RECOMMENDATIONS FOR STANDARDS OF MONITORING DURING ANAESTHESIA AND RECOVERY

4th Edition

Published by
The Association of Anaesthetists of Great Britain and Ireland,
21 Portland Place, London W1B 1PY
Telephone 020 76311650 Fax 020 7631 4352
www.aagbi.org

March 2007

MEMBERSHIP OF THE WORKING PARTY

Dr R J S Birks	Chairman/Vice President
Dr L W Gemmell	Council Member
Dr E P O'Sullivan	Council Member
Prof D J Rowbotham	Council Member
Prof J R Sneyd	Council Member

Ex-Officio

Dr D K Whitaker	President
Prof M Harmer	Immediate Past President
Dr I H Wilson	Honorary Treasurer
Dr A W Harrop-Griffiths	Honorary Secretary
Prof W A Chambers	Immediate Past Honorary Secretary
Dr I G Johnston	Honorary Membership Secretary
Dr D G Bogod	Editor-in-Chief, *Anaesthesia*

This document will be reviewed regularly and may be revised or updated before the formal publication of a new edition. For the latest version, please refer to the AAGBI website: http://www.aagbi.org

CONTENTS

SECTION I: SUMMARY

The Association of Anaesthetists of Great Britain and Ireland regards it as essential that certain core standards of monitoring must be used whenever a patient is anaesthetised. These minimum standards should be uniform irrespective of duration, location or mode of anaesthesia.

1. The anaesthetist must be present and care for the patient throughout the conduct of an anaesthetic. *

2. Monitoring devices must be attached before induction of anaesthesia and their use continued until the patient has recovered from the effects of anaesthesia.

3. The same standards of monitoring apply when the anaesthetist is responsible for a local /regional anaesthetic or sedative technique for an operative procedure.

4. A summary of information provided by monitoring devices should be recorded on the anaesthetic record. Electronic record keeping systems are now recommended.

5. The anaesthetist must ensure that all equipment has been checked before use. Alarm limits for all equipment must be set appropriately before use. Audible alarms must be enabled during anaesthesia.

6. These recommendations state the monitoring devices which are essential and those which must be immediately available during anaesthesia. If it is necessary to continue anaesthesia without a device categorised as 'essential', the anaesthetist must clearly note the reasons for this in the anaesthetic record.

* In hospitals employing Anaesthetic Practitioners (APs), this responsibility may be delegated to an AP supervised by a consultant anaesthetist in accordance with guidelines published by the Royal College of Anaesthetists (www.rcoa.ac.uk).

7. Additional monitoring may be necessary as deemed appropriate by the anaesthetist.

8. A brief interruption of monitoring is only acceptable if the recovery area is immediately adjacent to the operating theatre. Otherwise monitoring should be continued during transfer to the same degree as any other intra- or inter-hospital transfer.

9. Provision, maintenance, calibration and renewal of equipment is an institutional responsibility.

SECTION II: INTRODUCTION

The presence of an appropriately trained and experienced anaesthetist is the main determinant of patient safety during anaesthesia. However, human error is inevitable, and many studies of critical incidents and mortality associated with anaesthesia have shown that adverse incidents and accidents are frequently attributable, at least in part, to error by anaesthetists[1,2].

Monitoring will not prevent all adverse incidents or accidents in the perioperative period. However, there is substantial evidence that it reduces the risks of incidents and accidents both by detecting the consequences of errors, and by giving early warning that the condition of a patient is deteriorating for some other reason[3-9].

The introduction of routine monitoring in anaesthesia coincided with numerous improvements in clinical facilities, training and other factors likely to affect patient outcomes. The progressive reduction in anaesthesia-related morbidity and mortality is therefore linked to instrumental monitoring by association rather than proof from prospective randomised trials.

