NORTH ATLANTIC TREATY ORGANIZATION

SCIENCE AND TECHNOLOGY ORGANIZATION

AC/323(HFM-250)TP/925

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STO TECHNICAL REPORT **TR-HFM-250**

Improving Anaesthesia and Sedation through the Battlefield

(Sédation et anesthésie en opérations extérieures)

Presentation of Clinical Guidelines related to sedation and anaesthesia throughout the battlefield. Minimal standards of care for NATO anaesthesia providers are described.

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The NATO Science and Technology Organization

Science & Technology (S&T) in the NATO context is defined as the selective and rigorous generation and application of state-of-the-art, validated knowledge for defence and security purposes. S&T activities embrace scientific research, technology development, transition, application and field-testing, experimentation and a range of related scientific activities that include systems engineering, operational research and analysis, synthesis, integration and validation of knowledge derived through the scientific method.

In NATO, S&T is addressed using different business models, namely a collaborative business model where NATO provides a forum where NATO Nations and partner Nations elect to use their national resources to define, conduct and promote cooperative research and information exchange, and secondly an in-house delivery business model where S&T activities are conducted in a NATO dedicated executive body, having its own personnel, capabilities and infrastructure.

The mission of the NATO Science & Technology Organization (STO) is to help position the Nations' and NATO's S&T investments as a strategic enabler of the knowledge and technology advantage for the defence and security posture of NATO Nations and partner Nations, by conducting and promoting S&T activities that augment and leverage the capabilities and programmes of the Alliance, of the NATO Nations and the partner Nations, in support of NATO's objectives, and contributing to NATO's ability to enable and influence security and defence related capability development and threat mitigation in NATO Nations and partner Nations, in accordance with NATO policies.

The total spectrum of this collaborative effort is addressed by six Technical Panels who manage a wide range of scientific research activities, a Group specialising in modelling and simulation, plus a Committee dedicated to supporting the information management needs of the organization.

- AVT Applied Vehicle Technology Panel
- HFM Human Factors and Medicine Panel
- IST Information Systems Technology Panel
- NMSG NATO Modelling and Simulation Group
- SAS System Analysis and Studies Panel
- SCI Systems Concepts and Integration Panel
- SET Sensors and Electronics Technology Panel

These Panels and Group are the power-house of the collaborative model and are made up of national representatives as well as recognised world-class scientists, engineers and information specialists. In addition to providing critical technical oversight, they also provide a communication link to military users and other NATO bodies.

The scientific and technological work is carried out by Technical Teams, created under one or more of these eight bodies, for specific research activities which have a defined duration. These research activities can take a variety of forms, including Task Groups, Workshops, Symposia, Specialists' Meetings, Lecture Series and Technical Courses.

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Published March 2020

ISBN 978-92-837-2250-2

Table of Contents

List of Figures

List of Tables

List of Acronyms

5-HT	5 HydroxyTryptamine
ALI	Acute Lung Injury
ARDS	Acute Respiratory Distress Syndrome
ASA score	American Society of Anaesthesiology score
AVPU scale	Alert / Visual / Pain / Unresponsive scale
BATLS	Battlefield Advanced Trauma Life Support
BIS	BISpectral Index
CO	Cardiac Output
CPNB	Continuous Peripheral Nerve Blockade
CPP	Cerebral Perfusion Pressure
CT scan	Computed Tomography scanner
DC	Damage Control
DCR	Damage Control Resuscitation
DCS	Damage Control Surgery
DLT	Double Lumen Tube
DVT	Deep Venous Thrombosis
EMT	Emergency Medical Team
ET	Endotracheal Tube
etCO2	end tidal CO2
FFP	Fresh Frozen Plasma
FWB	Fresh Whole Blood
GCS	Glasgow Coma Scale
GFR	Glomerular Filtration Rate
GP	General Practitioners
HPMK	Hypothermia Prevention and Mitigation Kits
ICP	Intra-Cranial Pressure
ICU	Intensive Care Unit
IM	Intra-Muscular
IN	IntraNasal
IO	Intra-Osseus
IV	IntraVenous
MAP	Mean Arterial Blood Pressure
MDZ	Midazolam
MEDEVAC	MEDdical EVACuation
MT	Massive Transfusion
MTF	Medical Treatment Facility
NIP	Non-Invasive Pressure
NMBA	Neuro Muscular Blocking Agent

NPWT	Negative Pressure Wound Therapy
NSAID	Non-Steroid Anti-Inflammatory Drug
OTFC	Oral Transmucosal Fentanyl Citrate
Plt	Platelets
POC	Point Of Care
PRBC	Packed Red Blood Cells
R1	Role 1
R2	Role 2
R3	Role 3
RSI	Rapid Sequence Induction
SC	Sub-Cutaneous
SpO2	Saturation of Peripheral Oxygen
ST	Spinal Trauma
STRAT-AE	STRATegic Aeromedical Evacuation
SXM	Suxamethonium
TBI	Traumatic Brain Injury
TBSA	Total Burn Surface Area
TCCC	Tactical Combat Casualty Care
TXA	Tranexamic Acid
US	Ultra-Sound device
VAS	Visual Analogue Scale
WHO	World Health Organization

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Improving Anaesthesia and Sedation Through the Battlefield

(STO-TR-HFM-250)

Executive Summary

Large numbers of NATO personnel have been injured over the last two decades in recent high intensity combat operations. These personnel would almost certainly have required at least one episode of anaesthesia or procedural sedation. However, there are currently no standardised NATO guidelines for anaesthesia or sedation. This could be a significant concern as anaesthesia providers credentials, qualifications and practices will vary amongst NATO contributing forces.

Combat related injuries differ significantly from those sustained in civilian trauma care and are characterised by an increased proportion of blast related injuries as well as high energy transfer penetrating injuries. The injuries sustained are often multiple and may be combined with blunt trauma and burns. Consequently the anaesthesia and sedation in the combat environment will differ from the civilian setting. Also the military environment is characterised by multiple patient transfers and interventions at different levels of care where capabilities of providers and equipment vary between different nations and at different echelons of care.

HFM-250 reviewed the national policies of all the panel contributing nations, as well as other NATO countries where available, in seven key areas of anaesthesia and sedation for combat injuries:

- Airway management;
- Analgesia;
- Damage Control Resuscitation;
- Traumatic Brain Injury;
- Anaesthesia for combat related thoracic injury;
- Anaesthesia for burns; and
- Anaesthesia data sets.

The panel agreed on some common basic principles across these key areas but detailed guidelines are limited due to the constraints of national policy and regulations. Healthcare providers actions must remain within the scope of practices of their national regulatory policies. Where multiple nations are delivering care in a joint facility a lead nation must be identified and a Memorandum of Understanding (MOU) produced which include areas of difference in practice. Application of the lead nation's governance structure may restrict the practice of some providers and their use of certain medications and techniques but a common set of procedures in this joint working environment is key.

Airway Management – Emphasis is placed on the importance of a rehearsed 3 stage plan (Plan A,B,C) following national guidelines when securing the airway.

