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The Ghost in the Triage Tent: Mastering the Art and Chaos of Field Anaesthesia

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ABSTRACT

Background: Modern battlefield and austere medicine demand a radical departure from the hyper-monitored, resource-abundant practices of tertiary trauma centres. In environments defined by active conflict, disrupted supply chains, and the absolute absence of Post-Anaesthesia Care Units (PACU) or Intensive Care Units (ICU), the anaesthesia provider must shift from a guardian of pristine physiological homeostasis to an adaptive tactical asset.

Objective: This article establishes an operational framework and narrative synthesis of the technical strategies required to deliver safe, effective field anaesthesia under extreme operational conditions.

Discussion: We analyse the delicate balance of low-resource infrastructure, emphasizing the optimization of draw-over systems and volume-fractioned intravenous strategies to eliminate pharmaceutical and equipment wastage. We evaluate a multi-technique playbook, ranging from advanced regional nerve blocks to highly specialized Ketamine-based Total Intravenous Anesthesia (TIVA) infusions and clock-timed manual bolus protocols tailored for the profoundly shocked patient. Crucially, we address the unique risks of managing severe haemorrhage in the absence of a blood bank, relying instead on walking blood bank activation, strict permissive hypotensive resuscitation, and targeted haemostatic pharmacotherapy. Finally, we establish a paradigm for prolonged post-operative field care and clinical situational awareness where the provider's refined sensory acuity completely replaces electronic telemetry.

Conclusion: Field anaesthesia is not merely stripped-back civilian practice; it is a highly specialized, distinct discipline requiring extreme cognitive flexibility, hyper-vigilance, and an intimate understanding of low-resource pharmacology.

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Introduction

The transition from a modern, sterile operating suite to a forward-deployed field hospital or humanitarian disaster zone is a profound shock to the clinical ego. In the civilian sanctuary, anaesthesia is a specialty of fractions-micro-adjustments of volatile gases, precise titrations of vasoactive infusions, and continuous feedback from an array of digital monitors. The luxury of immediate backup, from a fully stocked blood bank to an adjacent ICU staffed by intensivists, creates a safety net that permits aggressive, ultra-complex surgical interventions.

In the field, that safety net is vaporized.

Field anaesthesia is defined by the tyranny of austerity. The environment is frequently loud, thermally unstable, and kinetically dangerous. The provider is confronted with a stark reality: the supply chain is fragile, electricity is intermittent, compressed medical gases are a luxury, and there is no PACU or ICU to inherit the patient once the skin is closed. Every milligram of drug must be accounted for, every breath must be carefully considered, and every decision must factor in the reality that the patient may remain on your canvas cot for days before evacuation is possible.

This article provides an operational framework for navigating this chaos. By blending historical military lessons with modern tactical medicine, we examine how to maintain safety, employ adaptive techniques, manage profound haemorrhage without blood, and maintain absolute situational awareness when the machines go dark [1].

The Operational Framework: Core Concerns and Environmental Stressors

To practice field anaesthesia successfully, one must first dismantle the assumption that clinical algorithms are universal. In austere environments, the pathology of the patient is intimately bound to the pathology of the surroundings.

The Physics of the Field

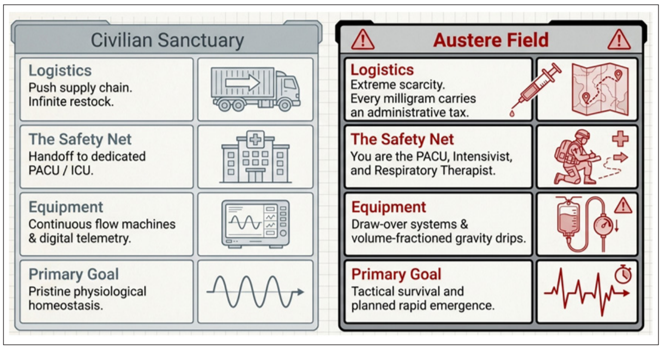
Environmental extremes dictate pharmacology and equipment function. At high altitudes or in extreme cold, volatile anaesthetic vaporizers calibrated for sea-level atmospheric pressure exhibit predictable but dangerous variances. For instance, the output of a standard plenum vaporizer changes with ambient pressure, requiring meticulous mathematical adjustments to avoid under- or over-dosing. In freezing conditions, intravenous lines freeze, batteries lose their charge exponentially faster, and patients succumb to the lethal triad of trauma (hypothermia, acidosis, and coagulopathy) before surgical incision is even made. Conversely, in desert heat, volatile agents volatilize prematurely inside their containers, and synthetic rubber components in ventilators rapidly degrade.

The Logistics of Scarcity

The fundamental concern of the field anaesthetist is supplying chain vulnerability. In a protracted conflict or disaster response, the "push" system of logistics often fails. You cannot simply order more propofol or extra neuromuscular blocking agents. Every clinical decision carries an administrative tax. This introduces a psychological burden unique to military and humanitarian providers, the constant balancing of individual patient needs against the collective survival of future casualties [2].

