

Recommendations for Standards of Monitoring and Alarms during Cardiopulmonary Bypass

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This document is available on the following websites:

Society of Perfusionists of Great Britain & Ireland
Association of Cardiothoracic Anaesthetists
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www.sopgbi.org
www.acta.org.uk
www.scts.org

Introduction

It is accepted that monitoring during the operative period reduces risks for patients. In 1988 the Association of Anaesthetists of Great Britain and Ireland first published Recommendations for Standards of Monitoring during Anaesthesia and Recovery. Within these recommendations it was recognised that additional monitoring may be required during cardiopulmonary bypass.

The aim of this document is to determine standards for monitoring and alarms during cardiopulmonary bypass. This includes monitoring for the onset of and weaning from cardiopulmonary bypass, for example confirmation of anticoagulation and ventilation of the lungs. These standards are for use in conjunction with the Society of Perfusionists of Great Britain and Ireland Standards of Practice document ¹ and local protocols.

Sources of reference include publications from the Society of Perfusionists 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 as well as two UK surveys ^{4,5}.

Within these Recommendations for Standards of Monitoring and Alarms during Cardiopulmonary Bypass “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.

The recommended monitors and alarms that should be used during cardiopulmonary bypass are considered by the Society of Perfusionists of Great Britain and Ireland, the Association of Cardiothoracic Anaesthetists and the Society of Cardiothoracic Surgeons of Great Britain and Ireland to be the minimal monitoring requirements during cardiopulmonary bypass. All centres undertaking cardiac surgery involving cardiopulmonary bypass should plan to institute these standards of monitoring and alarms by the 1st January 2003

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. There may be additional monitoring requirements during cardiopulmonary bypass for paediatric patients.

Only an accredited clinical perfusionist registered with the College of Clinical Perfusionists of Great Britain and Ireland can undertake or supervise the conduct of cardiopulmonary bypass^{1,6,7}. 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 bypass¹.

The safe conduct of cardiopulmonary bypass is a joint responsibility of surgeons, anaesthetists and clinical perfusionists and requires a high level of communication between the team members. At all times during the conduct of cardiopulmonary bypass a surgeon, an anaesthetist and a clinical perfusionist **must** be present in the operating room.

The Recommendations for Standards of Monitoring and Alarms during Cardiopulmonary Bypass will be reviewed in the year 2005.

General Recommendations

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

During cardiopulmonary bypass the electrocardiograph (ECG), intravascular pressures and core body temperature should be **continuously displayed and visible to the clinical perfusionist, surgeon and anaesthetist**. This will normally entail the use of a main monitor with at least one additional slave screen monitor.

Monitoring of clinical parameters acquired directly from the patient

-- The following should be monitored continuously:

Electrocardiograph (ECG)

Systemic arterial pressure

Central venous pressure

Core body temperature

Urine output should be monitored using a freely draining urinary catheter. Local protocols should dictate the frequency of measurement.

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

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

Monitoring associated with the cardiopulmonary bypass circuit

-- The following should be monitored continuously:

Venous oxygen saturation of the blood in the venous return line of the cardiopulmonary bypass circuit.

Arterial oxygen tension or saturation of the blood in the arterial line of the cardiopulmonary bypass circuit.

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

Oxygen concentration of the fresh gas flow to the oxygenator using an oxygen analyser with alarms and sited after the oxygen blender and vaporiser if used ⁵.

Blood flow rate generated by the arterial pump of the cardiopulmonary bypass circuit of the cardiopulmonary bypass circuit.

Arterial line pressure of the cardiopulmonary bypass circuit.

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

Temperature of the blood in the cardiopulmonary bypass circuit.

Temperature of water in the heater/cooler system.

-- The following measurements should be available at a near patient facility. Local protocols should dictate the frequency of measurements:

Activated clotting time (ACT) to confirm anticoagulation should be measured after heparinisation and before cardiopulmonary bypass. Confirmation of anticoagulation within 20 minutes before the start of cardiopulmonary bypass should be considered if the time between initial heparinisation and the start of cardiopulmonary bypass is greater than one hour. During cardiopulmonary bypass the ACT should be measured at intervals.

Blood gases

Red cell concentration (haemoglobin or haematocrit).

Serum potassium

Blood sugar

Filtrate volume should be measured when a haemofilter/concentrator is being used.

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

Clotting studies

Serum calcium

Serum lactate

Serum magnesium

Safety devices

Local protocols for the conduct of cardiopulmonary bypass should be formulated by all hospitals undertaking cardiac surgery using cardiopulmonary bypass. (Examples of UK protocols can be seen on the Society of Perfusionists of Great Britain and Ireland website: www.sopgbi.org)

-- **The following should be used:**

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

Anaesthetic gas-scavenging apparatus whenever volatile agents are used in the cardiopulmonary bypass circuit⁸.

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

References

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5. Weatherall M, Sherry KM. Monitors and alarms used by perfusionists during cardiopulmonary bypass. *The Perfusionist* 2000, 24(3): 10.
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8. Health Services Advisory Committee. Anaesthetic Agents: Controlling Exposure under COSHH. London: HMSO, 1995.