The overwhelming view is that such studies would today be unethical and the circumstantial evidence that is already available indicates clearly that the use of such monitoring improves the safety of patients. Consequently, it is appropriate that the AAGBI should make clear recommendations about the standards of monitoring which anaesthetists in the United Kingdom and Ireland must use. New monitoring modalities such as those describing depth of anaesthesia have not yet become established as 'routine' and the opportunity exists to critically evaluate their utility before general introduction. A clear distinction may reasonably be made between consensus-based recommendations for 'core' monitoring and requiring that new monitoring techniques be shown by clinical trials to improve patient outcomes[10].

SECTION III: THE ANAESTHETIST'S PRESENCE DURING ANAESTHESIA

An anaesthetist of appropriate experience must be present throughout general anaesthesia, including any period of cardiopulmonary bypass. Using clinical skills and monitoring equipment, the anaesthetist must care for the patient continuously. The same standards must apply when an anaesthetist is responsible for a local/regional anaesthetic or sedative technique for an operative procedure. When there is a known potential hazard to the anaesthetist, for example during imaging procedures, facilities for remotely observing and monitoring the patient must be available[11].

Accurate records of the measurements provided by monitors must be kept. It has become accepted that core data (heart rate, BP and peripheral oxygen saturation) should be recorded at intervals no longer than every five minutes, and more frequently if the patient is clinically unstable. It is recognised that contemporaneous records may be difficult to keep in emergency circumstances. Electronic record keeping systems are now available, and the Association recommends that departments consider their procurement. It is likely that their use will become routine.

Local circumstances may dictate that handing over of responsibility for patient care under anaesthetic may be necessary. If so, hand-over time must be sufficient to apprise the incoming anaesthetist of all information concerning the patient's anaesthesia and the time and details must be noted in the anaesthetic record.

Very occasionally, an anaesthetist working single-handedly may be called upon to perform a brief life-saving procedure nearby. Leaving an anaesthetised patient in these circumstances is a matter for individual judgement. If this should prove necessary, the surgeon must stop operating until the anaesthetist returns. Observation of the patient and monitoring devices must be continued by a trained anaesthetic assistant. Any problems should be reported to available medical staff.

SECTION IV: MONITORING THE ANAESTHETIC EQUIPMENT

It is the responsibility of the anaesthetist to check all equipment before use as recommended in *Checking Anaesthetic Equipment*[12]. Anaesthetists must ensure that they are familiar with all equipment that they intend to use and that they have followed any specific checking procedure recommended by individual manufacturers. More complex equipment will require more formal induction and training in its use.

Oxygen Supply
The use of an oxygen analyser with an audible alarm is essential during anaesthesia. It must be placed in such a position that the composition of the gas mixture delivered to the patient is monitored continuously. The positioning of the sampling port will depend on the breathing system in use.

Breathing Systems
During spontaneous ventilation, observation of the reservoir bag may reveal a leak, disconnection, high pressure or abnormalities of ventilation. Carbon dioxide concentration monitoring will detect most of these problems. Capnography is therefore an essential part of routine monitoring during anaesthesia.

Vapour Analyser
The use of a vapour analyser is essential during anaesthesia whenever a volatile anaesthetic agent is in use.

Infusion Devices
When any component of anaesthesia (hypnotic, analgesic, muscle relaxant) is administered by infusion, the infusion device unit must be checked before use. Alarm settings and infusion limits must be verified and set to appropriate levels before commencing anaesthesia. It is essential to verify that these drugs are delivered to the patient. The infusion site should be secure and preferably visible.

Alarms
Anaesthetists must ensure that all alarms are set at appropriate values. The default alarm settings incorporated by the manufacturer are often inappropriate and during the checking procedure the anaesthetist must review and reset the upper and lower limits as necessary. Audible alarms must be enabled when anaesthesia commences.

When intermittent positive pressure ventilation is used during anaesthesia, airway pressure alarms must also be used to detect excessive pressure within the airway and also to give warning of disconnection or leaks. The upper and lower alarm limits must be reviewed and set appropriately before anaesthesia commences.

Provision, maintenance, calibration and renewal of equipment are institutional responsibilities.