The Absence of the Safety Net

In a civilian hospital, the anaesthetists' job technically concludes with the handoff to a dedicated PACU or ICU nurse. In the field, the anaesthetist is often the PACU nurse, the intensivist, the respiratory therapist, and the ward physician rolled into one. The lack of post-operative critical care infrastructure means that an anaesthetic plan cannot be designed purely for intraoperative convenience. If a patient is left intubated because of excessive opioid administration or over-reliance on long-acting muscle relaxants, that patient now ties up a ventilator, consumes precious oxygen supplies, and requires 1:1 nursing care that simply does not exist. The anaesthetic must be designed from the outset for rapid emergence, immediate return of protective airway reflexes, and minimal post-operative metabolic derangement.



In an austere theatre, waste is not an environmental faux pas; it is a clinical failure that costs lives. The field provider must understand the engineering of their equipment as thoroughly as the physiology of their patient.

Draw-Over Anaesthesia: The Workhorse of the Field

When compressed oxygen cylinders run dry and electricity fails, the standard civilian anaesthesia workstation becomes an expensive piece of sculpture. The saviour of field anaesthesia is the draw-over system, most classically exemplified by the Triservice Anaesthetic Apparatus (ATA) or the Diamedica systems.

Unlike a continuous-flow machine, which relies on high-pressure gas to drive volatile vapor into a breathing circuit, a draw-over system utilizes the patient's own inspiratory effort (or manual compression of a self-inflating bag) to pull ambient air through a low-resistance vaporizer (e.g., the OMV - Oxford Miniature Vaporizer).

Oxygen Conservation: Standard circle systems waste massive quantities of gas through scavenging. A draw-over system can run purely on room air (21% O2) if necessary. When supplemental oxygen is available via an oxygen concentrator or a cylinder, it can be bled into the system at ultra-low flows (1–2 L/min) directly into a reservoir tube, achieving an inspired oxygen fraction (FiO2) of 40–60%. This extends the lifespan of an oxygen cylinder by hundreds of percent compared to civilian high-flow techniques.

Volatile Efficiency: Because the gas only flows through the vaporizer when the patient inspires, there is no continuous wasting of volatile agent into the room during expiration or apnoea.

Total Intravenous Anesthesia (TIVA) and the Syringe Conservation Strategy

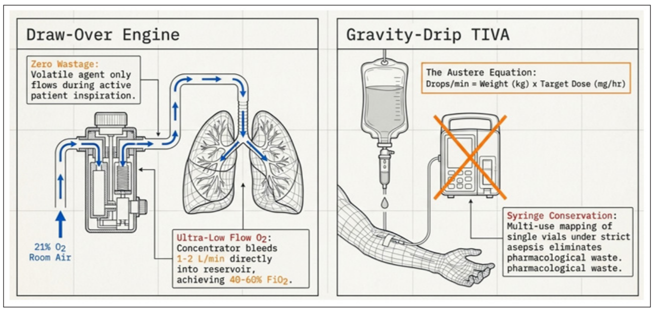
When draw-over equipment is unavailable, TIVA becomes the primary modality. However, running a TIVA protocol without automated syringe pumps requires deep pharmacological understanding and manual precision.

To reduce wastage of precious intravenous agents, the provider must embrace micro-dosing and multi-use strategies under strict aseptic techniques, despite traditional civilian guidelines mandating single-use vials. If a 500 mg vial of ketamine is reconstituted, it must be mapped out for multiple casualties using distinct sterile syringes for each withdrawal.

Furthermore, to prevent the wastage of IV tubing and extension sets, standard gravity-fed micro-drip chambers (60 drops/mL) are used to titrate maintenance infusions, calculating drip rates manually using standard formulas:

$$\text{Drips per minute} = \frac{\text{Desired Dose (mg/min)} \times \text{Drop Factor (gtt/mL)}}{\text{Concentration of Solution (mg/mL)}}$$

This eliminates the dependence on electricity-guzzling infusion pumps while preserving precious IV consumables.



The Multi-Technique Playbook: Tailoring the Anaesthetic

There is no place for the "one-size-fits-all" anesthetic in a combat zone. The successful field provider must be a chameleon, fluent in regional, intravenous, and inhalational techniques, often blending them to minimize the side effects of each.

Regional Anaesthesia: The Ultimate Field Multiplier

If field anaesthesia has a holy grail, it is regional anaesthesia. Utilizing ultrasound-guided or anatomical landmark-guided nerve blocks transforms the perioperative landscape in a low-resource environment.

Technique	Anatomical Target	Clinical Indications in the Field	Advantages
Interscalene / Supraclavicular Brachial Plexus Block	Roots/Trunks of Brachial Plexus	Upper extremity trauma, shrapnel debridement, amputations	Avoids airway manipulation; provides up to 24 hours of profound analgesia.
Femoral Nerve / Fascia Iliaca Compartment Block	Femoral nerve space beneath fascia iliaca	Femoral fractures, anterior thigh debridement	Profoundly reduces the systemic opioid requirement; stabilizes patients for transport.
Sciatic/Popliteal Block	Sciatic nerve division in popliteal fossa	Lower leg, foot trauma, blast injuries	Preserves hemodynamic stability; allows the patient to remain awake and converse.
Spinal (Intrathecal) Anaesthesia	Subarachnoid space (L3-L4 / L4-L5)	Lower abdominal, perineal, and lower extremity surgeries	Rapid onset, requires minimal equipment, complete muscle relaxation.