Analgesia – Measuring pain scores is key to allow the objective assessment of pain. Pain is treated using a sequential approach based on pain scores. It should be noted there is an increasing sophistication of

interventions, particularly the use of fentanyl (transmucosal) and Continuous Peripheral Nerve Blockade placed under ultra-sound guidance.

Damage Control Resuscitation (DCR) – Requires prompt haemorrhage control (often requiring surgical intervention), minimal use of crystalloids, hypothermia mitigation and early use of blood products in a 1:1:1 ratio until the application of goal direct therapy using an agreed Massive Transfusion Protocol (MTP).

Traumatic Brain Injury (TBI) – Objective, regular neurological assessment is required to detect severity and deterioration. The key management principle is the need to maintain a Cerebral Perfusion Pressure (CPP) of 60-70 mm Hg. Therefore, the use of Intracranial Pressure monitoring is required in severe TBI as soon as practicable to allow the use of internationally agreed ICP/CPP driven treatment strategies.

Thoracic Injury – A Double Lumen Tube (DLT) is rarely required in the early management of combat related thoracic injury.

Burns – Significant burns cause major changes in physiology and pharmacokinetics and pharmacodynamics which change over the initial time course and need to be anticipated.

Data Sets – Minimal requirements agreed.

Sédation et anesthésie en opérations extérieures

(STO-TR-HFM-250)

Synthèse

Un nombre important de personnels de l'OTAN ont été blessés au cours des vingt dernières années dans des opérations de combat de haute intensité. Ces blessés auront bénéficié d'au moins une anesthésie ou une sédation dans leur prise en charge. A ce jour, il n'existe cependant aucun protocole commun pour la prise en charge anesthésique au sein de l'OTAN. Cette absence est potentiellement problématique car les personnels, leurs qualifications et les pratiques varient parmi les nations qui composent l'Alliance.

Les blessures de guerres ne sont pas similaires à la traumatologie civile et diffèrent en particulier par une incidence plus élevée de lésions par explosion ou par des projectiles à haute énergie. Ces blessures sont le plus souvent multiples et associées à des brûlures ou des traumatismes fermés. Ceci explique que l'anesthésie et la sédation réalisées sur le champ de bataille diffèrent de celles réalisées en traumatologie civile. L'organisation de la chaîne santé en opération est caractérisée par la succession des équipes et des structures de niveau croissant lors de la prise en charge du blessé. Chacune de ces étapes est caractérisée par des acteurs et des des équipements qui varient selon l'échelon de soins et les nations.

Le groupe de travail HFM-250 a analysé les différents principes de prise en charge des pays participants, ainsi que ceux d'autres nations de l'OTAN lorsqu'ils étaient disponibles, concernant sept point clés de l'anesthésie et de la sédation du blessé de guerre :

- Le contrôle des voies aériennes,
- L'analgésie,
- La réanimation en situation de « Damage Control »
- Le traumatisme crânien grave,
- l'anesthésie du blessé thoracique,
- L'anesthésie du blessé brûlé,
- Le dossier d'anesthésie.

Les discussions de groupe de travail ont permis d'identifier des principes de conduite communs sur ces différents sujets, cependant la production de protocoles détaillés est limitée par l'existence de particularités règlementaires et académiques parmi les différentes nations. Les actions des soignants restent soumises au cadre règlementaire législatif national et à l'autorité scientifique de leurs sociétés savantes. Dans le cas d'une structure de soins multinationale, une nation cadre doit être identifiée et un protocole d'entente doit être établi pour régir les différents domaines de compétence et les règles de conduite. L'application des règles de fonctionnement de la nation cadre peut restreindre le champ d'action de certains professionnels de santé, le travail en équipe dans ces structures impose de formaliser des procédures communes.

Contrôle des voies aériennes – l'accent est placé sur l'importance d'un protocole par étapes successives (plan A,B,C) en accord avec les recommendations nationales respectives.

Analgésie – L'evaluation de l'intensité de la douleur par des échelles est la clé de voute de la prise en charge. La prise en charge est basée sur une réponse graduée en fonction des scores de douleur. La place de techniques d'anesthésie avancée est discutée (fentanil transmuqueux, anesthésie loco-régionale échoguidée).

La réanimation en situation de « Damage Control » – Elle repose sur le contrôle rapide de l'hémorragie (le plus souvent chirurgical), l'utilisation de faibles volumes de cristalloïdes, la lutte contre l'hypothermie, et l'usage précoce produits sanguins labiles d'abord selon un ratio 1:1:1 puis guidé par les examens de laboratoire et un protocole de transfusion massive.

Le traumatisme crânien grave – Une évaluation régulière et reproductible est nécessaire pour estimer la gravité et détecter une aggravation. Le maintien d'une pression de perfusion cérébrale à 60-70 mmHg est l'objectif central de la prise en charge. Ainsi le monitorage de la pression intracrânienne doit être réalisé au plus vite en cas de traumatisme crânien grave pour guider la réanimation.

Anesthésie du blessé thoracique – une sonde d'intubation double lumière est rarement nécessaire dans la prise en charge initiale des blessures thoraciques de guerre.

Anesthésie du brûlé – Les brûlures graves sont responsables de perturbations physiologiques et pharmacologiques majeures évolutives dans le temps et doivent être anticipées dans la conduite de l'anesthésie.

Dossier d'anesthésie – les informations minimales nécessaires sont validées.

IMPROVING ANAESTHESIA AND SEDATION THROUGH THE BATTLEFIELD

1.0 SECURING THE AIRWAY THROUGHOUT THE BATTLEFIELD

Following review of the national policies of participating nations, the following recommendations are made regarding airway management throughout the battlefield. These recommendations apply from Role 1 where the first anaesthesia provider is likely to be located. The nature of anaesthesia providers differs significantly throughout the medical chain according to national regulations and may include paramedical staff, nurses, emergency physicians, general practitioner, nurse anaesthetists and anaesthesiologists. These anaesthesia providers have different skill sets and training and will act according to their national professional regulations and in multinational facilities under the terms of any Memorandum of Understanding (MOU) agreed by the participating nations.

Before Role 1, national policies are inconsistent and care providers are unlikely to have the skills and/or equipment to perform oro-tracheal intubation.

It is recommended that throughout the medical chain airway management should follow a structured three stage plan, moving sequentially from Plan A through Plan B to Plan C depending on the success or failure to secure the airway at each stage. The skills and equipment available to providers vary between medical roles.

It is recommended that videolaryngoscopy should be made available at Role 2 and 3 and is highly recommended further forward. The provision of a fiberoptic device (re-usable or disposable) should be considered. On arrival at a higher level of medical care the airway management should be reassessed by a new team who are likely to have enhanced skills, experience and equipment and they may choose to continue with the selected option or proceed with another plan.

Before attempting to secure the airway, the patient should be oxygenated as well as possible and airway management established using basic airway manoeuvres with airway adjuncts as required. If basic airway manoeuvres fail or the decision is made that the patient requires a definitive airway (Note 3) then providers should follow the proposed three stage plan depending on their skills and the equipment available to them and adopt a formal step-by-step protocol (Note 2: the Seven Ps).

