

Risks associated with your anaesthetic

Section 13: Equipment failure

This article describes the equipment used by anaesthetists. It gives information about the ways in which equipment is made as safe as possible and it describes what is done to protect you if equipment failure occurs. There is also a final section that deals with the possibility of equipment transmitting an infection from patient to patient.

What equipment will be used when I have an anaesthetic?

Pipes bring anaesthetic gas (nitrous oxide), piped air and oxygen into the operating theatre and connect these to the anaesthetic machine. If you are having a general anaesthetic, the anaesthetic machine mixes these with a volatile anaesthetic agent (a vapour).

A breathing system, made of light plastic tubing, delivers these anaesthetic gases from the gas outlet of the anaesthetic machine to you, the patient. A plastic bacterial filter is placed at the end of the breathing system and this is connected to a face mask or to a tube placed in your throat. (You can find out more about tubes which may be placed in your throat in Section 2 in this series.)

The breathing system may also include a chemical absorber to remove carbon dioxide from the gas you breathe out, allowing the remaining gas to be used again.

During some anaesthetics, you will be breathing for yourself. However, in some general anaesthetics a machine is used to take over your breathing. This machine is called a ventilator. Your anaesthetist will be able to tell you if he/she plans to use a ventilator during your anaesthetic.

Monitors are used to measure your heart rate, your blood pressure, your blood oxygen level and the amount of anaesthetic gases, oxygen and carbon dioxide in your breath. These measurements will warn your anaesthetist of any change in your general condition.

How am I protected from equipment failure?

An anaesthetist and a trained technician/assistant are present and pay constant attention to you and all the equipment being used throughout your anaesthetic. In this they are assisted by audible and visual alarms. The anaesthetist will also ensure that alarm limits are set appropriately. If a problem occurs, the anaesthetist will be in a position to identify the cause immediately, and either correct it or change to an alternative anaesthetic and/or alternative equipment.

Equipment is designed to prevent misuse or mistakes. Gas pipe connections are colour coded and non-interchangeable, thus preventing accidental administration of the wrong gas. Other connections are of standard sizes to prevent misconnections. Anaesthetic gases cannot be administered without oxygen because anaesthetic machines are equipped with a device that prevents low oxygen levels in the gas mixture that you breathe.

Other design features prevent injury from certain kinds of equipment failure. For example, pressure relief valves are built into anaesthetic machines to prevent high pressure gas reaching your lungs.

Regular documented checks should be performed on equipment as follows.

- ▶ Servicing of the anaesthetic machine should be performed at regular intervals according to the manufacturer's instructions and a service record is kept.
- ▶ It is the responsibility of the anaesthetist to check anaesthetic equipment at the beginning of each operating session and before each new patient. The Association of Anaesthetists has published guidelines on checking anaesthetic machines¹ and these form an important part of anaesthetic training and practice. The guidelines cover all aspects of anaesthetic equipment from gas pipelines to machine and breathing systems, ventilators and monitoring equipment. A summary of the guidelines is attached to every anaesthetic machine and the anaesthetist must be satisfied that this has been carried out correctly.

All equipment failures that cause harm or could have caused harm should be reported and investigated. These are known as 'critical incidents'.

Anaesthetic machines and monitors are fitted with comprehensive alarm systems. These emit both visual and audible signals, which are appropriate in terms of urgency, loudness and specificity. An alarm will go off when there has been a specific machine failure, or if a quantity being measured deviates from an expected normal value (e.g. a falling blood pressure).

If equipment fails, is alternative equipment available?

- ▶ In the event of an oxygen supply failure, a backup oxygen cylinder, which is attached to every anaesthetic machine, can be used immediately.
- ▶ If the anaesthetic gas fails, drugs may be given into a vein to maintain anaesthesia until the problem is fixed or the operation is over.
- ▶ If the ventilator (the breathing machine) fails, a self inflating bag and valve system can be used to supply air manually to the patient. Replacement equipment and technical assistance are also available in the theatre area.
- ▶ In the event of a power failure, a generator should take over immediately without any loss of power supply to the equipment. This is tested regularly.

What type of failures can occur?

Unexpected pure equipment failure is uncommon. In an investigation of 83,154 anaesthetics given over a five-year period, equipment problems were found in 41 (0.05%) regional anaesthetics and in 191 (0.23%) general anaesthetics.