The Strategic Benefits of Regional Blocks

- **Airway Preservation:** The patient retains their protective airway reflexes. In a noisy field hospital where monitoring is done visually, an awake patient who can protect their own airway is infinitely safer than an intubated patient.

- **Resource Preservation:** A single regional block consumes perhaps 20 mL of local anaesthetic (e.g., 0.5% bupivacaine or 0.75% ropivacaine) and a single needle. It requires zero oxygen, zero volatile gas, and zero post-operative ventilator support.

- **The "Silent" Post-Op Ward:** By providing 12–24 hours of dense post-operative analgesia, regional blocks drastically reduce the nursing burden in the post-operative holding area. Patients do not require frequent boluses of IV opioids, preventing opioid-induced respiratory depression in an unmonitored environment.

Ketamine: The Austere Sovereign

When general anaesthesia is unavoidable, Ketamine is the undisputed backbone of field medicine. Its pharmacology is perfectly suited for the chaotic ecosystem of field surgery.

- **Hemodynamic Profile:** Unlike propofol or thiopental, which cause profound vasodilation and myocardial depression, ketamine stimulates the sympathetic nervous system. It induces a transient increase in heart rate, systemic vascular resistance, and cardiac output, making it the induction agent of choice for the hypovolemic, shocked trauma casualty.
- **Airway and Respiration:** Ketamine preserves pharyngeal-laryngeal reflexes and maintains skeletal muscle tone. While transient apnoea can occur with rapid IV boluses, patients generally maintain spontaneous ventilation. Furthermore, its potent bronchodilatory properties are invaluable when treating patients exposed to blast-induced bronchospasm or smoke inhalation.
- **The Dissociative State:** Dissociative anaesthesia separates the sensory cortex from the limbic system. The patient may have their eyes open and look awake, yet they are completely amnestic and analgesic to the surgical stimulus [3-10].

Volatile Anaesthesia via Draw-Over: Isoflurane and Halothane

While TIVA is highly versatile, volatile anaesthesia via draw-over remains crucial when intravenous supplies run low. Isoflurane is preferred due to its stability in variable temperatures and relatively rapid kinetics. However, in many developing regions or deep field locations, Halothane remains prevalent due to cost. The field provider must remember that Halothane sensitizes the myocardium to catecholamines; in a highly stressed, hyper-adrenergic combat casualty, the co-administration of epinephrine (e.g., in local tissue infiltration) must be strictly limited to avoid fatal ventricular arrhythmias.

Advanced Clinical Protocols

To establish standardization and reduce cognitive overload in high-stress operational environments, providers must rely on validated chemical mixtures and titration parameters that do not require automated electronic delivery hardware.

Protocol A: The Classic Ketamine-Midazolam Infusion ("Field Mix")

To prevent the vivid, often terrifying emergence delirium associated with ketamine especially in soldiers or civilians suffering from acute psychological stress, ketamine must be systematically paired with a benzodiazepine.

- **Clinical Indication:** Maintenance of general dissociative anaesthesia for major soft-tissue injuries, amputations, or damage control procedures.
- **The Formulation:** Add 500mg Ketamine and 10mg Midazolam into a 500mL bag of Normal Saline or Lactated Ringer's.
- **Final Concentration:** 1mg/mL Ketamine, 0.02mg/mL Midazolam.
- **Delivery Protocol (Gravity/Micro-drip System):**

a. **Maintenance Rate:** Infuse at 1-2mg/kg/hour, which translates directly to a manual drip rate of 1-2mL/kg/hour. Utilizing a standard 60gtt/mL micro-drip set, the number of drops per minute matches the patient's weight in kilograms multiplied by the target milligram dose.
b. Titrate to clinical endpoints (absence of purposeful movement, suppression of sympathetic surges during incision).

Protocol B: The Tactical Multimodal "K-F" Drip (Analgesia/ Sedation Maintenance)

When a casualty requires prolonged surgical intervention but skeletal muscle relaxation is not mandatory, combining low-dose opioid delivery with ketamine preserves respiratory drive while mitigating the psychomimetic side effects of ketamine without relying heavily on long-acting benzodiazepines.

- **Clinical Indication:** Intact or secured airway; stable to moderately shocked patients undergoing protracted surgery; ideal for transitioning to Prolonged Field Care (PFC).
- **The Formulation:** Add 250mg Ketamine and 1000mcg Fentanyl to a 250mL bag of Normal Saline or Lactated Ringer's.

- **Final Concentration:** 0.92mg/mL Ketamine / 3.7mcg/mL Fentanyl.
- **Delivery Protocol:**

a. **Maintenance Rate:** Run at 1-2mL/kg/hour (60gtt/mL - micro-drip matching weight in kg/hr).
b. **Titration:** Adjust downward if respiratory rate drops below 10 breaths per minute or if structural jaw relaxation compromises airway patency.

Protocol C: The "Stanford/Austere" Analgesic Cocktail (Sub-dissociative PFC Analgesia)
For post-operative management in a chaotic triage tent where 1:1 nursing monitoring does not exist, deep sedation is highly dangerous. This sub-dissociative protocol targets pain pathways while leaving cognitive faculties intact, allowing the patient to protect their own airway and converse.