When the airway has been secured, the correct positioning of the tube in the trachea must be checked by clinical examination and measurement of end tidal CO_2 (waveform capnography is the preferred method).

1.1 Plan A: Perform Regular Oro-Tracheal Intubation

- Establish airway with basic manoeuvres and airway adjuncts.
- Pre-oxygenate the patient.
- Perform Rapid Sequence Induction (RSI) of Anaesthesia if required, adjusting drug doses as necessary (Note 1).
- Laryngoscopy using a single use blade (routine use of bougie or stylet is recommended). Up to three attempts are allowed. Between every attempt it is recommended that you re-oxygenate the patient and make adjustments to your technique: e.g., adjust head position, change blade (size, disposable, straight, McCoy), use a Gum Elastic Bougie, BURP (laryngeal manipulation), release cricoid pressure. If available, a video laryngoscope or fiberoptic device may be used if appropriate. If cervical spine injury is suspected, ongoing in-line stabilisation must be performed.
- After three unsuccessful attempts, consider plan A has failed and move to plan B.

1.2 Plan B: Place a Supra-Glottic Device

- If available (depending on national policy), a Supra-Glottic Device (SGD) must be used. There is no evidence for the superiority of any particular Supra-Glottic Device and the SGD will be chosen according to national policy.
- Up to two attempts are allowed.
- If oxygenation and/or ventilation fails, move to Plan C.

1.3 Plan C: Surgical Airway

Perform surgical airway according to national policy (cuffed or no-cuffed percutaneous method).

1.4 Notes

1.4.1 Note 1: Rapid Sequence Induction

Rapid Sequence Induction (RSI) comprises at least the association of one hypnotic drug and one neuromuscular blocking agent (NMBA) to provide the optimum conditions for intubation. Ketamine (1 – 3 mg/kg) is considered the ideal hypnotic agent, although other drugs may also be considered (Propofol, Thiopental). Succinylcholine is often used for muscle paralysis (1 – 1.5 mg/kg) although Rocuronium (1 – 1.3 mg/kg) is a suitable alternative.

Pre-treatment, such as with Benzodiazepines or Opioids, can be considered according to national policy.

1.4.2 Note 2: The Seven Ps

Step-by-step protocol to perform oro-tracheal intubation:

- Prepare: material and drugs, assistance, patient, position;
- Pre-oxygenation;
- Pre-medication (consider);
- Paralysis (and sedation as required);
- Pressure (cricoid);
- Pass the endotracheal tube; and
- Post-intubation care: confirm tube position, maintain sedation ± paralysis and ventilation.

1.4.3 Note 3: Reasons for a Definitive Airway

- Failure to secure airway with basic manoeuvres and adjuncts;
- Protect the airway e.g., from blood or vomit;
- Provide controlled ventilation (to improve oxygenation and/or control CO_2);
- Humanitarian (compassionate) ; and
- Likely clinical course.

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2.0 PAIN MANAGEMENT THROUGHOUT THE BATTLEFIELD

2.1 Analgesia

Pain relief is vital for casualty care throughout the battlefield and apart from its humanitarian necessity has many benefits including morale and facilitating casualty evacuation. Pain relief is initially administered by the casualty (self-aid) or a colleague ("buddy aid") and must be continued and improved, if possible, at each stage of the patient care pathway. Initial pain assessment is important in order to guide treatment and should be done before administering any medication. A variety of pain scores are used including numerical scales (Visual Analogue Scale – VAS or a four-point numerical rating scale) or visual scales (e.g., Henry Wong faces). The choice of pain score depends on national policy, but the key is that pain scores are assessed and repeated to evaluate the response to treatment.

2.1.1 Part 1: From the Point of Injury to the First Medical Provider

At or near the point of wounding analgesia can be provided by the casualty (self-aid) or a colleague ("buddy aid").

Initial simple analgesia may be carried by the soldier as a personal supply or issued as a "pill pack" according to national policy (which will be influenced by national regulation).

Simple analgesia consists of WHO Class 1 agents, for example paracetamol and/or non-steroidal anti-inflammatory drugs (NSAID). There is little place for WHO Class 2 agents due to the variability of clinical response.

Opioids, such as morphine or fentanyl, are available at this stage.

Morphine is used for the treatment of severe pain administered from an auto-injector syringe using the Sub-Cutaneous (SC) or Intramuscular (IM) route for many nations. The initial recommended dose is 10 mg and the IM route is considered superior to SC because of concerns about the pharmacokinetic profile in the hypotensive patient (haemorrhagic shock), but even the IM route may not be ideal in the severely compromised patient. Many national policies only allow one dose of 10 mg to be administered by untrained personnel, with no place for repeat injection. Fentanyl citrate with different routes of administration is an alternative which is increasingly being adopted.

The value of non-pharmacological methods of analgesia should be emphasised, e.g., physical (warming, immobilisation, cooling and dressing of burns) and psychological (reassurance, distraction).

Personnel with additional skills and medication may act outside of these guidelines according to their national policy (e.g., oral transmucosal fentanyl citrate administration).

The first medical responder (nurse, paramedic, combat medic) may have a variety of additional skills, training and equipment and may be allowed to deliver further opioids (morphine or fentanyl) through a variety of routes (IM, SC, IV, IO, IN, transcutaneous).

2.1.2 Part 2: Role 1

Role 1 is often the first occasion where a casualty is evaluated by a physician.

Assessing and re-assessing pain in an objective fashion, using a pain scale is considered essential.

A three-step response protocol based on a pain score is recommended:

- Mild pain (Visual Analogue Scale (VAS) < or = 3): class 1 WHO agents (paracetamol +/- NSAID), PO;
- Moderate pain (VAS between 4 and 7): class 1 agents + class 2 WHO agent (tramadol, codeine); and
- Severe pain (VAS > 7): class 1 agents + class 3 agents (opioids) using morphine titrated to response via the IO or IV routes, ensuring the patient has an appropriate level of consciousness and cardiovascular stability.

Many nations currently prefer morphine rather than fentanyl as the opioid of choice, however favourable experiences using transmucosal fentanyl lozenges in recent conflicts have led to its increased adoption as an analgesic option in many NATO national medical services.

If the Role 1 medical provider is appropriately trained, Ketamine can be used as an adjuvant in severe pain or to provide additional analgesia for a painful procedure after an appropriate dose of opioid has been administered.

The use of ketamine alone is not recommended because of the occurrence of hallucinogenic side effects during emergence and its relatively short duration effect.

2.1.3 Part 3: Role 2 and 3

In the deployed hospital environment, the treatment of mild and moderate pain is essentially unchanged although, if the oral route is not available, the intravenous route can be used to administer most classes of analgesic agents including Paracetamol and NSAIDs.

At this level of medical care, more skills and material are available for severe pain control and therefore advanced pain control techniques may be available such as:

- Use of alternative opioids: morphine, fentanyl, sufentanil or Remifentanil according to national policy;
- Patient-controlled analgesia;
- Continuous infusion of morphine or ketamine (with appropriate monitoring); and
- Regional anaesthesia.

