9. ANAESTHESIA OUTSIDE A HOSPITAL SETTING

2022 new addition by R Hofmeyr

Introduction

Clinicians may be called upon to provide services including patient assessment, monitored care, sedation, anaesthesia and resuscitation outside of the traditional hospital environment. This is not limited to sedation/anaesthesia in day surgery units and consulting rooms for proceduralists but extends to the prehospital and interfacility transfer environments, and 'HARD anaesthesia' conditions in the humanitarian, austere, remote, and disaster settings.

Whilst the conditions and context may vary dramatically, fundamental principles for the provision of safe anaesthesia are universal and reflect the core tenets of in-hospital anaesthesia as detailed in the established practice guidelines. Importantly, it is essential to understand that resource limitations are common in the out-of-hospital setting, but adverse environments are not an excuse for poor quality anaesthesia care.

Context

Practice guidelines for procedural sedation and anaesthesia in consulting rooms and similar settings are well described and beyond the scope of this guideline. The specific case of getting infusions for psychiatric indications is also discussed separately. This document will provide basic guidance for anaesthesia in the prehospital, remote, humanitarian and disaster settings. Practitioners are encouraged to read this in the context of the greater body of the SASA Practice Guidelines. They are encouraged to undertake specific study and training if anticipating practising within this field.

International guidelines exist for the practice of anaesthesia within the hospital, outside of the operating theatre, in the prehospital environment, as well as in the disaster setting. Practitioners developing protocols and systems for out-of-hospital anaesthesia are encouraged to read these international resources in conjunction with this document, in order to adjust the guidance to their specific South African context.

Guidance

Clinical governance

The ethical and medicolegal requirement to maintain adequate clinical notes is not obviated by the austere environment. In all cases where anaesthesia services are provided, a record must be kept, even if this is limited to a retrospective progress note. Increasingly, pro forma case report forms which can be completed electronically using a mobile device or tablet, are being integrated with automated patient monitoring and dictated voice notes. In the absence of such technological solutions, practitioners can use simple paper notes or the notes feature of their mobile device, including photographs of vital signs, to create a contemporaneous record.

Ideally, all cases should be recorded in a central database or registry, and all adverse events should be subjected to a morbidity and mortality review process. Mechanisms must be in place to disseminate lessons learnt through case review into clinical practice.

Knowledge, skills and personal preparation

Outside of the unanticipated emergency, practitioners planning to perform anaesthesia in the prehospital or 'HARD' (humanitarian, austere, remote or disaster) settings should undertake specific training in the field. This may be through specific courses or while working in the environment under supervision. Simulation training is of particular value in learning to adapt in-hospital anaesthesia skills to the out-of-hospital setting. Prehospital and disaster anaesthesia is frequently simplified and protocolised to streamline equipment requirements, improve the reproducibility of care, and enhance safety. Simulation is an ideal tool to learn and practice protocols in a safe environment.

Anaesthesia practitioners working in the out-of-hospital environment may need enhanced general medical and procedural skills to cope with complications of anaesthesia care which might be managed by other specialities in a more well-resourced environment. For instance, percutaneous or surgical tracheostomy and tube thoracotomy for placement of intercostal drainage are skills less commonly performed by anaesthesiologists in the in-hospital setting. But in the austere environment, this falls within the realm of skills required.

Recognising that the out-of-hospital environment can be adverse, even in an urban setting, is important. This is amplified to the point of discomfort or personal danger when practising in an austere or disaster setting. Practitioners must fully understand the environment's and mission's demands, including duration, working conditions, baseline infrastructure requirements of self-care, self-sustainability, physical demands, what personal protective equipment (PPE) is required, environmental hazards, endemic diseases, and requirements for vaccination. Critically, the practitioner must be competent to work and care for themselves in the environment so as not to be an additional burden on other staff, or in turn, become a casualty.

Protective clothing and equipment

Enhanced personal clothing and equipment to protect the practitioner from both the environment and the patient is frequently required in the out-of-hospital setting. This may be limited to sun protection and more robust disposable gloves but can include specialised clothing such as exposure or Nomex® suits, respirators or other breathing apparatus, height protection and fall arrest equipment, and enhanced PPE for infectious diseases. Again, training in simulations in providing anaesthesia care while using enhanced PPE is essential to adjust practices to the adverse environment.

Equipment for out-of-hospital anaesthesia

Equipment for out-of-hospital anaesthesia is subject to multiple and often contradictory requirements. These include ruggedness (including resistance to vibration, droppage, dust and water), ability to operate for extended periods without electrical power, user interfaces which can be interpreted and

operated easily while wearing a range of PPE, displays which are readable in daylight conditions outdoors but do not place excessive drain on battery systems, interoperability with readily available disposables, integration with telemedicine systems, ability to be recharged from conventional and vehicle power systems, compact size and limited weight, field serviceability, and longevity. Devices with integrated interventional and monitoring capability (such as multi-parameter monitor-defibrillators with pacing capacity or ventilators with integrated capnography) are advantageous.