- **Clinical Indication:** Severe post-operative pain; post-blast orthopaedic injuries; dressing changes; no electronic monitoring available.
- **The Formulation:** Add 100mg Ketamine to a 100mL bag of Normal Saline.
- **Final Concentration:** 1mg/mL Ketamine.
- **Delivery Protocol:**

a. **Infusion Rate:** Run via macro- or micro-drip to deliver 0.1-0.3mg/kg/hour
b. **Example for a 70kg patient:** Deliver 7-21mg/hour (7-21mL/hour)
c. **Clinical Safety Advantage:** Unlike systemic opioids, this dose profile preserves the hypoxic ventilatory response, eliminates the risk of chest wall rigidity, and yields a predictable, awake state.

Protocol D: The Low-Resource Syringe-Pump Infusion Protocol (Pure TIVA for ETT/SGA)
When an oxygen concentrator is running and the patient is intubated or managed via a second-generation supraglottic airway, this protocol relies on manual, volume-fractioned syringe injections timed via a watch to mimic automated target-controlled infusions.

- **Clinical Indication:** Fully instrumented airway; necessity for deep surgical anaesthesia; prevention of intraoperative awareness without using volatile agents.
- **The Single-Syringe Blend (The "K-P" Mix):** Draw 200mg Ketamine directly into a standard 50mL syringe containing 400mg Propofol (40mL of 1% propofol solution), then top up with 6mL of Normal Saline to create a total 50mL solution.
- **Final Concentration:** 4mg/mL Ketamine / 8mg/mL Propofol.
- **Delivery Protocol:**

a. **Induction:** Give 0.2-0.5mL/kg IV over 60 seconds (blends the sympathetic push of ketamine with the vasodilatory drop of propofol to achieve hemodynamic neutrality).
b. **Manual Maintenance:** Inject a 2-3mL bolus every 10–12 minutes, timed strictly using a wristwatch, or run via an extension line using a gravity-fed micro-drip calculated to deliver approximately 0.02mL/kg/minute.

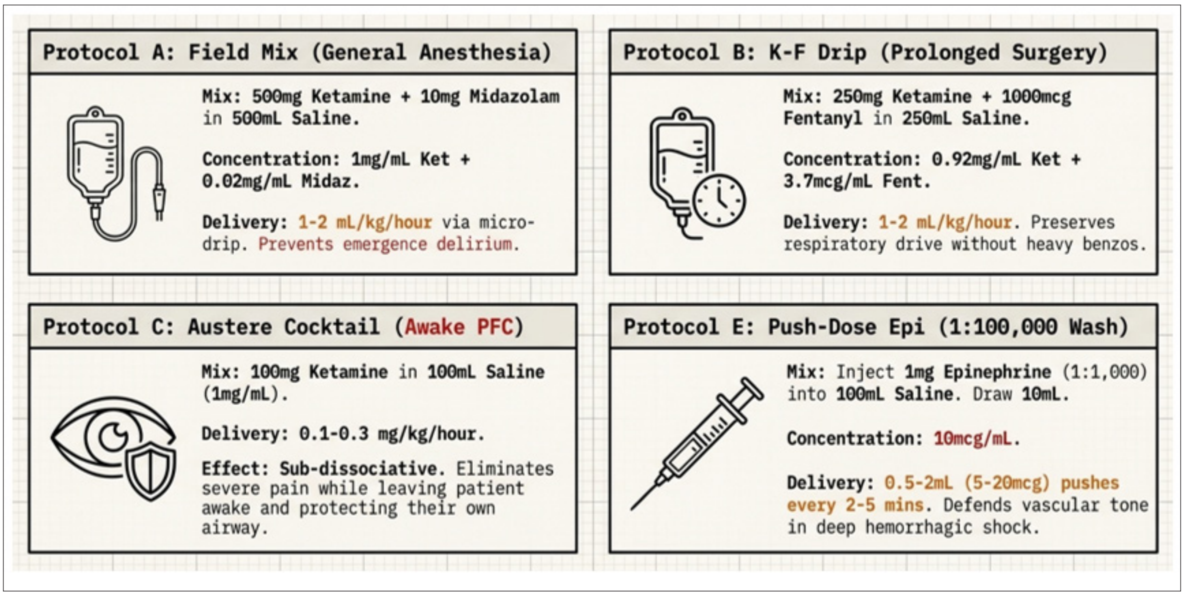
Protocol E: The Low-Resource Adrenergic Support Regimen ("Push-Dose" Epinephrine)
In deep haemorrhagic shock, even ketamine can trigger a drop in blood pressure due to depleted endogenous catecholamine stores. When commercial vasopressor infusions are unavailable, this simple pharmacy manipulation provides immediate, micro-dosed cardiovascular support without risking the profound tachyarrhythmias caused by standard cardiac arrest doses.

- **Clinical Indication:** Refractory hypotension during induction or surgical manipulation in a volume-depleted patient prior to blood arriving from the walking blood bank.
- **Preparation Strategy (The "1-in-100,000" Wash):**

a. Take a standard 1mg ampule of Epinephrine (1:1,000, 1mg/mL).
b. Inject this 1mg into a 100mL bag of Normal Saline. Shake well. The concentration is now 10mcg/mL.
c. Draw 10mL of this mixture into a standard syringe.

