



Pre-hospital Anaesthesia

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1. Summary and recommendations

- Pre-hospital anaesthesia is a desirable intervention in relatively few patients but can result in unnecessary morbidity and mortality if performed poorly.
- It should be performed only by appropriately trained and competent practitioners working in a properly structured pre-hospital system.
- Standards of practice and monitoring should be similar to those recommended for in-hospital emergency anaesthesia.
- Every pre-hospital service should have a clinical governance structure that includes case review, appraisal, standard operating procedures, airway management algorithms, failed intubation algorithms, audit and a clearly identified lead clinician with responsibilities for anaesthesia providers.

2. Background

Pre-hospital anaesthesia is currently carried out regularly by a only small number of doctors in the UK. Although mostly predictable, pre-hospital conditions can be more difficult than those in hospital and, in addition, trained assistance and peer support is not usually available. It is therefore important that patient safety is paramount and that systems are in place to ensure that the highest standards are achieved.

Tracheal intubation has not been shown to improve outcome in patients who suffer cardiac arrest [1], and drugs are rarely required to facilitate intubation in these patients. In contrast, most trauma patients and those medical patients with intact reflexes require drugs to enable tracheal intubation. The exact proportion of trauma patients that requires early airway intervention is unclear but likely to be relatively small [2]. However, many trauma patients requiring urgent tracheal intubation do not undergo tracheal intubation until their arrival in hospital, which is suboptimal [2]. A recent report on trauma care in the UK from the National Confidential Enquiry into Patient Outcome and Death (NCEPOD) [3] highlighted poor airway care in trauma patients and emphasised the need for pre-hospital anaesthesia.

Rapid sequence induction (RSI) with oral intubation followed by maintenance of sedation is the technique of choice in the emergency department and, where resources and skills permit, in the pre-hospital phase [2,4]. Most current UK pre-hospital practitioners cannot and should not practise pre-hospital anaesthesia. Those practitioners who do not have competence in RSI or who operate outside an appropriate supporting system may make significant contributions to the management of injured patients without this skill and should not be in any way pressurised to perform the technique without appropriate training, resources and local support. Where patients with airway compromise are encountered, oxygenation should be attempted with simple airway manoeuvres, meticulous bag-mask ventilation and airway rescue devices, e.g. the use of supraglottic airway devices familiar to the individual practitioner.

3. Local organisation

All pre-hospital organisations, e.g. immediate care schemes, hospital-related schemes and ambulance service Trusts, should provide the following support to practitioners. Where trainees are practising pre-hospital anaesthesia they must have immediate access to advice from a senior doctor who is also fully competent in pre-hospital anaesthesia who practise RSI:

- A named, responsible lead clinician who ensures competency-based practice, regular review and appraisal of practitioners. Where trainees are practising pre-hospital anaesthesia they must have immediate access to advice from a senior doctor who is also fully competent in pre-hospital anaesthesia.
- A clinical governance structure that includes regular case review, audit, an adverse event reporting system and regularly reviewed guidelines and standard operating procedures. This structure should be integrated into the clinical governance programme of a regional trauma service where one exists [3].
- Equipment should be appropriate, functional and maintained to the same standard as ambulance service or hospital equipment. Minimum standards of monitoring should be the same as for hospital anaesthesia [5].
- Anaesthesia in hospital is conducted only in the presence of an appropriately trained assistant. The same standards should apply in pre-hospital care. The pre-hospital team that provides anaesthesia should therefore include an appropriately trained assistant. Rarely, it may be appropriate to proceed without trained assistance on the basis of an individual case risk : benefit analysis.

4. Technique (general principles)

The general principles for undertaking pre-hospital general anaesthesia are similar to those for uncomplicated emergency anaesthesia in hospital. To ensure safe and effective anaesthesia in the challenging pre-hospital environment, techniques should be as simple as possible and well practised. Most of the commonly used induction agents and neuromuscular blocking drugs are also used in pre-hospital care. The choice of drug depends on the physiological state of the patient and the operator's familiarity with the drug.

