Conclusion: We could show that TIC already exists on scene in severe trauma. For detection of those patients the measurement of base deficit could be a trustable early detection parameter for trauma induced coagulopathy whereas lactate is not valuable for the detection of early coagulopathy in trauma. For Determination and Evaluation of Thresholds in Early Coagulopathy in Trauma, we soon will start another OOH study named TIC-DETECT.

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Is There an Indication for Pre-hospital Trepanation?

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Traumatic brain injury (TBI) can be a severe injury. In case of a severe traumatic brain injury the patient should arrive in a trauma center within 60 minutes. Computed tomography scan of the brain has to be performed quickly in order to assess the extent of intracranial injury. In the case of post-traumatic unconsciousness, direct transport to a trauma center with neurosurgical care is recommended. If required after the computed tomography an operation should be performed. Glasgow Coma Scale (GCS) score under 9, intubation and ventilation should be performed. Normoventilation, normoxemia and normotension should be achieved.

According to the literature and examples there is no indication for pre-hospital trepanation in military missions or in the civilian emergency medical service. Trepanation without diagnostic is life-threatening for the patient. Critical bleeding of the scalp must be stopped in pre-hospital settings.

A Look to Future – Ways to a Complete Scarless Regeneration After Severe Skin Trauma

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The treatment of soft tissue injuries is the dominating operative procedure curing soldiers wounded in action. Frequently, the initial injury and/or further surgical treatment leave huge soft tissue defects which need to be reconstructed due to functional and aesthetic reasons. Additionally, the mainly young and prior to the trauma active patients have high expectations concerning their outcome. Although reconstructive possibilities and skills in central Europe and northern America are consistently impressive, the mostly severe and multiple wounded soldiers often stretch the caring surgeon to his limits. While tissue defects and their reconstruction are a relevant task especially in the acute and post-acute phase of rehabilitation, functional restrictions and psychological burden because of scar formation are medium- to long-term problems which must be avoided as good as possible.

Modern science might offer great options for the treatment of different types of defects in future, e.g. the use of stem cell supported or based therapies in severe injuries of the skin. Options for reducing or avoiding scar formation might come along with these attempts.

It is well known that proper activation of macrophages in the inflammatory phase of acute wound healing is essential for physiologic tissue repair. While fetal wound healing is able to proceed without scars, massive macrophage inflammatory responses may be causal for the fibrotic response always accompanying adult wound healing. The presented study addressed the question whether mesenchymal stem cells (MSCs)—due to their anti-inflammatory properties—represent a strategy to control macrophage activation and scar formation in a murine model of full-thickness skin wounds.

When MSCs were injected into wound margins we observed a significantly accelerated wound closure as well as a histologically reduced scar formation in contrast to the control group (injection of phosphate-buffered saline [PBS]).

We were able to show that the TNF- α stimulated protein 6 (TSG-6), which is released by MSCs, following injection into wound margins, suppressed the release of TNF- α from activated macrophages. This is of major importance because TNF- α leads to an enhancement of the inflammatory response causing impaired wound healing and most likely the extend of scar formation. Furthermore, our results showed that the injection of MSCs or recombinant TSG-6 lead to a suppression of myofibroblast differentiation which eventually is responsible for the characteristic tissue organization of scars in adult wound healing. Following this perception, we were able to show that injecting MSCs in acute wounds leads to a significantly reduced scar depth and a better scar texture compared to PBS-injected control wounds.

This study provides insight into what we believe to be a previously undescribed multifaceted role of MSCs-released TSG-6 in wound healing. MSCs-released TSG-6 was identified to improve wound healing by limiting macrophages activation, inflammation and fibrosis. TSG-6 and MSCs-based therapies may thus qualify as promising strategies to enhance tissue repair and to prevent excessive scar formation.

GU-Trauma – What We Can Do and What We Should Be Able to Do

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Introduction

The GU-tract is most often affected in polytrauma patients resulting from blast injuries. As part of a multinational team, currently one German urologist is on deployment at Bagram Airfield, Afghanistan. GU-trauma-cases become more frequent and these mutilating injuries are resulting in voiding and sexual dysfunctions, leaving the patients stigmatised and handicapped, not able to start a family.

Aim of the Talk

Training and qualification of urologist on missions are sufficient for managing acute trauma cases for medical evacuation and protection of sexual and voiding function. Critical discussion should be raised about currently used protection wear and the possibilities of recovering of reproductive and rehabilitation of sexual function.