- **Delivery Protocol:**

a. **Administration:** Give 0.5-2mL IV pushes (5-20mcg) every 2 to 5 minutes as needed.
b. **Target:** Maintain a palpable radial pulse or MAP of 50mmHg (Permissive Hypotension threshold). This gives the provider direct, safe control over vascular tone without wasting bags of IV crystalloids.

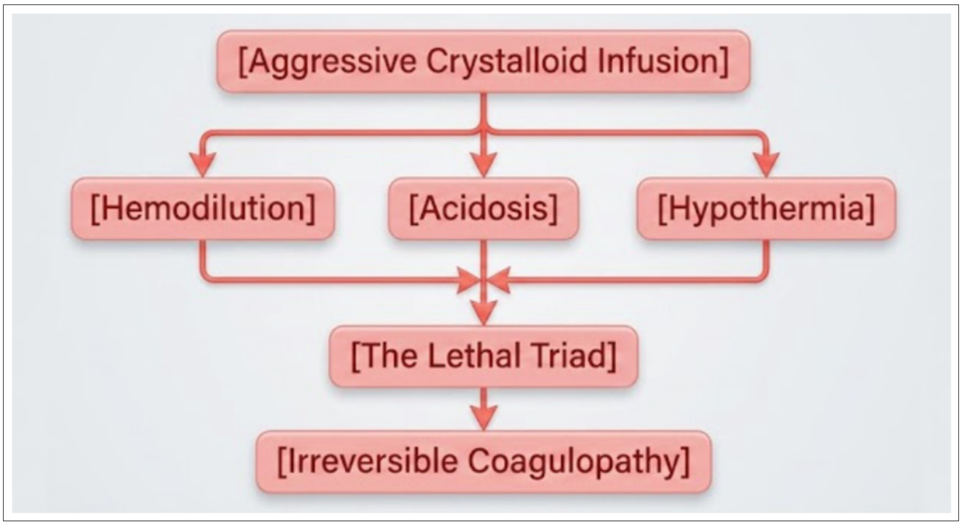


The Shocked Patient and the No-Blood Paradox

The ultimate test of a field anaesthetists' competence is the management of catastrophic haemorrhage in an environment completely devoid of typed, cross-matched stored whole blood or component therapy (Packed Red Blood Cells, Fresh Frozen Plasma, Platelets).

The Lethal Triad and the Failure of Crystalloids

For decades, civilian and military doctrines mistakenly advocated for aggressive crystal-clear fluid resuscitation (Normal Saline or Lactated Ringer's) for haemorrhagic shock. In the field, this practice is lethal. Large volumes of cold crystalloids cause haemodilution, washing out what few clotting factors the patient has left, while simultaneously worsening hypothermia and metabolic acidosis.



When there is no blood in the cooler, your fluid resuscitation strategy must change drastically.

Damage Control Resuscitation (DCR) and Permissive Hypotension

In the absence of definitive haemostasis (surgical control of the bleeding vessel), the provider must practice permissive hypotension.

The goal is not to normalize the blood pressure, but to maintain just enough perfusion to vital organs (indicated by a palpable radial pulse or a baseline mental status) while avoiding "popping the clot." Raising the systolic blood pressure to 120mmHg via fluids or vasopressors will dislodge the fragile, newly formed fibrin clots at the site of vascular injury, leading to catastrophic re-bleeding [11-15]

- **Target Metrics:** Aim for a Mean Arterial Pressure (MAP) of 50-60mmHg or a systolic blood pressure of 80-90mmHg.
- **The Expiration Date:** Permissive hypotension is a temporary bridge, not a definitive state. It can generally be tolerated for 1 to 2 hours before cellular hypoperfusion leads to irreversible multi-organ dysfunction syndrome (MODS).

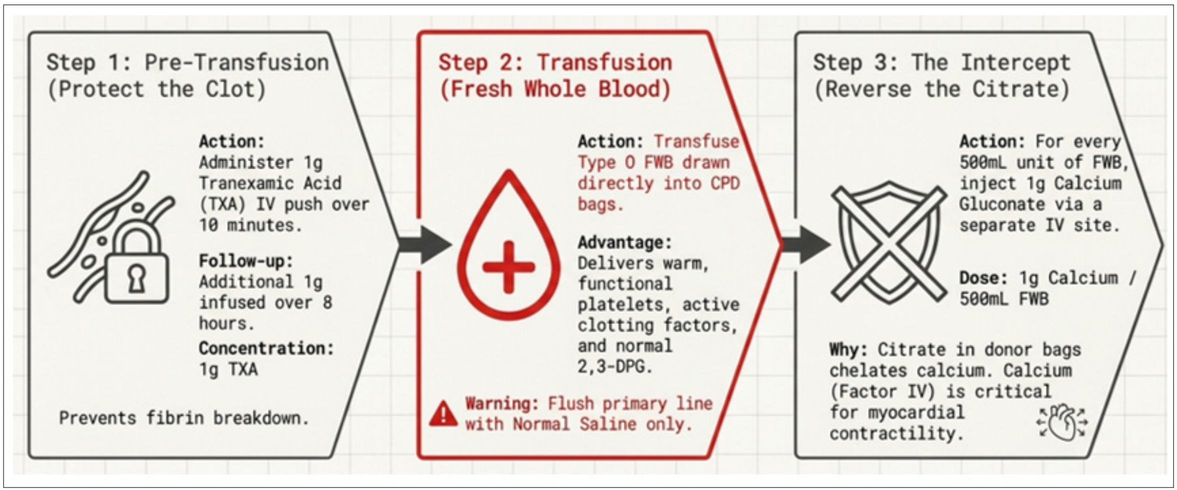
The Walking Blood Bank (WBB) and Delivery Co-Protocol

