Recommendations for Standards

of

Monitoring

during

Cardiopulmonary Bypass

Membership of the working party (2006)

Ian Curle	Society of Clinical Perfusion Scientists of Great Britain & Ireland
Fiona Gibson	Association of Cardiothoracic Anaesthetists
Jonathan Hyde	Society for Cardiothoracic Surgeons in Great Britain and Ireland
Alex Shipolini	Society for Cardiothoracic Surgeons in Great Britain & Ireland
David Smith	Association of Cardiothoracic Anaesthetists
J P van Besouw	Association of Cardiothoracic Anaesthetists
Kate Wark	Association of Cardiothoracic Anaesthetists
Mike Weatherall	Society of Clinical Perfusion Scientists of Great Britain & Ireland
David Whitaker	Association of Cardiothoracic Anaesthetists

This document is available on the following websites:

Society of Clinical Perfusion Scientists of Great Britain & Ireland

www.scps.org

Association of Cardiothoracic Anaesthetists

www.acta.org.uk

Society for Cardiothoracic Surgeons in Great Britain & Ireland

www.scts.org

Introduction

The aim of this document is to determine **standards of monitoring** during cardiopulmonary bypass for adult and paediatric surgery. These standards are considered by the Society of Clinical Perfusion Scientists of Great Britain and Ireland, the Association of Cardiothoracic Anaesthetists and the Society for Cardiothoracic Surgeons in Great Britain and Ireland to be the minimal monitoring required during cardiopulmonary bypass. This includes monitoring for the onset of and weaning from cardiopulmonary bypass, and for confirmation of anticoagulation and ventilation of the lungs.

These standards are for use in conjunction with the Society of Clinical Perfusion Scientists of Great Britain and Ireland Standards of Practice document[1] and local protocols. Sources of reference include publications from the Society of Clinical Perfusion Scientists of Great Britain and Ireland[1], the Association of Anaesthetists of Great Britain and Ireland[2] and the American Society of Extra-Corporeal Technology[3].

(Within this document "on site facility" is defined as on the hospital site, "near patient facility" is defined as within or in close proximity to the cardiac theatre.)

All centres undertaking cardiac surgery involving cardiopulmonary bypass should plan to institute these recommendations of monitoring by 6 months from the date of publication.

The safe conduct of cardiopulmonary bypass is the joint responsibility of surgeons, anaesthetists and clinical perfusionists and requires a high level of communication between the team members. Whilst it is considered best practice during the conduct of cardiopulmonary bypass for a surgeon and an anaesthetist to be present in the operating room at all times during cardiopulmonary bypass, it is recognised that there are circumstances where this may not be essential. However, safety of the cardiopulmonary bypass remains the primary responsibility of the perfusionist who must be present at all times. These situations should be managed using locally agreed clinical governance guidelines and protocols should be in place to ensure patient safety.

(Examples of such locally agreed guidelines, in relation to anaesthetic practice, can be found on the ACTA website.)

Only an accredited clinical perfusionist registered with the College of Clinical Perfusion Scientists of Great Britain and Ireland can undertake or supervise the conduct of cardiopulmonary bypass[1,4,5]. A named and accredited clinical perfusionist not distracted by other clinical commitments, in close proximity and freely available must supervise a trainee undertaking a cardiopulmonary bypass[1].

This document is a review of the original guidelines—it 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 ACTA website; www.acta.org.uk

General Recommendations

Adequate records of monitoring should be kept at all times and where a variable is monitored it should be regularly recorded. All units should have electronic acquisition and storage of this data, including the ability to produce a printout [2]. Records should be retained in the patient's notes and electronically.

All monitors and alarms used should be **calibrated and maintained regularly** according to the manufacturer's instruction and the recommended service schedule. All equipment must be checked before use.