Preparation

Careful preparation of the patient and equipment will decrease the incidence of complications. If the position of the patient makes airway management difficult, the patient should, if time permits, be moved to an area that gives good 360-degree access to the head and neck, and ideally to the whole body. Steps should be taken to improve inadequate light or to shade against bright sunlight, both of which can make tracheal intubation difficult.

A standard 'equipment dump' with all the drugs and equipment necessary for general anaesthesia should be prepared. This includes drugs, airway devices and adjuncts, intubating bougie, suction, adequate oxygen, a breathing and ventilation system, and monitoring equipment. Drugs should be either pre-prepared or drawn up into labelled syringes. The pre-hospital team should be thoroughly familiar with the medical equipment.

The ideal patient position for RSI is on an ambulance trolley at waist height. If the patient's airway is obstructed and cannot be managed using simple airway adjuncts, tracheal intubation may have to be attempted in less than ideal positions. 'Trapped' patients can usually be extricated rapidly to facilitate airway management. Genuine entrapment is uncommon but can make intubation very difficult. A supraglottic or surgical airway may be required.

Assistants should be fully briefed. Ideally four people are required, with the following tasks:

1. Tracheal intubation
2. Assisting the anaesthetist
3. Providing manual, in-line stabilisation
4. Performing cricoid pressure and laryngeal manipulation

General anaesthesia

Before induction

In spontaneously breathing patients, routine pre-oxygenation is achieved using high-flow oxygen delivered through a breathing system with an oxygen reservoir bag. Patients with poor respiratory effort may require ventilatory assistance with a bag and mask. Care should be taken to minimise gastric distension and the risk of subsequent aspiration. A hard collar limits jaw opening and severely restricts the view at laryngoscopy. After manual, in-line stabilisation is established, the front of the collar and head blocks can be removed before induction.

Induction

A slight head-up position may reduce the risk of passive regurgitation of gastric contents and decrease intracranial pressure. Induction is undertaken with the same considerations as in hospital, e.g. modified for hypotensive or head-injured patients, but the technique should be as straightforward as possible, minimising the number of decisions that need to be made in the pre-hospital phase. The practitioner should fully understand the pharmacology of the drugs used.

Badly-applied cricoid pressure is a cause of a poor view at laryngoscopy. It may need to be adjusted or released to facilitate intubation or ventilation.

Pre-hospital airways are often challenging [2], and frequent difficult intubations should be anticipated. An intubating bougie and suction should be immediately to hand. Routine use of an intubating bougie should be considered in pre-hospital practice. Other 'difficult airway' equipment may be approved by individual pre-hospital organisations. Tracheal intubation should not be attempted more than three times. If a patient becomes hypoxaemic during these attempts, gentle ventilation of the lungs should be performed, if possible with maintenance of cricoid pressure.

Every pre-hospital organisation must have a **written and well-rehearsed 'failed intubation' plan**. This should include the use of a rescue supraglottic airway device and clear indications and instructions for performing a surgical airway. Standard techniques that are easily used in the pre-hospital phase are described in the UK TEAM (Training in Emergency Airway Management) Course [6] and by the Difficult Airway Society [7].

The breathing system should be connected using an in-line heat and moisture exchange filter (HME). Correct placement of the tracheal tube must be confirmed by conventional and carbon dioxide detection techniques. This must be repeated after patients are moved.

Once correct placement has been confirmed, the tracheal tube must be secured. A circumferential tie may impair venous drainage of the head and neck. Therefore, it is preferable to use self-adhesive tape for head-injured patients. Consideration should also be given to commercially available tracheal tube holders. Once the airway is secured, head blocks and adhesive tape usually provide sufficient cervical spine stabilisation.

Care after tracheal intubation

All anticipated practical procedures should be completed before transport, as they are more difficult to perform safely once transport is under way. The patient should be prepared appropriately for transfer, ensuring that intravenous access is readily accessible. There should be sufficient oxygen and reserve available for the journey. Although high-flow oxygen therapy is routine practice in trauma care, it may sometimes be necessary to use lower flows for stable patients in order to conserve supplies for the duration of the transfer.

Ventilation to normal end-tidal carbon dioxide values (4.5 – 5.5 kPa) is usually appropriate. The use of transport ventilators will decrease the risk of hyperventilation and free up a member of the pre-hospital team.