When stored blood is non-existent, the field hospital must transform into a living blood bank. A pre-screened roster of personnel (soldiers, humanitarian workers, uninjured civilians) with known blood types, specifically Type O Negative (the universal donor) or Type O Positive (acceptable for males and females past childbearing age in extremis) is activated.

The Power of Fresh Whole Blood (FWB): FWB drawn directly from a walking donor into a citrate-phosphate-dextrose (CPD) bag is biologically superior to stored components. It contains fully functional, warm platelets, highly active clotting factors, and red blood cells with normal levels of 2,3-diphosphoglycerate (2,3-DPG), meaning it delivers oxygen to tissues far more effectively than cold, stored red cells that have undergone storage lesions.

The WBB Delivery Co-Protocol:

- **Prior to Transfusion Line Attachment:** Administer 1g Tranexamic Acid (TXA) IV push over 10 minutes.
- **During Transfusion:** Flush the primary IV line only with Normal Saline (never use Lactated Ringer's in the same line as blood, as the calcium content can precipitate clotting inside the tubing).
- **The Calcium Intercept:** For every 500mL unit of FWB administered, inject 1g of Calcium Gluconate (or 300mg Calcium Chloride) through a separate IV site or a thoroughly flushed side-port. This reverses the immediate chelating effects of the CPD storage solution used in the donor draw bags.



Pharmacological Substitutes and Haemostatic Adjunct
When even the Walking Blood Bank is unavailable or delayed, the provider relies on an aggressive pharmacological strategy to optimize the patient's intrinsic coagulation cascade:

- **Tranexamic Acid (TXA):** An antifibrinolytic that prevents the breakdown of fibrin clots. Administered as close to the injury as possible (ideally within 3 hours). The field regimen consists of 1g IV over 10 minutes, followed by an additional 1g infused over 8 hours. Based on the CRASH-2 and CRASH-3 trials, early TXA administration significantly reduces mortality in trauma patients with significant haemorrhage.
- **Calcium Administration:** Citrate used in blood collection bags, as well as shock itself, precipitates a massive drop in ionized calcium. Hypocalcaemia impairs myocardial contractility and halts the clotting cascade (Calcium is Factor IV). For every 1-2 units of Fresh Whole Blood given or early in the resuscitation of severe shock 1g of Calcium Chloride (or 3g of Calcium Gluconate) must be administered IV.
- **Hypertonic Saline (3% or 7.5%):** When volume expansion is absolutely required to maintain cerebral perfusion (especially in concomitant traumatic brain injury), a small bolus (250mL) of hypertonic saline provides rapid intravascular volume expansion by drawing water out of the intracellular space, without causing the profound tissue oedema or massive volume overloading associated with isotonic crystalloids.

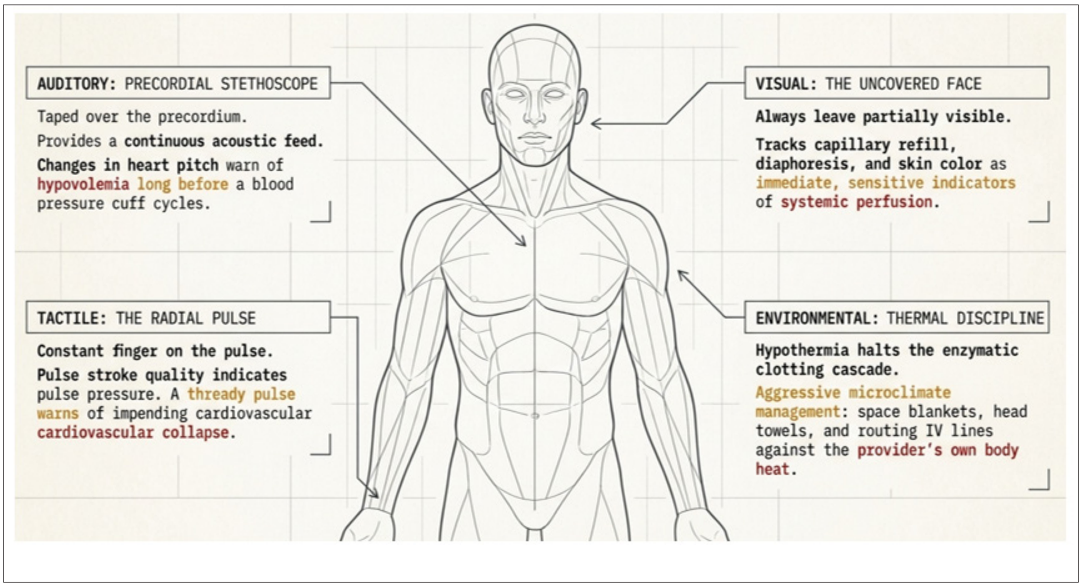
Situational Awareness, Risk Mitigation, and Clinical Monitoring
In a high-tech operating room, the anaesthesiologists' eyes are frequently glued to the multi-parameter monitor, tracking pulse oximetry plethysmography, end-tidal CO2 waveforms, and invasive arterial lines. In the field, these devices fail. Power supplies die, sensor cables snap, and ambient sunlight washes out LCD screens [16-19].