In specific situations, such as pain unresponsive to previous techniques, regional anaesthesia is increasingly being used in the military trauma environment and is particularly effective for severe traumatic limb injuries. National policies vary, but Continuous Peripheral Nerve Blockade (CPNB) inserted under ultra-sound guidance is considered by many to be the optimal analgesia choice and is particularly effective during medical evacuation.

There remains a limited place for central neuraxial blockade, with concerns about infection and coagulation being particularly relevant in the Role 2 environment, but the risks and benefits should be carefully evaluated. At the Role 3 environment epidural analgesia may be useful in specific circumstances e.g., to aid ventilator weaning of local national patients but must be carefully considered. Concerns include the sterility of the deployed hospital environment and the coagulation status after major trauma.

At Role 2 and 3, the workgroup recommends the early administration of tricyclic antidepressants (e.g., Amitriptyline) and anticonvulsants (Gabapentin, Pregabalin, or Clonazepam) as an adjunct in patients with traumatic amputations or neuronal damage in order to attempt to reduce the onset of neuropathic pain.

2.1.4 Remarks

Example of intravenous morphine titration: initial bolus for paramedics 2 mg, for General Practitioners (GP) 0.1 mg/kg, then 2 mg/5 minutes.

When a total morphine dose of 10 mg has been administered and a pain score is still high or a painful procedure is planned, ketamine may be considered (ketamine bolus 10 mg every 5 minutes in association with morphine bolus 2 mg every 5 minutes).

As soon as an opioid is used by the IV route, face mask oxygen, appropriate monitoring, and naloxone must be available. Anti-nausea agents (e.g., 5HT antagonists or Droperidol) and laxative agents are recommended.

2.2 Procedural Sedation

Sedation delivered to a patient designed to provide analgesia, hypnosis and amnesia for a short period of time during the performance of a procedure (e.g., shoulder dislocation or fracture reduction).

2.2.1 Role 1

Procedural sedation will vary depending on the skills of the provider and the drugs available. The most frequently used agents are opioids (morphine or fentanyl), ketamine, and midazolam.

It is recommended that a combination of drugs is used to provide hypnosis, analgesia and amnesia. A combination of agents will improve the quality of sedation and reduce the incidence of adverse events. A single opioid may be administered in combination with ketamine and/or midazolam. The use of propofol in the Role 1 setting is not recommended because of its respiratory and cardiovascular effects. Prior to starting sedation, adequate analgesia should be achieved followed by the careful titration of hypnotic drug(s).

When performing procedural sedation, monitoring, ventilation and resuscitation equipment (including suction) must be available. Oxygen delivery using face mask is mandatory. Starvation is not required.

2.2.2 Role 2 and 3

Procedural sedation is usually performed by anaesthesia providers (anaesthesiologist, anaesthetic nurse) or emergency physicians.

Additional drugs are available for procedural sedation which these providers will be familiar with such as alfentanil, remifentanil, sufentanyl, fentanyl, and propofol. Propofol can be used if the patient is

haemodynamically stable. If not, a careful titrated combination of ketamine and/or an opioid with midazolam is recommended.

When performing procedural sedation, monitoring, ventilation and resuscitation equipment (including suction) must be available. Oxygen delivery using face mask is mandatory.

Management of procedural sedation and monitoring of the patient should be the only task of the anaesthetic provider.

2.3 En Route Care Sedation

2.3.1 From the Point of Injury to the Medical Treatment Facility (MTF)

The sedation technique used will depend on the level of skill and knowledge of the provider(s) in the transfer team. Sedation can be performed by titrating morphine and a hypnotic drug such as midazolam and/or ketamine. The use of propofol is not recommended.

2.3.2 Between MTF

Standards of care should be maintained during transfer between MTFs. The transferring team should have the appropriate skills and equipment (such as infusion pumps) to maintain sedation initiated before or during the transfer. Continuous infusions or bolus titration are possible and should be tailored to the level of skill. Simple protocols are preferred, such as an opioid (i.e., morphine) and a hypnotic (i.e., midazolam).

2.3.3 From MTF to Homeland Facility

The patient should be escorted by an intensive care medical team with an anaesthesiologist or an intensivist physician. As critical care material is available, continuous infusions of a hypnotic and opioids are preferred for sedation. Neuromuscular blockade agents are not systematically used if monitoring anaesthesia depth is not available, they are reserved for specific situation (ventilatory issues).

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3.0 DAMAGE CONTROL RESUSCITATION

Damage Control (DC) is a combined process between Damage Control Surgery (DCS) and Damage Control Resuscitation (DCR). DC can be characterised by:

- Early initiation of blood products transfusion;
- Minimisation of the use of crystalloid fluid administration;
- Permissive hypotension; and
- Prompt haemorrhage control including surgery and interventional radiology when required.

The objective of DCR is to terminate the lethal triad (hypothermia, acidosis and coagulopathy) and the objective of DCS is to stop the surgical bleeding and prevent contamination.

DCR may start before surgery is available but DCS is usually required as definitive haemorrhage control is almost invariably surgical. NATO doctrine therefore states that a surgical facility shall be ideally reachable within one hour from the point of injury.

Performing DCR requires a team approach, a team leader should be identified early in the DCR process. At Role 1, the team leader is often an emergency physician, General Practitioner (GP) or General Duties Medical Officer. At Role 2 and higher, the trauma team leader will be a physician experienced in the role (surgeon/anaesthesiologist/emergency physician).

DCR is a continuous process starting from the point of injury, through surgery and into the Intensive Care Unit (ICU).

3.1 From Point of Injury to the First Medical Treatment Facility (MTF)

Basic manoeuvres in order to start DCR can be performed at the point of injury by the first responder, who may be a fellow soldier, aidman, combat medic, nurse or physician.

3.1.1 Stop the Bleeding

- Compressive dressing;
- Haemostatic dressing;
- Use of a tourniquet if indicated;
- Repositioning and stabilisation of a broken limb;
- Pelvic stabilisation; and
- Recognition of trunk haemorrhage that requires prompt evacuation.

3.1.2 Hypothermia Mitigation

Every effort should be made to prevent hypothermia using passive and active methods. A variety of Hypothermia Prevention and Mitigation Kits (HPMKs) are used by different nations. Attempts should be made to maintain a high temperature in the treatment environment.

3.1.3 Permissive Hypotension

Blood pressure should be maintained at levels below normal in order to prevent disruption of any clot formation. The objective is to maintain a radial pulse or an adequate level of consciousness. IV or IO access

is possible but not mandatory and if obtained may be used to deliver small volume fluid resuscitation titrated to a palpable radial pulse (SBP ≥ 70 mm Hg).

3.2 Role 1

At Role 1, previous interventions should be re-evaluated and continued if required. If the tactical situation allows, it may be justified to evacuate a bleeding patient directly to a surgical facility (Role 2 or 3).