In most patients, small doses of a hypnotic drug such as midazolam or propofol will be necessary during transfer in order to maintain anaesthesia. Accidental awareness is a possibility whenever neuromuscular blocking drugs are used and is more likely in those patients with near-normal pre-induction Glasgow coma scores. Small, frequent doses minimise haemodynamic side effects and should be titrated against physiological variables. Infusions may be preferable, although infusion pumps are bulky, heavy and make transfer more complex.

Ketamine

Ketamine is a versatile anaesthetic and analgesic drug that is used extensively in developing countries for induction and maintenance of anaesthesia. It has a variety of side effects and is therefore not used extensively for inducing

anaesthesia in UK practice. However, it is used regularly for pre-hospital analgesia and procedural sedation. It may be given intramuscularly when intravenous access is impractical or impossible, and is less likely to lead to airway compromise than other agents. Relative cardiovascular stability makes it an attractive induction drug for pre-hospital care. Many services do not use ketamine to induce anaesthesia in patients with head injuries because it can increase intracranial pressure. The clinical significance of this effect is questionable and the benefit of cardiovascular stability may outweigh the theoretical risk of intracranial hypertension.

5. Personnel and training

Individual competence

The induction of anaesthesia in the pre-hospital environment carries more risks than the same procedure undertaken in hospital. Skilled anaesthetic assistance may not be available and both environmental and patient factors increase the risks associated with tracheal intubation and induction of anaesthesia. Pre-hospital practitioners should not practise pre-hospital anaesthesia in professional isolation. They should have the same level of training and competence that would enable them to perform unsupervised RSI in the emergency department [8,9]. RSI and tracheal intubation are potentially hazardous interventions and considerable time has been spent ensuring that anaesthetists who perform RSI in hospital can do so safely. Standards in pre-hospital care must be the same.

Some studies have demonstrated significant complications when RSI and tracheal intubation are undertaken by paramedics with relatively little training. [10,11]. The recent NCEPOD trauma report [3] concluded that ‘if pre-hospital intubation is to be part of pre-hospital trauma management then it needs to be in the context of a physician-based pre-hospital care system’.

The precise training required for undertaking pre-hospital anaesthesia safely, and by implication achieving competence in this procedure, has never been defined. The individual will require skills in both anaesthesia and working in the pre-hospital environment. Competence should be defined by these skills rather than by the primary specialty of the individual.

The Royal College of Anaesthetists requires that all anaesthetists in training complete an Initial Assessment of Competency Certificate (IACC) before giving anaesthesia without direct supervision. This assessment is completed by the typical trainee after about three months of anaesthesia training and includes the ability to perform an RSI and failed intubation routine. Attaining the IACC provides the individual with the essential skills to undertake anaesthesia in ASA I or II patients in hospital. However, achievement of this standard does not imply competence to induce anaesthesia in a severely injured patient in any setting, whether pre-hospital or in hospital.

The two-year acute care common stem (ACCS) training programme provides individuals with six months of training in emergency medicine and acute

medicine and one year in anaesthesia and intensive care medicine. The ACCS programme is mandatory for emergency physicians and it is hoped that this will provide them with the skills to undertake RSI in the emergency department [8]. The recently developed two-day UK TEAM (Training in Emergency Airway Management) Course will also teach skills relevant to emergency airway management and should usefully supplement the experience gained during the ACCS programme. Many anaesthetic trainees will also complete ACCS training before continuing in anaesthesia.

The ACCS programme, or equivalent training, should be regarded as the absolute minimum required by an individual practising pre-hospital anaesthesia. However, specific training for working in the pre-hospital environment is also essential. The Faculty of Pre-hospital Care of the Royal College of Surgeons of Edinburgh and BASICS UK are currently the lead organisations setting standards for physician pre-hospital working, qualification and competence.

Closely supervised working by experienced practitioners is an essential step towards independent pre-hospital practice. Assessment of competence in pre-hospital anaesthesia should always involve direct pre-hospital observation by practising senior clinicians. Simulator practice may be helpful in this period but is not a substitute for clinical experience.