The Five Senses as the Primary Monitor
The field anaesthetist must resurrect the art of physical assessment. The human body provides remarkably clear signals if the provider knows how to read them.

- **Tactile Monitoring (The Radial Pulse):** Keeping a constant finger on the patient's radial or carotid pulse yields vast quantities of data. The quality of the pulse stroke indicates pulse pressure; a thready, rapid pulse warns of impending hypovolemic collapse, while a bounding pulse suggests adequate stroke volume or vasodilation.

- **Visual Monitoring (The Uncovered Face):** Always leave the patient's face partially visible to the anaesthetist, even during extensive facial or upper airway surgery. Skin colour, diaphoresis, and capillary refill time of the forehead or earlobe are sensitive indicators of systemic perfusion. Watch the rise and fall of the chest walls continuously; do not rely on a ventilator's pressure alarm.

- **Auditory Monitoring (The Precordial Stethoscope):** Taped securely over the patient's precordium or suprasternal notch, a simple precordial stethoscope provides a continuous acoustic feed of both cardiac and respiratory cycles. A change in the pitch of heart sounds can warn of myocardial depression or hypovolemia long before a traditional blood pressure cuff cycles. A sudden loss of breath sounds provides instant notification of an endotracheal tube displacement, bronchospasm, or tension pneumothorax.



Cognitive Adaptation and Environmental Management

Situational awareness extends beyond the patient's physiology to the entire environment. The field anaesthetist must continuously track environmental threats:

- **Noise Management:** The roar of generators, incoming artillery, or chaotic weather makes auditory monitoring difficult. The provider must position themselves physically to optimize visual lines of sight to the patient's chest and the surgical field.
- **Thermal Discipline:** Hypothermia is a silent killer that halts the enzymatic reactions of the clotting cascade. The field anaesthetist must aggressively manage the patient's microclimate. Wrap the patient's head in towels, use reflective space blankets, and route all intravenous lines under the operating table's heating blankets or even against the provider's own body heat to warm fluids prior to infusion.

Airway Mastery in Challenging Terrain

Airway management in the field is a high-stakes gamble. The patients are uniformly assumed to have "full stomachs," increasing the risk of aspiration. Furthermore, maxillofacial trauma, blast injuries, and thermal burns are commonplace, distorting normal anatomy.

The Tactical Airway Decision Matrix

The primary question for the field provider is: "Does this airway actually need to be instrumented?" In civilian practice, general anaesthesia with endotracheal intubation is often selected for convenience. In the field, every intubation is a liability. It requires induction drugs, paralytics, a confirmed oxygen source, and post-operative ventilatory support. If an operation can be performed under regional anaesthesia or deep sedation with spontaneous ventilation (e.g., Ketamine), that is inherently safer.

Advanced Techniques for the Modified Airway

When intubation is mandatory, the field provider must execute a rapid strategy:

• Rapid Sequence Induction (RSI) with Ketamine and Succinylcholine/Rocuronium

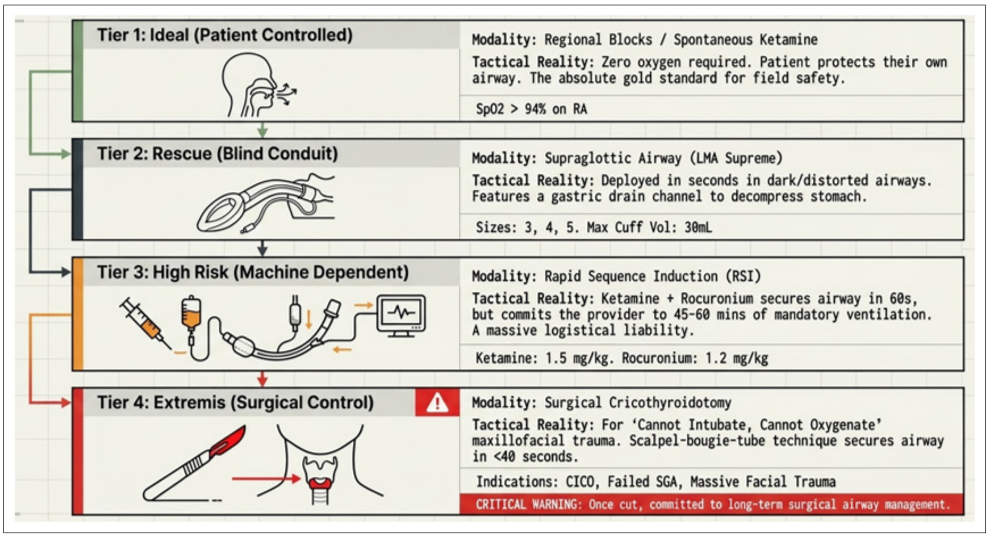
If the patient is hemodynamically unstable, standard induction doses of propofol or midazolam will cause immediate cardiovascular collapse. Ketamine (1-2mg/kg IV) paired with Succinylcholine (1.5mg/kg IV) or Rocuronium (1.2mg/kg IV) allows for rapid airway control within 60 seconds. If Rocuronium is used, the provider must accept that its long duration of action (45-60minutes) means they are committed to maintaining ventilation for an extended period, as Sugammadex is rarely available in low-resource environments.