Topics:

German urologists are well trained in managing GU-trauma to the kidney, ureter, bladder, penis, urethra and testicles. GU-traumatic cases are rarely life-threatening and often part of complex injuries. Acute urological care for GU-trauma is only the first part on the way to total rehabilitation. There are open questions on preservation of reproductive function and restoring sexual life in young soldiers after surviving life-threatening blast injuries.

Conclusion

Acute management of GU-trauma is demanding, but German urologists are well trained. Current focus has to be the late sequela of blast injuries and their total rehabilitation including sexual and reproductive function.

EPICSAVE – A Multi-user Virtual Reality-Simulation for Paramedic Education

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Introduction: Rare exposure to critical, complex, highly dynamic emergencies, such as severe anaphylaxis, is a major challenge during vocational training. Widespread training methods using low- or high-fidelity simulators or even standardized simulation patients show considerable limitations in representing the dynamically fluctuating symptoms (e.g. cyanosis, rash, level of consciousness, postural change) and vital signs. Immersive VR environments are learn-effective and cost-efficient solutions for creating simulations in a vast set of areas, especially in emergency medicine. Furthermore, multi-user VR-environments enable social interaction through several multisensory channels; they also support coordinated and cooperated actions and improve collaborative learning and team training.

Methods: EPICSAVE (www.epicsave.de) is a project funded by the German Ministry of Education and Research and the European Union Social Funds (support file: 01PD15004). It involves an interdisciplinary consortium that incorporates expertise from all relevant disciplines, i.e., emergency medicine, paramedic-training academies, media education, media design, and VR-technology.

Project aims were:

1. Development of a virtual reality-(VR)-simulation environment and
2. Implementation and evaluation of the training system within two paramedic vocational training institutions.

In an iterative process, we developed an immersive, navigable, multi-user 3D VR emergency scenario with an integrated virtual patient (VP). The VP represents all common clinical symptoms of anaphylaxis—and many other cardiovascular and pulmonary emergencies. The VR environment allows the training of task-work skills, such as clinical and procedural reasoning, and of teamwork skills, which are necessary for effective crisis resource management. The VR environment, in which the trainees interact via a head-mounted display and hand-controllers, offers many interaction tools, such as the use of diagnostic (penlight, stethoscope, ECG, pulse oximetry, measurement of blood pressure, temperature, and blood glucose) and therapeutic equipment (e.g. oxygen insufflation, airway management, defibrillation, i.v. and i.m. injection, pharmacotherapy). The system allows spatial navigation through the emergency scenario and verbal communication with trainees and trainer. A tutoring system records all actions within the VR and supports trainers in the debriefing phase.

Results: In a formative evaluation of the prototype by 24 paramedic trainees, we could demonstrate a positive and sustained learning experience that depends on a high presence experience, which in turn depends on an acceptable usability.

Discussion: Usability in VR is an important issue as there are no standards, yet. We identified and solved several aspects in our VR-prototype that caused “breaks in presence” and cognitive load (e.g., communication and navigation problems). Further studies should focus on long-term learning effects.

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3D-SC1, a Serious Game for Forward Combat Casualty Care Training of French Soldiers: Development, Deployment and Assessment

Soldiers: Development, Deployment and Assessment
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Background: The French Military Medical Service has standardized its military prehospital care policy in a “Sauvetage au Combat” (SC) program (Forward Combat Casualty Care). A major part of the SC training program relies on simulations, which are challenging and costly when dealing with more than 80,000 soldiers. In 2014, the French Military Medical Service decided to develop and deploy 3D-SC1[®], a serious game intended to train and assess soldiers managing the early steps of SC.

Objective: The purpose of this paper is to describe the creation and production of 3D-SC1[®] as well its deployment and assessment, based on a study aiming to evaluate the impact on performance of additional training with 3D-SC1[®].

Methods: A 10 experts group, and the Paris Descartes University Medical Simulation Department spin-off, Medusims, co-produced 3D-SC1[®]. Medusims are virtual medical experiences using 3D real-time videogame technology designed for educational purposes (training and assessment) to simulate medical situations. These virtual situations have been created based on real cases and tested on mannequins by experts. Trainees are asked to manage specific situations according to best practices recommended by SC, and receive a score and a personalized feedback regarding their performance. Furthermore, a recent study assessed the performance of soldiers randomly assigned to one of two groups, before (measure 1) and after (measure 2) receiving additional training. This training involved either 3D-SC1[®] (Intervention group), or a DVD (Control group). The principal measure was the individual performance (on a 16-point scale), assessed by two investigators during a hands-on simulation. First, the mean performance score was compared between the two measures for Intervention and Control groups using a two-tailed paired t-test. Second, a multivariable linear regression was used to determine the difference in the impacts of 3D-SC1[®] and DVD training, and the order of presentation of the two scenarios, on the mean change from baseline in performance scores.