- **Re-evaluation** of the wounded soldier should occur according to national policy (TCCC, BATLS). Start monitoring: Heart Rate, Blood Pressure (BP), oxygen saturation, core body temperature and oxygen administration / airway control if needed.
- **Evaluate dressings, tourniquets and bleeding again.** Specific devices may be available to treat junctional haemorrhage at Role 1 (e.g., Combat Ready Clamp®).
- **Reassess the need for needle decompression.** In the case of haemothorax, consider chest tube placement with a blood collecting device if the skills and equipment are available.
- **IV access** should be secured, large bore if possible. If impossible, IO access or femoral venous access are alternatives.
- **BP objective** remains unchanged: SBP≥70 mm Hg, unless the casualty has an isolated head injury where higher Systolic BP objective may be required. Isotonic crystalloids are preferred for vascular expansion, although hypertonic saline solution may be an alternative in some systems.
- **Blood products** may be available at this stage, according to national policy and availability: PRBC (ORhNeg) or Dried Plasma.
- **Tranexamic acid** 1 gram (IV or IO) should be administrated as soon as possible and no later than three hours after injury.
- **Hypothermia prevention and mitigation** (T° > 36°C). Consider the need for active warming (chemical warming blanket, fluid warmers and forced air blankets). Attempt to maintain a high environmental temperature in the treatment facility.
- **Antibioprophylaxis** is started according to national policy.

3.3 Role 2/3

Role 2/3 is the first opportunity where surgery is available to control haemorrhage and prevent contamination.

At Role 2/3, DCR can be fully applied with the addition of surgery to perform haemostasis and medical resuscitation including transfusion, control of acidosis and reversal of coagulopathy.

DC surgery is aimed at restoring physiology not anatomy: control of bleeding, control of contamination, vascular shunt, temporary abdominal closure [1].

These procedures should be performed as rapidly as possible in order to limit hypothermia exposure. Particular attention should be paid to:

- **Re-evaluation of the wounded soldier**: clinical examination, radiology (including chest and pelvic X-ray, ultra-sound scan using FAST protocol, CT if available) and laboratory investigations (arterial blood gas analysis, blood crossmatch, chemistry, haematology, clotting profile, Platelet count).
- **Active warming**: a warming blanket should be available, the resuscitation fluid pre-warmed and a fluid warmer used, as well as maintaining the environmental temperature within the facility.
- **Massive Transfusion (MT)**: a dedicated protocol must be available in every Role 2/3 structure consistent with national policies. Triggers for MT are based on clinical criteria and medical history

(mechanism of injury, estimated blood loss). Moreover, a number of predictors for massive transfusion in traumatic settings have been identified:

- Systolic blood pressure < 110 mmHg;
- Heart rate > 105 bpm;
- Hematocrit < 32%; and
- pH < 7.25.

The presence of three out of four factors predicts the risk of massive transfusion to be approximately 70% [2].

- The initial **ratio of blood products** is recommended to be 1:1:1 (PRBC:FFP:Plt) until a goal directed strategy can be followed guided by laboratory results (including point of care devices). Fibrinogen and Calcium supplementation as well as careful management of electrolytes is usually required. A large bore central venous access is recommended (inserted using US guidance) and combined with a fluid warming device that is able to warm fluids infused at a rapid rate.
- The ability to collect **Fresh Whole Blood** (FWB) should be available too as part of a Massive Transfusion Protocol when individual components are unavailable or if severe coagulopathy continues despite optimal management.
- **Thromboelastography** is considered useful for the management of blood transfusion after the massive transfusion protocol is initiated in order to guide goal directed administration of blood products.
- **Tranexamic Acid** (TXA) therapy should be continued: 1st dose of 1 gram over 15 minutes within 3 hours of injury if not already delivered and a second dose of 1 gram over 8 hours.
- **Acidosis reversal** is achieved by fluid resuscitation and the use of Bicarbonate is NOT recommended.
- **The use of vasopressors** should be limited to clinical situation where volume replacement is not rapid enough, when a spinal injury is suspected or occasionally to counter the cardiodepressant effects of induction agents. Although vasopressors may reduce the amount of fluid needed to achieve resuscitation goals and so limit dilution, they contribute to the maintenance of acidosis.
- **Adjuncts**: The use of single coagulation factors is only considered in resistant coagulopathy as part of a Massive Transfusion Protocol when hypothermia and acidosis are corrected.
  - rVIIa is administrated at the usual dose of 100 mcg/kg intravenously; may be repeated in 20 minutes; and
  - Desmopressin may be considered in order to improve platelet activity although the evidence only supports their use in patients using platelet activity inhibitors (IV 0.3 mcg/kg) [3].

3.4 Fluid Therapy

At Role 1, the use of crystalloids is recommended. The most isotonic, iso-oncotic, iso-osmolar solution is chosen according to national availability.

Despite concerns about their use colloids are considered by some nations in the management of major bleeding.

Balanced crystalloids are an interesting option for their capability to add benefit in several clinical concerns (haemorrhage, TBI, burn).

Mannitol or hypertonic saline may be required as adjunctive fluids in the management of patients with Traumatic Brain Injury (TBI).

Hypertonic saline may have a role in the military setting for rescue in case of major bleeding, particularly if there are logistic constraints and TBI.

3.5 En Route Care

DCS is generally not available during en route care. Therefore, surgical bleeding must be controlled before considering STRAT-AE and the patient should be as well resuscitated as possible i.e., temperature, acidosis and clotting profile normalised.

DCR must be continue during evacuation: including ongoing transfusion, pharmacological agents and warming.

POC monitoring is helpful at this stage and should be available. Some devices can provide basics information such Hb, Platelet count, pH, and lactate.

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4.0 ANAESTHESIA FOR TRAUMATIC BRAIN INJURY AND SPINAL TRAUMA

Similar physiological principles apply to the brain and spinal cord and therefore similar anaesthetic principles apply in the management of Traumatic Brain Injury (TBI) and Spinal Trauma (ST). The key management goals are preventing and/or minimising the primary injury and avoiding worsening outcomes by limiting secondary injury.

Primary brain injury is prevented and/or minimised by policy decisions and the adoption of appropriate Personal Protective Equipment (PPE) and is not influenced by direct medical intervention. However, the primary injury will have a watershed area, or penumbra, around it of tissue with disordered metabolism and physiology which is potentially salvageable with appropriate and timely medical intervention which will influence the eventual outcome.

4.1 Assessment of Neurological Status

A variety of scales are available to assess the neurological status, monitor progress and aid prognostication of patients with TBI. The simple Alert/Verbal/Pain/Unresponsive (AVPU) scale is appropriate for use in the pre-hospital and forward space and has been shown to correlate well with the Glasgow Coma Scale (GCS).

The GCS, pupillary examination and examination for signs of herniation (hemiplegia) are the key indicators of severity of TBI and have been shown to correlate with outcome, they should be used to assess the neurological status of TBI from Role 1 onwards. Frequent reassessment of the GCS and pupils is recommended particularly once haemodynamic and ventilation parameters are restored in order to detect deterioration and allow early intervention.