Where a full spectrum of patient ages and body masses is anticipated, a careful selection of devices which require a specific size (such as laryngoscope blades or IV cannulas) to bridge the full spectrum with a smaller number may be effective. When packing equipment, items which must be used together must always be packed together.

Equipment should be packaged and transported according to the envisaged usage. Where it will be deployed at a fixed remote location, transportation should occur in robust containers which allow equipment to be fully secured and protect against dust and water ingress while allowing equalisation of atmospheric pressure. Dedicated rigid cases or crates may double as mounting systems at the point of deployment. Where designed for use in a vehicle or plane, equipment must be firmly secured and accessible to the practitioner without requiring disconnection of seat belts or safety harnesses. In the prehospital or a wilderness setting, equipment that must be carried should be packaged in well-padded and ergonomic backpacks or bags designed for the specific purpose. Typically, such bags allow clamshell opening and immediate access to all content within themed sub-containers.

Equipment and monitoring for out-of-hospital anaesthesia should aim to replicate the same standards of care and safety as are achieved in a traditional operating theatre setting.

Recommended minimum equipment for providing anaesthesia in an out-of-hospital setting includes:

1. Patient monitoring devices which can read and display heart rate, O_2 saturation and NIBP. ECG and capnography monitoring and the ability to automatically record measurements for later recall are highly advisable.
2. Basic diagnostic equipment including stethoscope, pupil torch and blood glucose test kit. Expanded POC diagnostics including handheld blood gas and chemistry, Hb concentration, core temperature and field US are desirable.
3. Advanced airway equipment and adjuncts which allow the full standard spectrum of airway management, including face mask ventilation, intubation, rescue supraglottic airway device placement, and front-of-neck access.
4. Provision for suctioning is essential, whether using a handheld manual device or pump apparatus.
5. A means of providing ventilation independent of pressurised gas supplies must be present.
6. A means of providing supplemental O_2 is highly recommended. This may be from cylinder supply or through the use of an O_2 concentrator.
7. Equipment for IV access, including disposables and appropriate fluids. In transport environments where height limitations reduce the ability to achieve sufficient gravity pressure for infusions, pressure bags and/or infusion pumps are advisable.
8. A securely packaged and well-selected range of anaesthetic, analgesic and resuscitation medications is essential. Specific reversal agents such as naloxone and flumazenil should be included. Careful consideration should be given to whether a specific antidote to rare anaesthetic complications can or should be included (such as provision for malignant hyperthermia or local anaesthetic systemic toxicity).
9. Equipment must be available for patient positioning. This may be a portable operating table, gurney or bed, or may be improvised using a stretcher, cot or wilderness equipment. Ideally, it must allow 360-degree access to the patient, leg elevation, and the ability to rapidly put the patient in the left lateral position.
10. An independent, hands-free light source of sufficient (ideally adjustable) brightness and suitable colour temperature is essential. This may be a simple commercially available headlamp, adequate room lighting or portable theatre lights.

Medical gasses in the austere/remote setting

Outside of the hospital, it is very rare to have access to pipeline gasses. Prehospital ventilators usually rely on pressurised O_2 from cylinders but may incorporate a piston or turbine, which allows varied inspired oxygen fraction (F_iO_2), or ventilation with air in the absence of an O_2 source. Care must be given to the estimation of the duration of ventilation depending on the O_2 demand and capacity available, especially when ventilators use O_2 as a drive gas. In the austere setting, it often falls to the anaesthetist to assess and manage gas supplies and scavenging/vacuum. Medical air, N_20 and scavenging are rare. Where electrical power is available, O_2 concentrators are an excellent alternative to cylinders, require little maintenance and have excellent service lifetimes but are limited in output flow and pressure to drive many conventional anaesthesia devices. In this setting, even low flow rates can give a high F_iO_2 when used in conjunction with a draw-over anaesthesia system (see next section). Suction may be manual or by using stand-alone pumps, and scavenging may be limited to venting exhaust gasses into the atmosphere. Attention should thus be given to good ventilation of anaesthesia spaces.

Draw-over anaesthesia

Draw-over anaesthesia is rare outside of the military, humanitarian or disaster medicine setting, and is thus unfamiliar to most practitioners. However, it offers significant advantages where general anaesthesia is required in severely resource-constrained conditions. Therefore, practitioners should undergo specific training and initial supervised practice on draw-over systems before use for anaesthesia. The application of standardised checklists before use is highly recommended. Inhalational methoxyflurane analgesia using the commercially-available disposable draw-over device should be according to the existing indications.

Intravenous anaesthesia

Total intravenous anaesthesia (TIVA) has advantages in the out-of-hospital setting, of which the avoidance of requirement for vaporisers and complex gas administration systems is paramount.

