Care and monitoring of the anaesthetized patient

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Abstract

Anaesthesia and surgery produce significant physiological changes in the human body. These significant changes mandate the need to monitor the continuously changing physiological parameters for patient safety and optimization. It is not uncommon to encounter iatrogenic harm to the patient during anaesthetic and surgical intervention. This article covers the importance of monitoring and interventions to reduce harm to the patients and promote safety.

Keywords Adverse; anaesthesia; care and positioning; checklist; iatrogenic; incidence; monitoring; patient safety; temperature

Anaesthetic regimes

The standard anaesthetic management includes preoperative, intraoperative and postoperative stages. Preoperative assessment allows time to identify problems and optimize patient's clinical condition prior to surgery. Intraoperative management includes conduct of anaesthesia, which can be of different types as described below, patient care and monitoring. It is common practice to commence standard minimum monitoring while securing patent venous access (exceptions include uncooperative small children). There is substantial evidence to support that constant observation of patient's vitals by both anaesthetist and monitors improve patient safety. It is the responsibility of the anaesthetist to ensure appropriate functionality of anaesthetic apparatus. All alarm settings are set to appropriate value for an individual patient.

There are three main types of anaesthesia:

- general anaesthesia
- regional anaesthesia
- local anaesthesia.

General anaesthesia:

- Constitutes the triad of analgesia, loss of awareness and muscle relaxation.
- Can be delivered by administration of anaesthetic agents through intravenous, inhalational and/or intramuscular routes.
- Inhalational induction is commonly used in uncooperative patients.
- Ventilation can be maintained by either spontaneous or mechanical ventilation. Mechanical ventilation can be facilitated by muscle relaxants or ultra short acting opioids. Mechanical ventilation facilitates surgical access.

***Regional anaesthesia*:**

- Regional techniques block pain sensation in particular areas of the body to allow surgery.
- Can be central neuraxial blocks or peripheral nerve blocks. These techniques can be used as sole anaesthetic technique or as a supplement to general anaesthesia.
- Spinal, epidural, combined spinal epidural (CSE), caudal and brachial plexus blocks are examples of available techniques.
- Analgesic effects can be prolonged by using a nerve catheter with/without additives.

***Local anaesthesia*:**

- Local anaesthesia blocks sensation in a specific, localized part of body
- May need supplementation with sedation

***Conscious sedation*:**

- Is a drug induced depression of consciousness, where verbal contact is maintained with the patient (although exact definitions vary around the world).
- Is commonly used in dentistry, endoscopy suites and radiological investigations, especially children.

Patient safety

There are a number of safety initiatives in practice to reduce the incidence of avoidable errors during anaesthesia and surgery. Some of these are discussed below.

Surgery safety checklist

The World Health Organization (WHO) 'Surgical Safety Saves Lives' initiative addresses important safety issues including inadequate anaesthetic safety practices, avoidable surgical site infection and poor communication among team members. WHO identified a set of surgical safety checks to assist operating team in reducing these events – the WHO Surgical Safety Checklist. Specific check lists have been developed to address particular risk factors in some surgical specialities and to facilitate local practices.

Five steps to safer surgery: a part of 10 for 2010[1]

The UK National Patient Safety Agency (NPSA) advocates team briefing and debriefing sessions at the beginning and the end of theatre lists. These are to promote team performance and safety, with additional benefits of reductions in delays, smoother running lists, improved communication and improved safety climate. Recently, Safe Surgery Week 2012 was conducted to promote a number of local activities designed to improve the reliability of local implementation of five steps to safer surgery.

Stop before you block

The Safe Anaesthesia Liaison Group published an alert identifying learning points from 67 inadvertent wrong sided blocks. A national patient safety initiative aimed at reducing the incidence of inadvertent wrong sided nerve blocks during regional anaesthesia has been introduced, and is currently widely used in anaesthetic practice.

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Blood component administration

Blood and component administration may be needed to save a life in emergency or elective situations. However, lapses in safety measures during blood transfusion can lead to devastating complications. Annual Serious Hazards of Transfusion (SHOT) reporting[2] identifies many adverse events relate to basic, preventable errors in the transfusion process. The key lesson is therefore 'back to basics', which is an emphasis on following essential steps of transfusion process. These include collection of samples from correct patient, correct laboratory procedures, issuing of correct components and identification of the right patient at the time of transfusion. Blood products are accompanied with blood tags to facilitate traceability from donor to recipient. NHS trusts across the country have dedicated policies on blood checks and transfusion to promote patient safety.