- ▶ One third of problems involved the anaesthetic machine, with the most common being leakage from, and disconnection of, the breathing system.
- ▶ The next most common problem was with blood pressure equipment.
- ▶ In one quarter of equipment problems, human error was involved.
- ▶ Other problems were rare.
- ▶ Only 1 in 100 of all problems reported during these anaesthetics involved equipment failure.²

These findings agree with other published studies from different hospitals, and it is very rare for equipment failure to have serious consequences for the patient.³

In 2002 the Chief Medical Officer set up a group to investigate 11 cases in NHS hospitals where the breathing system had become blocked, obstructing the flow of oxygen to the patient. Two patients died. The recommendations from this investigation led to changes in manufacturing, supply and storage of breathing systems and were incorporated into revised guidelines for checking anaesthetic equipment.⁴

Is there a risk of infection from the equipment?

Anaesthetic equipment can transmit disease. Some items are used for only one patient and then thrown away.

Other items are cleaned in one of three ways. They may be:

- ▶ washed
- ▶ disinfected
- ▶ fully sterilised.

The method used will be determined by the hospital or national policies and depends on what the contamination is and what disease could possibly be transmitted.

The breathing system attached to the anaesthetic machine is changed at least every week. The bacterial filter is disposable and a new one is used for each

patient. Filters have been shown to prevent bacterial contamination of the breathing system. However, if the patient is known to have a serious lung infection (such as TB), the complete breathing system is discarded after the anaesthetic.⁵

New variant Creutzfeldt-Jakob disease is resistant to the methods of sterilisation currently used. No cases of infection with this very rare disease via anaesthetic equipment have been published so far. However, if you are having your tonsils removed, the Department of Health currently recommends that all non-disposable equipment placed in your mouth is covered with a disposable protective sheath. This is because the tonsils can be contaminated with this very rare disease and, in theory, the disease could be passed on in this way.

Summary

Anaesthetic equipment can fail, however sophisticated it may be. The number of equipment problems is low, and they seldom cause any harm to patients. Human error often plays a part in equipment problems. The continued presence of a vigilant anaesthetist combined with equipment checks, appropriate monitoring and activated alarms can prevent most, if not all, of these problems.

Authors

Dr Holly Robinson, MRCP, FFARCSI
Specialist Registrar in Anaesthetics
Royal Hospitals Trust, Belfast

Dr Peter Crean, FFARCSI
Consultant Paediatric Anaesthetist
Royal Belfast Hospital for Sick Children

President, Association of Paediatric Anaesthetists
of Great Britain and Ireland

Dr Anthony Chisakuta, BSc, MSc, MMEDSc,
FFARCSI
Consultant Paediatric Anaesthetist
Royal Belfast Hospital for Sick Children

Editor

Dr John A Carter, FRCA
Consultant in Anaesthesia and Intensive Care
Medicine
Frenchay Hospital, Bristol
Chairman, AAGBI Safety Committee
Chairman, AAGBI Working Group on Checking
Anaesthetic Equipment
Member, Department of Health Expert Group on
Blocked Anaesthetic Tubing
Member, Medical and Healthcare products
Regulatory Agency (MHRA) Committee
on Safety of Devices
Member, National Patient Safety Agency (NPSA)
Anaesthetic Reference Group

References

- 1 Checking anaesthetic equipment (3rd edn). *Assoc Anaes Gr Britain Ireland*, London 2004.
- 2 Fasting S, Gisvold SE. Equipment problems during anaesthesia – are they a quality problem? *Br J Anaes* 2002;**89**:825–831.
- 3 Cohen MM et al. The Canadian four-centre study of anaesthetic outcomes: II. Can outcomes be used to assess the quality of anaesthesia care? *Can J Anaesth* 1992;**39**:430–439.
- 4 Protecting the breathing circuit in anaesthesia. *Department of Health*, May 2004.
- 5 Sabir N, Ramachandra V. Decontamination of anaesthetic equipment. *Cont Educ Anaesth Crit Care Pain* 2004;**4**:103–106.



The Royal College
of Anaesthetists

The Royal College of Anaesthetists January 2006

The material from this article may be copied for the purpose of producing information materials for patients. Please quote the RCoA as the source of the information. If you wish to use part of the article in another publication, suitable acknowledgement must be given and the RCoA logo must be removed. For more detailed enquiries about the use of this leaflet please contact:

The Royal College of Anaesthetists
website: www.rcoa.ac.uk
email: profstans@rcoa.ac.uk

This leaflet will be reviewed three years from the date of publication.