

Risks associated with your anaesthetic

SECTION 14: 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 oxygen, compressed air and anaesthetic gas (nitrous oxide) to the operating theatre. More pipes run from the wall of the theatre to the anaesthetic machine. If you are having a general anaesthetic, an anaesthetic machine is used to mix these gases with a volatile anaesthetic agent (a vapour).

This gas mixture is delivered to you through a breathing system made of light plastic tubing. A bacterial and viral filter is placed at your 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 include a chemical absorber to remove carbon dioxide from the gas you breathe out, allowing the remaining gas to be used again.

During some general anaesthetics, you will be breathing for yourself. However, in others 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 electronic devices which measure your heart rate, blood pressure, blood oxygen level and the amount of anaesthetic gases,

oxygen and carbon dioxide in your breath. These measurements will inform 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 which the anaesthetist should 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 technique and/or alternative equipment.

Equipment is designed to prevent misuse or mistakes. Gas pipe connections are colour coded and are 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 checks of equipment are performed and documented 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 the anaesthetic delivery system including the gas supply pipelines, the anaesthetic machine and breathing systems, the ventilator and the monitoring equipment. A summary of the guideline is attached to every anaesthetic machine and the anaesthetist must be satisfied that this has been carried out correctly. A record is kept, with the anaesthetic machine, that this check has been done.

All equipment failures that cause harm or could have caused harm should be reported as a 'critical incident'. Critical incidents include any unwanted event that happens during hospital care which may or could potentially cause harm to a patient. All hospitals have important processes which monitor and investigate critical incidents, looking for ways to improve patient safety.

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?

- ▶ A back-up oxygen cylinder is attached to every anaesthetic machine and can be used immediately in the event of an oxygen supply failure.
- ▶ If the anaesthetic gas supply fails, drugs may be given into a vein to maintain anaesthesia until the problem is resolved or the operation is over.
- ▶ If the ventilator (the breathing machine) fails, a self inflating bag and valve system can be used by the anaesthetist to supply oxygen and air by hand to the patient. Replacement equipment and technical assistance are also available in the theatre area.
- ▶ If there is an electric power failure, a generator should take over immediately without any loss of power supply to the equipment. This is tested regularly. However, as already stated, oxygen and anaesthetic agents can be given using equipment that is operated manually and which is not dependent on an electricity supply.

What type of failures can occur?

Unexpected equipment failure is uncommon. In an analysis of 195,812 patient safety incidents from the National Reporting and Learning System for England and Wales between 2006 and 2008, 1,029 incidents related to anaesthetic equipment (0.52%).

A detailed analysis of the 1,029 incidents revealed that:

- ▶ 272 (0.14%) incidents related to problems with the monitors (electronic devices which measure vital signs such as pulse, blood pressure, oxygen levels etc)

- ▶ 185 (0.09%) incidents related to ventilator problems
- ▶ 138 (0.07%) incidents related to gas monitoring
- ▶ 99 (0.05%) incidents related to leak in circuit
- ▶ 54 (0.03%) incidents related to anaesthetic machines failing 'cockpit check' or condition of machine/equipment unacceptable
- ▶ 53 (0.03%) incidents related to intravenous infusion pumps
- ▶ 52 (0.03%) incidents related to vapouriser problems
- ▶ 20 (0.01%) incidents related to problems with gas supply to machine.²

Most of the incidents caused no patient harm. Only 30 (0.015%) were judged to have led to moderate or severe harm. These findings agree with other published studies, that it is very rare for equipment failure to have serious consequences for the patient.^{3,4}

In 2002 there was a series of reports of problems with breathing systems. 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 had died. This investigation led to important changes in practice relating to manufacture, supply and storage of breathing systems. Guidelines for checking anaesthetic equipment were rewritten and all anaesthetists were required to change their practice. This was an example of how national reporting systems can help to make things even safer for patients.⁵

Is there a risk of infection from the equipment?

Anaesthetic equipment can transmit disease but following correct practice, as set out in infection control guidelines, should prevent this.

Some items are used for only one patient and are 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 hospital or national policy and depends on what the contamination is and what disease could possibly be transmitted. MRSA is a well known hospital infection, but it is removed by standard hospital disinfectants and/or sterilisation.

The breathing system attached to the anaesthetic machine is changed at least every week. The bacterial and viral filter is disposable and a new one is used for each patient. Filters have been shown to prevent bacterial and viral contamination of the breathing system. MRSA is removed by these filters. However, if the patient is known to have a serious lung infection (such as TB), the complete breathing system is discarded after the anaesthetic.^{6,7}

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.⁷ 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. Human error may play a part in equipment problems. The number of equipment problems is low, and they very rarely cause serious harm to patients.

The continued presence of a vigilant anaesthetist combined with equipment checks, appropriate monitoring and activated alarms, is the most important factor in keeping patients safe when equipment fails.

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References

1. Checking anaesthetic equipment (4th edn). *AAGBI*, London 2012.
2. Cassidy CJ, Smith A, Arnot-Smith J. Critical incident reports concerning anaesthetic equipment: analysis of the UK National Reporting and Learning System data from 2006–2008. *Anaesthesia* 2011;**66**:879–888
3. Fasting S, Gisvold SE. Equipment problems during anaesthesia – are they a quality problem? *Br J Anaesth* 2002;**89**:825–883.
4. 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.
5. Protecting the breathing circuit in anaesthesia. *Department of Health*, May 2004.
6. Sabir N, Ramachandra V. Decontamination of anaesthetic equipment. *Cont Educ Anaesth Crit Care Pain* 2004;**4**:103–106.
7. Infection Control in Anaesthesia (2nd edition). *AAGBI*, London 2008.



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