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 to the operating theatre. More pipes run from the wall of the theatre to the anaesthetic machine. If you are having a general anaesthetic, the anaesthetic machine mixes these gases with a volatile anaesthetic agent (a vapour).

This gas mixture is delivered to the patient through a breathing system made of light plastic tubing. A plastic bacterial and viral 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 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, 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 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 machines 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 guidelines 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 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 have caused harm to a patient. All hospitals have important processes which monitor and investigate critical incidents looking for ways to improve patient safety. Important incidents will be reported to the National Patient Safety Agency so that anaesthetists in other hospitals are made aware of particular problems (www.npsa.nhs.uk).

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 manually 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. But, as already stated, oxygen and anaesthetic agents can be given using equipment that is operated manually and is not dependent on an electricity supply.

**What type of failures can occur?**

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

- One third of problems involved the anaesthetic machine, with the most common being leakage from the breathing system or 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 critical incidents 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 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 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 very 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. However, if the patient is known to have a serious lung infection (such as TB), the complete breathing system is discarded after the anaesthetic.⁵,⁶

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.⁶ 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.
4 Risks associated with your anaesthetic

Information for Patients: The Royal College of Anaesthetists

Section 13: Equipment failure

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