Double checking of drugs/electronic barcode

Drug errors are among most frequent patient safety incidents reported to NPSA, and remain a serious cause of patient harm, with a reported incidence between 1:131 and 1:5475 anaesthetics. Serious consideration should be given to implement methods of confirming drugs administered during anaesthesia to improve patient safety. Feasibility studies of confirming anaesthetic drug administration by double checking or barcode scanning have taken place, but these are not yet feasible for widespread implementation.

Patient monitoring (Box 1)

Minimum monitoring

The Association of Anaesthetists of Great Britain and Ireland (AAGBI) produce guidelines[3] on monitoring standards which should be established prior to commencement of anaesthesia, and continued throughout into the recovery period. An anaesthetist of appropriate experience shall be present throughout general anaesthesia, regional anaesthesia and monitored anaesthesia care (MAC). Monitoring devices supplement usual clinical observation of mucosal colour, pupil size and movement of reservoir bag. The standard monitoring includes pulse oximeter (SpO_2), electrocardiograph (ECG), and non-invasive blood pressure (NIBP) with appropriate alarm limits.

In addition, during general anaesthesia airway gases (oxygen, carbon dioxide and anaesthetic agent) are monitored to ensure adequate oxygenation, ventilation and anaesthetic depth. Capnography, which detects the end tidal carbon dioxide ($EtCO_2$), is vital monitoring equipment. During mechanical ventilation, airway pressure is monitored to identify disconnection, leakage of gases and high airway pressures.

Anaesthetists usually administer muscle relaxants to assist endotracheal intubation and surgical procedure. Nerve stimulators are used to assess the degree of neuromuscular block and administration of drugs to reverse the effect of muscle relaxants (reversal agents); as inadequate reversal interferes with respiratory mechanics leading to a high incidence of postoperative pulmonary morbidity.

Advanced monitoring

Advanced monitoring, used in certain situations, facilitates continuous assessment of physiological parameters and monitor responses to therapy. Advanced monitoring is used where significant fluid shift is anticipated, for prolonged or complex surgical interventions, and when patients have significant comorbidities. A selection of advanced monitoring is listed in Table 1, and discussed further in the appropriate articles elsewhere in this issue.

Principles of basic monitoring in anaesthesia

ECG: Electrocardiography

- Allows interpretation of rate and rhythm, identifies conduction disorders, electrolyte abnormalities and drug effects; early changes identify ischaemia
- Prone to artefacts from skin impedance and electromyographic noise
- Three- , five- and CM5 lead modifications can be used

NIBP: Non-invasive blood pressure

- Oscillometry is the most common method to measure blood pressure in clinical practice. The cuff is inflated above previous systolic pressure and then slowly deflates. The vibrations of arterial wall are sensed by the sensor. Systolic and mean pressures are measured usually. The cuff width must be 20% greater than of arm's diameter
- Atrial fibrillation and external pressure cause measurement inaccuracies
- Repeated measurements during prolonged surgical cases cause pressure injuries and ulnar nerve pathology

SPO_2: Pulse oximetry

- A non-invasive continuous measurement of arterial blood saturation, based on the difference in absorption spectra of oxygenated and de-oxygenated haemoglobin at 660 and 940 nm wavelengths
- It allows early intervention in case of desaturation
- Inaccuracies can arise due to low perfusion states, motion artefact, ambient light, venous congestion, carboxy- and methaemoglobin

$ETCO_2$: End tidal carbon dioxide

- The CO_2 in the exhaled gas sample from the patient is analysed by infra-red absorptiometry at a wavelength of 4.3 μm
- It is an indirect means of assessing cardiac output, and can be used to alter minute ventilation in certain situations; for example, head injury or raised intracranial pressure.
- It is raised in hypoventilation, rebreathing, and hypermetabolic states like sepsis, malignant hyperthermia, pyrexia; and is reduced in hyperventilation, pulmonary embolism, hypothermia and low cardiac output states

Box 1

Perioperative care

Temperature management

Perioperative hypothermia (core temperature <36 °C) is a recognized cause of poor outcome after surgery. Shivering occurs in up to one in four patients following a general anaesthetic.