• The Supraglottic Airway (SGA) Rescue

Second-generation laryngeal mask airways (e.g., i-gel or LMA Supreme) are invaluable field tools. They feature a gastric drain channel that allows for the decompression of the stomach, reducing aspiration risk. In a blind, dark, or anatomically distorted airway situation, an SGA can be placed in seconds, serving as a highly effective bridge to ventilation or as a conduit for fibreoptic-free blind intubation [20].

• The Surgical Airway (Surgical Cricothyroidotomy)

When confronted with a "cannot intubate, cannot oxygenate" (CICO) scenario such as severe maxillofacial trauma where blood and shattered tissue obscure all anatomical landmarks the field anaesthetist cannot waste time with repeated, futile laryngoscopy attempts. They must immediately transition to a surgical cricothyroidotomy. A scalpel-bougie-tube technique is the fastest, most reliable method in austere environments, securing an airway through the cricothyroid membrane in under 40 seconds.



Prolonged Field Care (PFC) and Post-Operative Management

The operation is complete, the surgical site is dressed, and the surgeon steps away. In a civilian setting, the anaesthetists' work is essentially done. In the field, a second, often more gruelling phase begins: Prolonged Field Care (PFC). When bad weather, active enemy fire, or broken transport assets delay medical evacuation, the anaesthesia provider must manage a critically ill, post-operative patient for 12, 24, or even 72 hours without ICU infrastructure.

The Strategy of Planned Emergence

Because there are no ventilators or ICU nurses to monitor an intubated patient over the long term, the intraoperative anaesthetic plan must be geared toward a planned, rapid emergence. The patient should be waking up, breathing spontaneously, and protecting their airway as the final skin sutures are placed.

- **Reversal of Neuromuscular Blockade:** If non-depolarizing muscle relaxants were used, complete reversal with Neostigmine (0.05mg/kg) and Atropine (0.02mg/kg) must be clinically verified via head lift or strong grip strength, rather than relying on peripheral nerve stimulators.
- **The Tapered Transition:** Shift the patient from general anaesthesia to a low-dose ketamine infusion (0.1-0.2mg/kg/hour) or scheduled regional nerve blocks to provide continuous, non-sedating analgesia. This keeps the patient awake, cooperative, and capable of coughing to clear secretions, minimizing the risk of post-operative atelectasis and pneumonia.

Post-Operative Monitoring in the Dark

In a makeshift post-operative tent, monitoring becomes a structured schedule of physical checks. The provider must establish a rigid rotation of vitals:

- **The Hourglass Urine Collector:** A urinary catheter is a vital low-resource monitor. In a post-operative patient recovering from haemorrhagic shock, urine output is an excellent surrogate marker for visceral organ perfusion. The goal is a steady output of $0.5-1.0mL/kg/hour. If output drops below this without an obvious mechanical obstruction, it indicates ongoing hypovolemia or acute kidney injury (AKI), necessitating careful, micro-titrated fluid challenges.
- **Mental Status:** If the patient is conscious, their cognitive orientation is the ultimate monitor of cerebral perfusion and oxygenation. A patient who becomes suddenly agitated, confused, or lethargic is hypoxic, hypercapnic, or experiencing occult internal re-bleeding until proven otherwise [21-25].
- **The Trend Chart:** In the absence of automated digital logs, the provider must manually log vital signs on a paper grid. It is not the isolated number that matters, but the trend. A slow, steady rise in heart rate accompanied by a narrowing pulse pressure over four hours is a classic warning sign of internal haemorrhage, allowing the provider to intervene long before the catastrophic drop in systolic blood pressure occurs.

Conclusion

Field anaesthesia is far more than a set of technical skills; it is a philosophy of clinical adaptability and psychological resilience. It forces the provider to shed the rigid dogmas of high-resource guidelines and return to the first principles of physiology, pharmacology, and physical diagnosis.

To succeed in this austere arena, the provider must accept that perfection is the enemy of the good. The goal is not to deliver a pristine, textbook anaesthetic that matches the standards of a tertiary university hospital. The goal is to deliver a safe, functional, and highly efficient anaesthetic that saves a life, protects a brain, preserves limited resources for the next casualty, and adapts fluidly to the chaotic realities of the field.

When the monitors are dark, the oxygen tanks are empty, and the casualties continue to arrive, the field anaesthetist stands as the vital bridge between trauma and survival—proving that the most powerful tool in medicine is not the machine, but the prepared, adaptive mind.

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