4.2 Prevention of Secondary Injury

Standard approaches to traumatic injury should initially be applied (the management of which is covered previously in Damage Control Resuscitation) as these almost invariable positively influence the key targets for secondary injury and have the maximum effect on eventual outcome. The key goals for preventing secondary injury include:

- Control of bleeding;
- Maintenance of cerebral perfusion;
- Maintenance adequate oxygenation;
- Control of ventilation; and
- Optimisation of biochemical and haematological status.

International consensus guidelines suggest the following targets in patients with severe TBI:

- Head up positioning – 30 degrees;
- Haemoglobin ≥ 10 g/dL;
- PaO2 ≥ 100 mm Hg (13 KPa);
- End tidal CO_2 35 to 45 mm Hg (4.5 – 6 KPa) until arterial blood gas analysis is available;
- $PaCO_2$ 35 to 45 mm Hg (4.5 – 6 KPa) once arterial blood gas analysis is available;
- Systolic Arterial Blood Pressure (SABP) ≥ 100 – 110 (according to age) mm Hg or Mean Arterial Pressure (MAP) ≥ 80 mm Hg;
- Cerebral Perfusion Pressure (CPP) 60 to 70 mm Hg;
- Intra-Cranial Pressure (ICP) ≤ 22 mm Hg;
- Serum Sodium ≥ 140 mmol/l;
- Blood glucose 6 to10 mmol/l; and
- Normothermia (35° – 37°C).

4.3 Intra-Cranial Pressure

ICP monitoring is recommended for the optimal management of patients with severe TBI and should be available in conjunction with CT imaging as soon as practically and logistically feasible. If ICP monitoring is not available then a strategy of Imaging and Clinical Examination (ICE) has been shown to be non-inferior in one study although the gold standard management strategy in most advanced healthcare systems remains ICP/CPP targeted therapy. In the absence of ICP monitoring cerebral pressures and blood flow can be assessed using other modalities such as ultra-sound (Transcranial Doppler and optic nerve ultrasonography) although their place in targeting therapy and prognostication currently remains unclear.

Raised ICP should be treated by following an agreed protocol applying the principles of optimising physiology, advanced neurological monitoring and imaging and escalating management strategies (Figure 1).

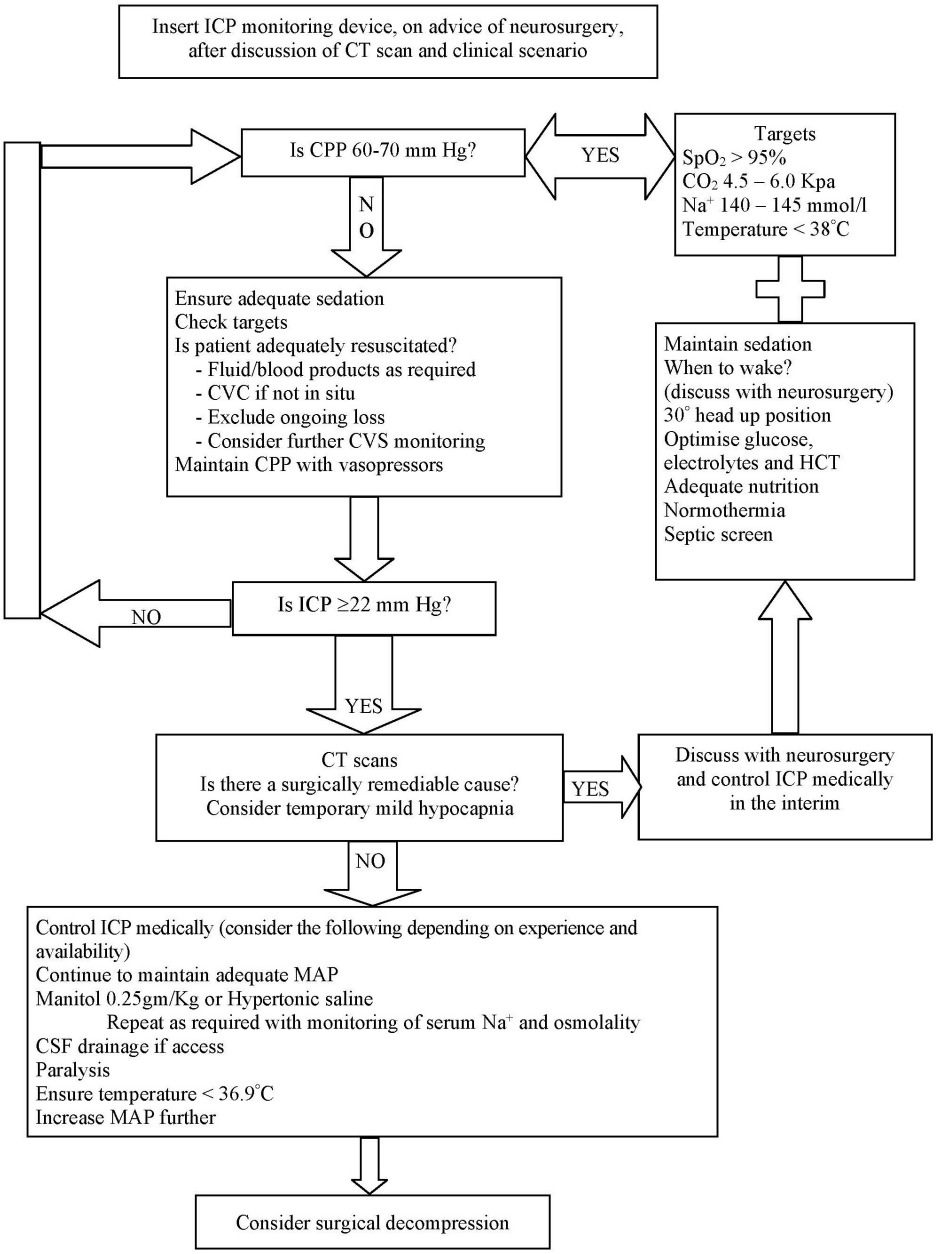

Figure 1: CPP/ICP Driven Protocol for the Management of Patients with Severe TBI.

4.4 Anaesthesia Principles

4.4.1 Drugs of Choice

Strategies designed to maintain Cerebral Perfusion Pressure (CPP), oxygenation and normocapnia are more important than specific drugs choices, although Ketamine appears to have the strongest evidence-base for use in TBI and/or ST due to its haemodynamic profile. As a consequence, the early use of invasive blood pressure monitoring is recommended. The maintenance of anaesthesia can be performed with intravenous agents (such as Midazolam, Propofol or Ketamine with or without an opioid) or volatile agents, the key principles again remain the maintenance of CPP, oxygenation and normocapnia.

4.4.2 Seizure Prevention

The scientific evidence is limited for seizure prophylaxis but there may be some benefit in its use to prevent early seizures. Levetiracetam is preferred to Phenytoin due to easier administration and a more favourable side effect profile.

4.4.3 Deep Venous Thrombosis (DVT) Prophylaxis for TBI

Because of possible associated haemorrhagic traumatic lesions, it is difficult to give strong recommendations for thromboprophylaxis. The consensus appears to be that if there are no concerns about haemorrhage or coagulopathy then chemical thromboprophylaxis should be started 24 hours after injury. Mechanical prevention (graduated stockings, intermittent pressure devices), if available, should be initiated without delay.