Having achieved competence in pre-hospital RSI, the practitioner and anaesthetic assistants will need to maintain their skills by undertaking the procedure regularly. The precise number of drug-assisted tracheal intubations required to maintain competence has not been defined, but an average of at least one a month would seem reasonable. Unless an individual is working in a very busy pre-hospital programme, it is likely that RSI competence will be achieved only with regular in-hospital RSI experience or simulator experience. All pre-hospital organisations should provide a clinical governance structure that ensures that each practitioner is competent. The individual undertaking pre-hospital RSI should keep a log of all procedures and should be included in a clinical governance structure that incorporates regular review of cases managed by that individual, in addition to an adverse incident reporting system.

6. Equipment and monitoring

Standards of equipment and monitoring used for pre-hospital anaesthesia should match those applied to hospital anaesthetic practice [5,12]. To prevent cross-infection, pre-hospital providers will usually have to use ambulance or hospital sterilisation facilities or rely on disposable equipment.

Equipment

Pre-hospital equipment must be portable, robust and weather-resistant, and be effective in different lighting conditions. Electrical equipment must have an appropriate battery capability.

The equipment required for pre-hospital anaesthesia includes the following:

- Monitoring equipment (see below)
- Oxygen (sufficient for the procedure and transfer to hospital)
- An adequate supply of drugs for induction and maintenance of anaesthesia. It may be appropriate to check, draw up and correctly label the drugs for immediate use in advance
- Intubation equipment, to include bougie and spare laryngoscope as routine
- Simple airway adjuncts
- Suction - hand or battery operated
- Ventilation equipment - self-inflating bag-mask with a reservoir, as a minimum)
- Mechanical ventilators, when used, must be properly serviced and checked regularly, and have the appropriate pressure relief systems and alarms
- Rescue devices - supraglottic airway device and surgical airway equipment
- Vascular access equipment – both intravenous and intra-osseous)
- Lighting where appropriate
- Pre-procedure checklists depending on local policy

There is no role for nerve stimulation devices in pre-hospital anaesthesia.

Monitoring

Clinical assessment combined with monitoring is used to record the patient's condition from the preparation phase, through induction and maintenance and into the recovery phase. Measured values can be recorded manually or

electronically during the whole period although it is recognised that doing this in real time is difficult in an emergency.

Clinical measurement and observation should include:

- Presence or absence of pulse
- Respiratory rate
- Pupil size and reactivity, lacrimation if present
- Presence or absence of muscular activity and limb movements

Invasive monitoring is difficult in the pre-hospital phase and is rarely used. Non-invasive monitoring should include, as a minimum:

- Heart rate
- Non-invasive blood pressure
- Oxygen saturation
- Capnography
- Electrocardiograph

Measurements should be made at least every three minutes. As oxygen is usually the only gas used during pre-hospital anaesthesia, there is no need for pre-hospital anaesthetic gas monitoring. Monitoring of end-tidal carbon dioxide is mandatory during pre-hospital anaesthesia. Although qualitative capnography can be used to confirm intubation, quantitative capnography is required to prevent hyperventilation or hypoventilation. It is important to make sure that the system is connected and functional before starting the procedure.

Alarms on monitoring equipment should be set by the practitioner, and should be loud enough to alert medical staff in the noisy pre-hospital environment. Monitoring should not be omitted unless this occurs because of equipment failure; under these circumstances, the practitioner should weigh the risks of continuing the procedure in the absence of monitoring against the benefits of carrying it out. A record should be made of the decision process. Some monitoring may need to be suspended temporarily during extrication of trapped patients.

Intravenous analgesia and sedation for interventions: patients must be monitored with at least–

- Pulse oximetry
- Non-invasive blood pressure
- Electrocardiograph

7. Transport

Standards of care initiated at induction of anaesthesia must be continued during transport. These include:

- Maintenance of anaesthesia - adequate sedation, analgesia and, if necessary, neuromuscular blockade
- Continued monitoring of vital signs - ECG, blood pressure, pulse oximetry and capnography
- The provision of supporting equipment - airway suction, intubation equipment, intravenous fluids
- Contemporaneous written or automatically generated records of the patient's vital signs and treatment interventions