Results: The scenario simulated in 3D-SC1[®] is an attack on a patrol of 3 soldiers with an improvised explosive device explosion as a result of which one soldier dies, one soldier is slightly stunned, and the third soldier experiences a leg amputation and other injuries. This scenario was first tested with mannequins in military simulation centers, before being transformed into a virtual 3D real-time scenario using a multi-support, multi-operating system platform, Unity. Processes of gamification and scoring were applied, with 2 levels of difficulty. A personalized debriefing was integrated at the end of the simulations. The design and production of 3D-SC1[®] took 9 months. The deployment, performed in 3 months, has reached 84 of 96 (88%) French Army units, with a total of 818 hours of connection in the first 3 months.

In the assessment study, a total of 96 subjects were evaluated: seven could not be followed-up, while 50 were randomly allocated to the Intervention group, and 39 to the Control group. Between measure 1 and measure 2, the mean (SD) performance score increased from 9.9 (3.13) to 14.1 (1.23), and from 9.4 (2.97) to 12.5 (1.83), for the Intervention group and Control group, respectively ($p < 0.0001$). The adjusted mean difference in performance scores between 3D-SC11 and DVD training was 1.1 (95% confidence interval 0.3, 2.5) ($p = 0.14$). Overall, the study found that supplementing SC1 training with either 3D-SC1[®] or DVD improved performance, assessed by a hands-on simulation.

Conclusion: The development of 3D-SC1[®] involved a collaborative platform with interdisciplinary actors from the French Military Medical Service, medical university, and videogame industry. Training each French soldier with simulation exercises and mannequins is challenging and costly. Implementation of 3D-SC1[®] into the training program offers a unique and efficient opportunity at a lower cost to improve training and subsequently the real-time performance of soldiers when managing combat casualties; ideally, these should be combined with physical simulations.

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Health Aspects of Mountain Warfare

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Mountain environment is one of the most challenging areas of warfare. Cold, wind, rugged terrain, avalanches/landslides, ultraviolet radiation, altitude/hypobaric hypoxia and often a combination of those factors are environmental threats, which cause specific health disorders, standard military medical units are often not sufficiently prepared for. In addition, military tactics aggravate those environmental challenges, compared to civilian mountaineering. A short preparation time, a lack of acclimatization possibilities, a prolonged stay at high altitudes, additional equipment, a weak chain of evacuation and hostile forces caused large number of casualties in past mountain campaigns, and still do today. A significant proportion of those casualties is caused by environmental factors.

Not least through the war on terrorism, mountain warfare is not a problem of the past - in contrast, it is of increasing frequency. Therefore, it is of utmost importance, that military leaders are able to identify, the most challenging environmental factors in addition to tactical threats: Rugged terrain, cold weather and altitude/hypobaric hypoxia. According to the main environmental hazards, different preventive measures exist. Personnel selection, intensive mountain mobility training, behavioral training in extreme environments, adapted time calculations, use of pack animals, a special diet, sufficient mountain equipment, training in treatment of mountain specific diseases and prolonged field care, training in air rescue and alternative evacuation techniques can reduce the influence of mountainous environment. However, most of them have to be initiated well in advance, some of them even years before deployment.

The environmental factor truly unique to mountainous environment is long-term exposure to altitude/hypobaric hypoxia. Experience outside specialized mountain units is often very rare and the effects are therefore often underestimated. Besides performance decrements (some strenuous military tasks like move under direct fire or carriage of heavy equipment might be impossible at high altitudes) potentially lethal high-altitude illnesses exist. To deal with this challenge, acclimatization protocols, adapted time calculations and profound knowledge in (medical) prevention and treatment of high altitude illnesses is paramount. However, natural acclimatization during combat missions is almost impossible, due to logistical and tactical reasons. Preacclimatization at natural heights or in hypobaric chambers is possible, however, deacclimatization has to be considered. A promising alternative may be acclimatization in normobaric hypoxia shortly before operations at altitude are launched.



Winter 2018
Volume 18, Edition 4

J^SO^M

JOURNAL of SPECIAL OPERATIONS MEDICINE™



THE JOURNAL FOR OPERATIONAL MEDICINE AND TACTICAL CASUALTY CARE



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