4.4.4 Spinal Trauma Specific Considerations

- Thromboprophylaxis: This cohort of patients is at high risk for thrombotic complications. If there are no coagulopathic or haemorrhagic concerns then thromboprophylaxis should start as soon as possible.
- Immobilisation: In the unconscious patient (due to injury or anaesthesia), full spinal immobilisation should be maintained (cervical and thoracolumbar). The gold standard is that spinal cord injury can only be excluded in a conscious patient with a negative clinical examination in combination with imaging. However, in view of the potential deleterious consequences of prolonged immobilisation different national policies exist for the clearance of spinal injury patients in unconscious critical care patients using advanced imaging modalities.
- Rigid spine boards are used for extraction and tactical evacuation but due to the risk of pressure areas and lower cervical spine movement the vacuum mattress is preferred for longer transportation time or strategic aeromedical evacuation.
- Vasopressor should be used to treat hypotension related to spinal shock, once hypovolemia has been excluded, to maintain an adequate spinal perfusion pressure.
- Patient with lesions above C4 will require early intubation. For vertebral lesions between C4 and T6, patients should be considered at risk of delayed ventilation failure and mechanical ventilation should be discussed.

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5.0 ANAESTHESIA FOR COMBAT THORACIC TRAUMA

Thoracic trauma on the battlefield accounts for 5 – 10 % of combat related injuries in modern conflicts due to the increasing use of body armour. However even though the incidence is reducing, thoracic trauma still has a high mortality (approximately 15%).

5.1 Before Role 1 and at Role 1

At this stage, a number of life-saving interventions common to most national guidelines should occur:

- Oxygen should be administrated if available via a face mask.
- The casualty should be placed in a comfortable position to aid ventilation, this is often the sitting position, at least lifting up the trunk or 3/4 prone.
- In the case of penetrating injury, an occlusive dressing with a one-way valve or a three-sided adhesive dressing should be applied.
- The casualty should be assessed for signs and symptoms of tension pneumothorax and needle decompression performed if required.
- Some national policies allow placement of an intercostal drain if clinically indicated and the practitioner has been adequately trained.
- If an intercostal drain has been inserted, connection to an auto-transfusion device may be appropriate if available.

5.2 At Role 2/3

This is often the first time the casualty will encounter an anaesthesia provider:

- Before specifically addressing the thoracic trauma, the management of major bleeding should follow the previous Damage Control Resuscitation guideline. Drugs of choice are discussed in the DCR recommendations.
- The severity of thoracic trauma can be simply and rapidly assessed using basic vital signs i.e., respiratory rate, heart rate, oxygen saturation, and blood pressure.
- Chest X-ray and ultrasonography should be performed to identify air or fluid in the pleura or pericardium.
- If an Endotracheal Tube (ET) is required after RSI for major trauma then a single lumen tube is generally preferred due to the ease of insertion.
- Mechanical ventilation should follow a protective lung strategy (Vt 6 – 8 ml/kg, PEEP 5 – 10 cmH2O, Plateau Pressure under 30 cmH2O).
- During an emergent surgical procedure, one lung ventilation is rarely required as the lung can usually be manually deflated and retracted. Therefore, double lumen tube placement is not usually required for DCR thoracic surgery. However, at R2 and higher, a fiberoptic device could be valuable in order to guide temporary lung exclusion by advancing the tube into a bronchus or for placing a bronchial blocker. Some national policies include the availability of Double Lumen Tubes (DLTs) for situations when lung isolation is required and the skill set to place the DLT exists.
- Communication with the surgical team during surgery for thoracic trauma is paramount as physiological changes such as haemodynamic or ventilation issues may be directly related to the surgical procedure.
- Fluid resuscitation requires a balance between adequate resuscitation and the desire to avoid fluid overload and its potential respiratory complications.

- Analgesia for thoracic trauma should be multimodal. Uncontrolled pain in thoracic trauma post-operatively may lead to respiratory failure and/or higher risk of pneumonia due to pain-related hypoventilation. Therefore, pain must be repeatedly assessed. Morphine or other opioids are widely used initially as intravenous boluses followed by patient-controlled analgesia devices, infusions or orally as indicated and supplemented by regular Paracetamol and NSAIDs. Ketamine may also be added, initially as intravenous boluses and then as a low dose infusion if required and the appropriate monitoring is available. Paravertebral nerve blockade or epidural analgesia can be very effective. However, there are concerns about the placement of epidural catheters after major trauma. The risks of epidural haematoma or abscess formation must be carefully considered against the benefits of quality analgesia. Non-Invasive Ventilation may help in blunt thoracic trauma but is rarely available. However, it is not a definitive solution as it is not suitable for medical evacuation.
- Any respiratory or haemodynamic failure must be identified and treated before considering prolonged evacuation.

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6.0 ANAESTHETIC CARE FOR MILITARY BURN CASUALTY FROM ROLE 1 TO AEROMEDICAL EVACUATION

6.1 Burn Care Is a Military Concern (see Refs. [1], [2])

Burn injury is estimated to occur in approximately 5 – 20 % of modern combat casualties depending on the type of conflict.

Combat related burns have two specific patterns:

- Face/hand burns in dismounted soldiers: fire or flame occurring an in open space affecting the uncovered parts of the body, responsible for superficial burns with limited TBSA.
- Vehicle explosion: fire and flames in closed space with associated trauma and intoxication, responsible for deep and extensive burns.

Burns also occur following fire and flame injury, flash injury, contact burns, chemical or radiation exposure. Various burn mechanisms may affect the same casualty. Burns are also frequently associated with blunt or penetrating trauma in combat casualties.

The logistic burden of burn care is heavy, they consume high material and human resources due to repeat dressing changes, high fluids requirements and repeat anaesthesia [3].

6.2 Severe Burns Kill [4]

Early deaths are related to:

- Hypovolemic shock; and
- Multiple organ failure.

Days or weeks later, burn casualty deaths are usually related to infection.

6.3 What Is a Severe Burn?

A severe burn can be defined as (see Ref. [5]):

- Total Burn Surface Area (TBSA) > or = 20%;
- Injury to an at-risk area e.g., face, neck, hands, groin; and
- Associated lesions (trauma, smoke inhalation, intoxication) [6].

6.4 Acute Thermal Injury

The acute thermal injury is the most frequent burn injury encountered in deployed settings. It is responsible for thermal tissue destruction and necrosis.

When TBSA is under 20%, there is only local skin destruction, it is a local and regional disease.

When TBSA is = or > 20%, systemic consequences are observed: plasma leakage, Systemic Inflammatory Response Syndrome (SIRS) and burn organ toxicity related to Lipo-Protein Complex (LPC).

6.4.1 Physiopathologic Modifications

Table 1: Phsyiopathologic Modifications.