SECTION V: MONITORING THE PATIENT

During anaesthesia, the patient's physiological state and depth of anaesthesia need continual assessment. Monitoring devices supplement clinical observation in order to achieve this. Appropriate clinical observations may include mucosal colour, pupil size, response to surgical stimuli and movements of the chest wall and/or the reservoir bag. The anaesthetist should undertake palpation of the pulse, auscultation of breath sounds and, where appropriate, measurement of urine output and blood loss. A stethoscope must always be available.

Monitoring Devices
The following monitoring devices are essential to the safe conduct of anaesthesia. If it is necessary to continue anaesthesia without a particular device, the anaesthetist must clearly record the reasons for this in the anaesthetic record.

A - Induction and Maintenance of Anaesthesia
1. Pulse oximeter
2. Non invasive blood pressure monitor
3. Electrocardiograph
4. Airway gases: oxygen, carbon dioxide and vapour
5. Airway pressure

The following must also be available

- A nerve stimulator whenever a muscle relaxant is used
- A means of measuring the patient's temperature

During induction of anaesthesia in children and in unco-operative adults it may not be possible to attach all monitoring before induction. In these circumstances monitoring must be attached as soon as possible and the reasons for delay recorded in the patient's notes.

B - Recovery from Anaesthesia
A high standard of monitoring should be maintained until the patient is fully recovered from anaesthesia. Clinical observations must be supplemented by the following monitoring devices.

1. Pulse oximeter
2. Non-invasive blood pressure monitor

The following must also be immediately available

- Electrocardiograph
- Nerve stimulator
- Means of measuring temperature
- Capnograph

If the recovery area is not immediately adjacent to the operating theatre, or if the patient's general condition is poor, adequate mobile monitoring of the above parameters will be needed during transfer. The anaesthetist is responsible for ensuring that this transfer is accomplished safely.

Facilities and staff needed for the recovery area are detailed in the Association booklets, The Anaesthesia Team and Immediate Post Anaesthetic Recovery[13, 14].

C - Additional Monitoring
Some patients will require additional, mainly invasive, monitoring, e.g. vascular or intracranial pressures, cardiac output, or biochemical variables.

Specific devices designed to monitor loss of consciousness using adaptations of either surface EEG monitoring or auditory evoked potentials have become available. However, their routine use has yet to be fully considered as part of our recommended minimum monitoring standards. The American Society of Anesthesiologists (ASA) recently published a report from a task force set up to assess the use of brain function monitoring to prevent intra-operative awareness[15]. This report summarised the state of the literature and reported the opinions

derived from task force members, expert consultants, open forums and public commentary. It concluded that "brain function monitoring is not routinely indicated for patients undergoing general anaesthesia, either to reduce the frequency of intra-operative awareness or to monitor depth of anaesthesia." It was the consensus of the task force that the decision to use a brain function monitor should be made on a case-by-case basis by the individual practitioner for selected patients. The task force reported that patients have experienced intra-operative awareness in spite of monitored values which would imply an adequate depth of anaesthesia. The AAGBI endorses the views of the ASA taskforce.

D - Regional Techniques & Sedation for Operative Procedures
Patients must have appropriate monitoring, including a minimum of the following devices.

1. Pulse oximeter
2. Non-invasive blood pressure monitor
3. Electrocardiograph

SECTION VI: MONITORING DURING TRANSFER WITHIN THE HOSPITAL

It is essential that the standard of care and monitoring during transfer is as high as that applied in the controlled operating theatre environment and that personnel with adequate knowledge and experience accompany the patient[16 17].

The patient should be physiologically as stable as possible on departure. Prior to transfer, appropriate monitoring must be commenced. Oxygen saturation and arterial pressure should be monitored in all patients and an ECG must be attached. Intravascular or intracranial pressure monitoring may be necessary in special cases. A monitored oxygen supply of known content sufficient to last the maximum duration of the transfer is essential for all patients. If the patient's lungs are ventilated, expired carbon dioxide should be monitored continuously. Airway pressure, tidal volume and respiratory rate must also be monitored when the lungs are mechanically ventilated.

SECTION VII: ANAESTHESIA OUTSIDE HOSPITAL

The Association's view is that the standards of monitoring used during general and regional analgesia and sedation should be exactly the same in all locations.