During cardiopulmonary bypass, the electrocardiogram (ECG), intravascular pressures and core body temperature should be continuously displayed and clearly visible to the clinical perfusionist, surgeon and anaesthetist. (Ideally, three separate screens)

Monitoring of clinical parameters acquired directly from the patient

The following should be monitored continuously, with local protocols dictating the frequency of recording:

Electrocardiogram (ECG)

Systemic arterial pressure

Central venous pressure

Core body temperature

Urine output should be monitored using a freely draining urinary catheter.

Pulse oximetry should be continuously displayed when there is a spontaneous pulsatile circulation.

Expired carbon dioxide tension/concentration should be continuously displayed when the lungs are being ventilated.

It is accepted that special clinical circumstances (for example emergency surgery or failure to insert a urinary catheter) may on some occasions preclude complete monitoring.

Monitoring associated with the cardiopulmonary bypass circuit

The following should be monitored continuously:

Oxygen saturation of the blood in the venous return line.

Oxygen tension or saturation of the blood in the arterial line.

Continuity of the fresh gas flow to the oxygenator using an in-line flow meter or rotameter [2].

Oxygen concentration in the gas circuit to the oxygenator using an oxygen analyser with alarms, sited after the oxygen blender and vaporiser if used [2].

Blood flow rate generated by the arterial pump.

Arterial line pressure.

Cardioplegia delivery line pressure when cardioplegia is delivered using the heart lung machine.

Temperature of the blood in the arterial limb of the cardiopulmonary bypass circuit.

Temperature of water in the heater/cooler system.

Fluid record; all fluids, drugs and blood products added to the extra corporeal circuit during bypass should be recorded on the perfusion chart. Filtrate volume should be measured and recorded when a haemofilter/ concentrator is being used.

Continuous "in line" monitoring screens (e.g. for potassium, haemoglobin, pH, arterial pO_2 and pCO_2, arterial and venous Oxygen saturation,) should be available.

The following measurements should be available at a near patient facility;

(Local protocols should dictate the frequency of measurements)

Anticoagulation should be confirmed by an acceptable method e.g. activated clotting time (ACT), which should be measured after heparinisation and before cardiopulmonary bypass and should be measured at regular intervals to ensure adequate anticoagulation.

Other parameters that should be measured are;

Blood gases

Red cell concentration (haemoglobin or haematocrit).

Potassium

Glucose

The following measurements should also be available at an on site facility:

Clotting studies

Calcium

Lactate

Safety devices

Local protocols for the conduct of cardiopulmonary bypass should be formulated by all hospitals undertaking cardiac surgery using cardiopulmonary bypass.

The following are considered best practice:

Power failure alarm with a **battery powered back-up unit** for the cardiopulmonary bypass machine.

Battery powered **Torch** sited near to the bypass machine.

Bubble detector on the arterial line of a roller pump cardiopulmonary bypass circuit with an **alarmed automatic pump cut out facility**.

Level sensor on a hard shell venous reservoir system in the cardiopulmonary bypass circuit with an **alarmed automatic pump cut out facility**.

A **Retrograde Flow Alarm** or an **occlusion device** is essential when using a Centrifugal Pump.

Anaesthetic gas-scavenging apparatus whenever volatile agents are used in the cardiopulmonary bypass circuit[6].

Out of range temperature alarm on the heater/cooler unit.

References

1. Standards of Practice. Society of Perfusionists of Great Britain and Ireland, London 1999. www.scps.org.uk

2. Recommendations for Standards of Monitoring during Anaesthesia and Recovery. The Association of Anaesthetists of Great Britain and Ireland, London 2007 www.aagbi.org

3. AmSECT Guidelines for Perfusion Practice. The American Society of Extra-Corporeal Technology, 1998. www.amsect.org

4. Guidelines for the Provision of Anaesthetic Services. The Royal College of Anaesthetists, London. 1999. www.rcoa.ac.uk

5. The Employment of Clinical Perfusionists in the NHS, The Department of Health's guidance on best practice for the employment of clinical perfusionists in the NHS, December 1999.

6. Health Services Advisory Committee. Anaesthetic Agents: Controlling Exposure under COSHH. London: HMSO, 1995.