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RECOMMENDATIONS FOR STANDARDS OF MONITORING DURING ANAESTHESIA AND RECOVERY

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 standards should be uniform irrespective of duration or location of anaesthesia.

1. The anaesthetist must be present 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 anaesthetic or sedative technique for an operative procedure.
4. All information provided by monitoring devices should be recorded in the patient's notes. Trend display and printing devices are recommended as they allow the anaesthetist to concentrate on managing the patient in emergency situations.
5. The anaesthetist must check all equipment before use. All alarm limits must be set appropriately. Infusion devices and their alarm settings must be checked before use. Audible alarms must be enabled when anaesthesia commences.
6. The recommendations state the monitoring devices which are essential and those which must be immediately available during anaesthesia. If a monitoring device deemed essential is not available and anaesthesia continues without it, the anaesthetist must clearly state in the notes the reasons for proceeding without the device.
7. Additional monitoring may be necessary as adjudged by the anaesthetist.

8. Only a brief interruption of monitoring is 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.

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}.

Instrumental monitoring will not prevent all adverse incidents or accidents in the peri-operative period. However, there is substantial evidence that it reduces 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. The introduction of modern instrumental monitors halved the number of intra-operative cardiac arrests in one study³, and the decrease was due almost entirely to a decrease in cardiac arrests from preventable respiratory causes. After the introduction of minimal monitoring standards in one American group of hospitals, the numbers of serious accidents and deaths were reduced substantially⁴. The Australian Incident Monitoring Study found that 52% of incidents were detected first by a monitor⁵; in more than half of these cases, the pulse oximeter or capnograph detected the first changes. It was calculated that a combination of pulse oximetry, capnography and blood pressure monitoring should detect 93% of serious incidents in the large majority of cases before organ damage occurs.

The use of pulse oximetry shortens the time to detection of critical events⁶. The introduction of pulse oximetry decreased the number of patients admitted unexpectedly from the operating theatre to the intensive care unit⁷. In a randomised, controlled study^{8,9}, the use of pulse oximetry reduced the number of episodes of hypoxaemia and the number of patients suffering myocardial ischaemia during anaesthesia and resulted in increases in the flow of oxygen used in the recovery area, the number of patients discharged to the ward with supplemental oxygen and the number of patients treated with naloxone.

There has never been a randomised, prospective study of instrumental monitoring in anaesthesia, proving conclusively that outcome is influenced. The overwhelming view is that such a study would be unethical and the circumstantial evidence that is 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 must use

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. The anaesthetist must undertake frequent clinical observations as well as reviewing the information provided by monitoring devices. The same standards must apply when an anaesthetist is responsible for a local 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.

Accurate records of the measurements provided by monitors must be kept. It is recognised that contemporaneous records may be difficult to keep in emergency circumstances. Many modern monitoring displays provide trend or printing facilities which help in subsequent retrieval of information. Printed records must be attached securely to hand-written records and any artifacts noted.

Handing over responsibility for a patient under anaesthesia should be avoided if at all possible. However, during long procedures primary responsibility may have to be passed to another anaesthetist. If so, hand-over time must be sufficient to appraise the incoming anaesthetist of all information concerning the patient's anaesthesia and the time and details noted in the anaesthetic record.

Very occasionally, an anaesthetist working single handedly may be called upon to attend a life-threatening emergency nearby. Leaving an anaesthetised patient in these circumstances is a matter for individual judgement. If this should prove necessary, the surgeon must stop the operation; another medical practitioner (usually the surgeon) must formally assume responsibility for the patient and a trained anaesthetic assistant must be instructed to observe the patient's vital signs and report them to the responsible doctor.

SECTION IV MONITORING THE ANAESTHETIC EQUIPMENT

It is the responsibility of the anaesthetist to check all equipment before use as recommended in *Checklist for Anaesthetic Apparatus*¹⁰. 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. During anaesthesia, it is important to monitor continuously the continuity of the oxygen supply and the correct function of the breathing system.

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. Oxygen analysers must be available whenever anaesthesia is administered.

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.

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.

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 therefore be visible and must be checked regularly to ensure that extravasation does not occur.

The anaesthetist must be fully familiar with the particular device being used before using it.

SECTION V MONITORING THE PATIENT

During anaesthesia, the patient's physiological state, depth of anaesthesia and function of equipment need continual assessment. Monitoring devices supplement clinical observation in order to achieve this. The anaesthetist should make observations of the patient's mucosal colour, pupil size, response to surgical stimuli and movements of the chest wall and of the reservoir bag and 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.

Induction of Anaesthesia

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

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.

For very short procedures e.g. electro-convulsive therapy (ECT) and orthopaedic manipulations under general anaesthesia the above monitoring standards for induction of anaesthesia will suffice under normal circumstances.

If the patient remains in the anaesthetic room for a prolonged period after induction of anaesthesia, for example siting of lines, then monitoring standards must equate to those for maintenance of anaesthesia as described below:

Maintenance of Anaesthesia

1. Pulse oximeter
2. Non-invasive blood pressure monitor
3. Electrocardiograph
4. Capnograph
5. Vapour analyser

The following must also be immediately available

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

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*^{11, 12}.

Regional Techniques & Sedation for Operative Procedures

Patients must have appropriate monitoring, including the following devices.

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

Additional Monitoring

Some patients will require additional, mainly invasive, monitoring; for example, of vascular or intracranial pressures, cardiac output or biochemical variables.

SECTION VI MONITORING DURING TRANSFER

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.¹³

The patient should be physiologically stable on departure. Prior to transfer, appropriate monitoring must be commenced. Oxygen saturation, electrocardiogram and arterial pressure should be monitored in all patients. It may be necessary in selected patients to monitor central venous pressure, pulmonary artery wedge pressure and/or intracranial pressure. 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, airway pressure, tidal volume and expired carbon dioxide concentration should be continuously monitored.

There are monitoring problems which are specific to transfer particularly if this involves an ambulance journey. The diagnosis of arrhythmias may be impossible in the presence of movement artifacts. Few devices can be relied upon to give accurate non-invasive arterial pressure measurements during transfers and invasive arterial pressure monitoring should be considered for all patients.^{14,15}

All monitors must be easily accessible and have clearly visible, illuminated displays. It is preferable that all monitoring functions are combined in one robust, battery operated monitor of reasonable weight and size.

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 locations¹⁶.

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