	From H0 to H48	After H48
Haemodynamic	Hypovolemia ± Shock Hypokinesis Vasoconstriction	Normal or High Volemia Hyperkinesis Vasoplégia
Pulmonary	ALI ± Smoke Inhalation ± Intoxication CO/CN	Pneumonia Respiratory Failure (ALI‣ARDS)
Renal	Acute Kidney Injury: Reduced GFR Renal Failure?	GFR elevated Tubular impairment if TBSA > 30% AKI related to sepsis or medication?
Haematology	Anaemia Thrombopenia Low Coagulation Activity	Anaemia Thrombocytosis High Coagulation Activity

6.4.2 Pharmacologic Modifications

6.4.2.1 Pharmacokinetic

- Initial period: low Cardiac Output (CO) = > low renal and hepatic clearance.
- Latter period: High CO = > high renal and hepatic clearance.
- Protein transport of medication is impaired (albumin/alpha1glycoprotein) and the binding and free fraction of medications are modified.
- Volume of distribution quickly increases.
- Other losses (exudation, bleeding and transfusion) should be considered.

6.4.2.2 Pharmacodynamic

- Hypnotic: tachyphylaxis for Benzodiazepines, Propofol, Ketamine can occur after 48 hours.
- Opioids: tachyphylaxis can occur for all opioids after 8 hours.
- Target Controlled Infusion models are no longer accurate.
- Volatile agent may cause intense vasodilatation during the acute burn phase.
- NeuroMuscular Blocking Agents (NMBAs): after Day 7, the effect and length of action decreases. Suxamethonium can be used only once in the first two days because of the risks of hyperkalaemia.

6.5 Practice Guideline

6.5.1 Emergency Situation

Securing the airway can be hazardous in burn casualties because of oedema or airway caliber reduction following burns to the neck and face. Previous guideline regarding the emergent airway should be followed.

Suggested protocol for rapid sequence induction in emergency burn care:

1) Ketamine 1 – 3 mg/kg;
2) Suxamethonium 1 – 1.5 mg/kg; and
3) then midazolam/ketamine/sufentanil (or other rapid acting opioid) +/- NMBA boluses.

Note: Rocuronium should be considered the NMBA for rapid sequence induction after Day 2.

If the patient is shocked, doses must be reduced. If available, Gamma hydroxybutyrate 1 – 2 g/45 min can be administrated instead of ketamine.

6.5.2 Anaesthesia for Dressing Change

Table 2: Anaesthesia for Dressing Change.

Secured Airway (TT or Tracheotomy)			
1st week		**later**	
Haemodynamic Failure?	**No Failure**	**Haemodynamic Failure?**	**No Failure**
Gamma hydroxybutyrate Ketamine (analgesia dosage) Sufentanil/Remifentanil NMBA if needed	Midazolam Sufentanil/ Remifentanil Ketamine (anaesthetic dosage) NMBA if needed	Sufentanil/Remifentanil Ketamine (anaesthetic dosage) NMBA if needed **or** Gamma hydroxybutyrate Ketamine (analgesia dosage) Sufentanil/Remifentanil NMBA if needed	Propofol Ketamine (analgesia dosage) Sufentanil/Remifentanil NMBA if needed
Spontaneous Ventilation			
1st Week		**Later**	
Haemodynamic Failure?	**No Failure**	**Haemodynamic Failure?**	**No Failure**
	Midazolam or Propofol Ketamine (analgesia dosage) Sufentanil/Remifentanil	Need to secure airway and apply upper protocol	Midazolam or Propofol Ketamine (analgesia dosage) Sufentanil/ Remifentanil

6.6 Anaesthesia for Burn Surgery

- Escharotomy and fasciotomy are emergent surgery and must be done as soon as required. A major risk is occurrence of crush syndrome; therefore, patient should have an arterial line for repeated arterial blood gas samples and a urinary catheter.
- Excision surgery is performed at Role 3 when evacuation is delayed. The major risk expected is bleeding, and the patient should be equipped for this surgery with arterial line, a large bore catheter and blood products available.

Suggested protocol:

- Midazolam + ketamine in continuous infusion.
- If available, gamma hydroxybutyrate can be administrated instead of ketamine according to haemodynamic status.
- Sufentanil/remifentanil or fentanyl as opioid.
- NMBA if needed.

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7.0 MINIMAL REQUIREMENTS FOR A JOINT ANAESTHETIC FILE

7.1 Required Items

- Patient identification including military rank;
- Demographic data including at least weight, height, age, sex;
- Pre-anaesthetic assessment: medical history, surgical history, allergy, airway evaluation;
- Surgical procedure planned;
- ASA score; and
- Relevant investigation results: laboratory (haematology, chemistry, crossmatch) and imaging (US, X-ray, CT scan if available and required).

7.2 Anaesthetic Record (Ideally an Electronic or Software Record)

- Date/time of procedure;
- Team involved;
- Technical considerations: anaesthetic protocol / airway (Cormack grade) / vascular access / ventilator settings;

- Vital signs every five minutes;
- Complications;
- Specific medications, antibiotic prophylaxis/therapy; and
- Estimated fluid loss, blood components and fluids administrated.

7.3 Post-Operative Orders

Post-operative orders should be included with the surgical record.

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REPORT DOCUMENTATION PAGE

1. Recipient's Reference	2. Originator's References	3. Further Reference	4. Security Classification of Document
	STO-TR-HFM-250 AC/323(HFM-250)TP/925	ISBN 978-92-837-2250-2	PUBLIC RELEASE

5. Originator

Science and Technology Organization
North Atlantic Treaty Organization
BP 25, F-92201 Neuilly-sur-Seine Cedex, France

6. Title

Improving Anaesthesia and Sedation through the Battlefield

7. Presented at/Sponsored by

Presentation of Clinical Guidelines related to sedation and anaesthesia throughout the battlefield. Minimal standards of care for NATO anaesthesia providers are described.

8. Author(s)/Editor(s)	9. Date
Multiple	March 2020
10. Author's/Editor's Address	**11. Pages**
Multiple	40

12. Distribution Statement

There are no restrictions on the distribution of this document. Information about the availability of this and other STO unclassified publications is given on the back cover.

13. Keywords/Descriptors

Combat related injuries	Role 1
Analgesia	Role 2
Sedation	Role 3
Anaesthesia	En route care

14. Abstract

Large numbers of NATO personnel have been injured over the last two decades in recent high intensity combat operations. These personnel would almost certainly have required at least one episode of anaesthesia or procedural sedation. However, there are currently no standardised NATO guidelines for anaesthesia or sedation. This could be a significant concern as anaesthesia providers credentials, qualifications and practices will vary amongst NATO contributing forces.

Combat related injuries differ significantly from those sustained in civilian trauma care and are characterised by an increased proportion of blast related injuries as well as high energy transfer penetrating injuries. The injuries sustained are often multiple and may be combined with blunt trauma and burns. Consequently, the anaesthesia and sedation in the combat environment will differ from the civilian setting. Also, the military environment is characterised by multiple patient transfers and interventions at different levels of care where capabilities of providers and equipment vary between different nations and at different echelons of care.

HFM-250 reviewed the national policies of all the panel contributing nations, as well as other NATO countries where available, in several key areas of anaesthesia and sedation for combat injuries.

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