In the prehospital emergency anaesthesia, this may be limited to induction for airway management with post-intubation sedation, or it can be for total operative anaesthesia. In the latter context, approaches range from simple hand boluses and protocolised infusions to TCI pumps. In very constrained settings, ketamine by intramuscular bolus or drip-controlled infusion is widely used, but the increasing capability and compactness of TCI syringe drivers make this option attractive and familiar where electrical power is available.

Performance of out-of-hospital anaesthesia

It is beyond the scope of this guideline to define standards for the practice of out-of-hospital anaesthesia in all settings. However, there are unifying general principles of technique which are common to most contexts:

1. Patients should be assessed before anaesthesia. In the prehospital environment, this may amount to a primary survey concurrent with resuscitative efforts; in a humanitarian setting, it may occur with screening days before surgery.
2. Preparation of the area and patient should occur before the provision of anaesthesia. This may include positioning, creation of 360-degree access, and equipment preparation using a standardised 'kit dump' so that all items are immediately at hand.
3. Out-of-hospital anaesthesia care should not be initiated without a dedicated practitioner, who is ideally supported during critical phases (such as peripheral nerve blockade or airway management) by a suitably trained assistant. Patients under anaesthesia in the out-of-hospital setting must always have a dedicated practitioner providing care who is not also undertaking other clinical interventions (such as surgery).
4. Before or concurrent with preparation, the care team should be briefed on the plan, anticipated steps, and initial responses to adverse events.
5. The use of algorithms and challenge-response checklists is highly recommended during the preparation, briefing and performance phases.
6. Local, regional and neuraxial anaesthesia are desirable in highly resource-constrained settings. The core prerequisites are practitioner experience and capability with the chosen technique, and having suitable skills, equipment, and medications immediately available to deal with complications (such as LA systemic toxicity or high spinal anaesthesia). The absence of skills or equipment to perform general anaesthesia or advanced resuscitation is a contraindication, not an indication, to use loco-regional anaesthesia. Field-expedient peripheral nerve blocks which do not require needle positioning adjacent to critical structures (such as the pleura or large vessels) should be preferred.
7. Where available, O_2 supplementation and preoxygenation should always be provided. Exceptions include procedures purely under regional anaesthesia, and where draw-over anaesthesia is provided in the absence of supplemental O_2 supplies. Ideally, adequate time for preoxygenation or measurement of end-tidal expired O_2 fraction of > 0.8 should always be achieved before induction of general anaesthesia.
8. Agent selection for general anaesthesia should be based on safety, titratability, and broad utility across various settings. Ketamine is favoured as IV anaesthesia for its preservation of spontaneous ventilation, relative cardiovascular stability, wide therapeutic index, and multiple administration methods. Sevoflurane is attractive as an inhalational agent using conventional plenum or draw-over vaporisers, although the utility of halothane and isoflurane to be used interchangeably in the same vaporiser is desirable in some settings.
9. Advanced airway management in the out-of-hospital setting should follow the accepted guidelines in the field. Attempts at intubation should be limited, and progression through the airway algorithm prompted by the assistant according to the preanaesthesia team briefing. Equipment for the entire airway algorithm must be immediately at hand (prepared in the kit dump) if not already open and prepared. It is not necessary to wait for the onset of hypoxaemia to progress through the chosen algorithm if attempts are unsuccessful.
10. Airway device placement must be confirmed by at least two modalities (for example, auscultation and capnography).
11. Post-intubation anaesthesia or critical care should commence immediately. This may include lung-protective ventilation to achieve normocarbia, analgesia and correction of haemodynamic instability. Depth-of-anaesthesia and neuromuscular blockade monitoring is seldom performed in the out-of-hospital setting.
12. Recovery from anaesthesia must occur in an environment with the same monitoring level as anaesthesia care if the patient is not being transferred to a higher level of care. The use of a validated recovery score is advisable.

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  - Basic diagnostic equipment including stethoscope, pupil torch and blood glucose test kit. Expanded POC diagnostics including handheld blood gas and chemistry, Hb concentration, core temperature and field US are desirable.
  - Advanced airway equipment and adjuncts which allow the full standard spectrum of airway management, including face mask ventilation, intubation, rescue supraglottic airway device placement, and front-of-neck access.
  - Provision for suctioning is essential, whether using a hand-held manual device or pump apparatus.
  - A means of providing ventilation independent of pressurised gas supplies must be present.
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  - An independent, hands-free light source of sufficient (ideally adjustable) brightness and suitable colour temperature is essential. This may be a simple commercially available headlamp, adequate room lighting or portable theatre lights.
- Practitioners should undergo specific training and initial supervised practice on draw-over systems before use for anaesthesia. The application of standardised checklists before use is highly recommended.
- The use of algorithms and challenge-response checklists is highly recommended during the preparation, briefing and performance phases.

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