SECTION VIII: REFERENCES

1 Buck N, Devlin HB, Lunn JN. Report on the confidential enquiry into perioperative deaths. London: Nuffield Provincial Hospitals Trust, The Kings Fund Publishing House, 1987

2 Webb RK, Currie M, Morgan CA, Williamson JA, Mackay P, Russell WJ, Runciman WB. The Australian Incident Monitoring Study: an analysis of 2000 incident reports. *Anaesthesia and Intensive Care* 1993; **21**: 520-28.

3 Keenan RL, Boyan CP. Decreasing frequency of anesthetic cardiac arrests. *Journal of Clinical Anesthesia* 1991; **3**: 354-7.

4 Eichhorn JH, Cooper JB, Cullen DJ, Maier WR, Philip JH, Seeman RG. Standards of patient monitoring during anesthesia at Harvard Medical School. *Journal of the American Medical Association* 1986; **256**: 1017-20.

5 Webb RK, Van der Walt JH, Runciman WB, Williamson JA, Cockings J, Russell WJ, Helps S. Which monitor? An analysis of 2000 incident reports. *Anaesthesia and Intensive Care* 1993; **21**: 529-42.

6 McKay WP, Noble WH. Critical incidents detected by pulse oximetry during anaesthesia. *Canadian Journal of Anaesthesia* 1988; **35**: 265-9.

7 Cullen DJ, Nemaskal JR, Cooper JB, Zaslavsky A, Dwyer MJ. Effect of pulse oximetry, age, and ASA physical status on the frequency of patients admitted unexpectedly to a post-operative intensive care unit. *Anesthesia and Analgesia* 1992; **74**: 181-8.

8 Moller JT, Pedersen T, Rasmussen LS, Jensen PF, Ravlo O, Rasmussen NH, Espersen, Johannessen NW, Cooper JB, Gravenstein JS, Chraemmer Jorgensen B, WibergJorgensen F, Djernes M, Heslet L, Johansen SH. Randomized evaluation of pulse oximetry in 20,802 patients. I. Design, demography, pulse oximetry failure rate, and overall complication rate. *Anesthesiology* 1993; **78**: 436-44.

9 Moller JT, Johannessen NW, Espersen K, Ravlo O, Pedersen BD, Jensen PF, Rasmussen NH, Rasmussen LS, Pedersen T, Cooper JB, Gravenstein JS, Chraemmer Jorgensen B, Djernes M, Wiberg Jorgensen F, Heslet L, Johansen SH. Randomized evaluation of pulse oximetry in 20,802 patients. II. Perioperative events and postoperative complications. *Anesthesiology* 1993; **78**: 444-53.

10 Thompson JP and Mahajan RP, Monitoring the monitors – beyond risk management. *British Journal of Anaesthesia* 2006; **97**: 1-3.

11 Provision of Anaesthetic Services in Magnetic Resonance Units, Association of Anaesthetists of Great Britain and Ireland, 2002.

12 Checking Anaesthetic Equipment. Association of Anaesthetists of Great Britain and Ireland, London, 2004.

13 The Anaesthesia Team. Association of Anaesthetists of Great Britain and Ireland, London, 2005.

14 Immediate Post Anaesthetic Recovery. Association of Anaesthetists of Great Britain and Ireland, London, 2002.

15 Practice Advisory for Intraoperative Awareness and Brain Function Monitoring. Task Force Report. *Anaesthesiology* 2006, 104, 847-64.

16 Transfer of the Critically Ill Patient. Wallace PGM, in Intensive Care Medicine (Bion J ed), London, BMJ Books, 1999: 404-13.

17 Recommendations for the Safe Transfer of Patients with Brain Injury. Neuroanaesthesia Society of Great Britain and Ireland & Association of Anaesthetists of Great Britain and Ireland, London, 2006.

THE ASSOCIATION OF ANAESTHETISTS

of Great Britain & Ireland

21 Portland Place, London W1B 1PY
Tel: 020 7631 1650
Fax: 020 7631 4352
Email: info@aagbi.org
www.aagbi.org