Transport must be supervised by a clinician skilled in managing an anaesthetised patient - preferably the clinician who induced anaesthesia. The balance between getting the patient into an optimal clinical condition before transfer and getting the patient to definitive care without delay will determine whether further interventions are undertaken before transfer. Pre-hospital anaesthesia will increase 'scene time' and the intervention must be weighed against the advantages of earlier transport to hospital. In all cases every effort must be made to keep 'scene time' to a minimum. The transport process should be carefully considered (availability and type of vehicle, distance and time to definitive care, journey and terrain) before undertaking pre-hospital anaesthesia. The transport vehicle must be suitable for the transfer of an anaesthetised patient. The vehicle should:

- Carry sufficient oxygen for the proposed journey, plus reserve
- Be able to carry the patient and the attending staff safely and within road safety or air transport regulations
- Carry a properly fixed, safe patient-carrying device. This must include enough straps to keep the patient secure when exposed to horizontal acceleration and deceleration forces or vertical movement
- Be driven or piloted by a suitably trained person experienced in the transportation of sick and injured persons

The AAGBI published recommendations on the 'Safe Transfer of Patients with Brain Injury' in May 2006 [13]. This publication contains many of the recommendations that are appropriate to the transportation of patients who have undergone pre-hospital anaesthesia.

8. Sedation

Sedation and analgesia may be required outside hospital to facilitate extrication, splinting or other procedures. Concerns have been raised about the potential for complications when sedation is undertaken by non-anaesthetists, even in hospital [14]. When sedation is performed, pre-hospital practitioners must be aware of the risk of airway deterioration and be competent to manage these complications. In critically unwell patients, sedation may precipitate the need for urgent RSI; in this situation practitioners should be competent to undertake RSI and tracheal intubation.

Sedation to facilitate RSI in the agitated patient

The combative, agitated patient requiring RSI and tracheal intubation presents a difficult clinical scenario and one that is rarely discussed in standard texts. Head injury, hypoxia, hypotension or concomitant use of drugs or alcohol may all make a patient confused, agitated and combative. Practitioners may be tempted to give induction agents and neuromuscular blocking drugs immediately with little attempt at pre-oxygenation. This section recommends a pragmatic approach to decreasing the degree of agitation, maximising pre-oxygenation and delivering a safe anaesthetic under demanding circumstances. As with all pre-hospital interventions, the balance of potential risk and benefit requires careful consideration in every case.

The problem

Physical restraint preceding RSI is unpleasant for the patient, relatives and bystanders, and may make the patient's condition worse. An increase in blood pressure may increase intracranial pressure or promote non-compressible bleeding. It may also cause further injuries or exacerbate spinal injuries. Most importantly, physical restraint also makes reliable pre-oxygenation difficult.

Principles of management

- Carefully titrated sedation with a period of pre-oxygenation before RSI is preferable to precipitate delivery of paralyzing agents and hypnotics
- Plan the sedation strategy in advance as part of the RSI preparation and include consideration of monitoring
- Avoid physical restraint where possible
- Do not physically enforce oxygen therapy and spinal immobilisation

- Attempt to keep patients calm by limiting the number of carers and physical restraint
- Inject small doses of sedative and, during the RSI, decrease the dose of induction agent accordingly

9. Pre-hospital anaesthesia for children

Pre-hospital anaesthesia for children is influenced by the fact that in-hospital anaesthesia for children aged eight years or under is increasingly recognised as a sub-specialist area of anaesthesia. Young children with severe injuries are uncommon but present pre-hospital practitioners with significant challenges.

All pre-hospital organisations must have written guidelines for the treatment of children. The guidelines will reflect the skills of their practitioners. In general terms, the threshold for RSI and tracheal intubation in a young child should be high. Most children can be treated with simple airway techniques [15]. Anaesthesia in this group should only be considered after a careful risk : benefit analysis. This will usually mean that a skilled anaesthetic practitioner with appropriate equipment is present and that simple airway manoeuvres, combined with oxygen therapy, have failed to provide a patent airway or adequate oxygenation.

In difficult circumstances, consider rapid transfer to the nearest hospital to enable advanced airway management, even if definitive care of the child's injuries needs to be undertaken at another hospital.

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