SAFETY FEATURES IN ANESTHESIA MACHINE

AN ESSAY

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ABSTRACT

One of the key features of the patient safety is the belief that safety can be improved by learning from incidents and near misses, rather than pretending they have not happened. A thorough understanding of the parts of anaesthesia machine is essential to the safe practice of anaesthesia. Malpractice claims associated with gas delivery equipment are infrequent but severe and continue to occur.

KEYWORDS:

- Anaesthesia machine design.
- Problems with anaesthesia machine.
- Safety features of anaesthesia machine.
- Checklist of anaesthesia

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FDA	US Food and Drug Administration.
ANSI	American National Standards Institute.
ASTM	American Society for Testing and Materials.
psig	Pounds per square inch gauge.
DISS	Diameter Index Safety System.
PISS	Pin Index Safety System.
UK	United kingdom.
in	Inch.
ADU	Anaesthesia delivery unit.
Tec	Temperature compensated.
CPU	Central processing unit.
T	Transport.
FGF	Fresh gas flow.
VE	Minute ventilation.
VT	Tidal volume.
APL	Adjustable pressure limiting valve.
I:E	Inspiratory: Expiratory.
HME	Heat and moisture exchanger.
NIOSH	National Institute for Occupational Safety and Health.
ASA	American Society of Anaesthesiologists.
TWA	Time-weighted average.
ppm	Parts per million.
PEEP	Positive end-expiratory pressure.
MAC	Minimum alveolar concentration.
OR	Operating Room.
PACU	Post anaesthesia care unit.
ICU	Intensive care unit.

kPa	Kilo pascal.
OFPD	Oxygen failure protection device.
VPO	Volume, Pressure, Oxygen.
PAC	Preanesthesia checkout.
ASATT	American Society of Anesthesia Technicians and Technologists.
AC	Alternating current.
AANA	American Association of Nurse Anaesthetists.
APSF	Anesthesia Patient Safety Foundation.
JCAHO	Joint Commission on Accreditation of Healthcare Organizations.

Rationale and background

One of the key features of the patient safety is the belief that safety can be improved by learning from incidents and near misses, rather than pretending they have not happened.

Anaesthetists have always taken a particular interest in the apparatus they use. Their original anaesthetic machines of the 1840s were not purpose-built devices but merely adaptations of other scientific or domestic apparatus. They were soon replaced by specific simple apparatus which could be widely used in all the known surgery of that era. This second generation of equipment could still be used today but has instead been replaced many times over the last 150 years by apparatus of increasing sophistication. Up until recently the evolution of the anaesthetic machine had mirrored the evolution of the speciality itself, this is because the majority of apparatus was built by the anaesthetist or at his request**.** (1)

Modern anaesthetic machines are rarely designed by the profession directly and no longer provide such insights into practice. There is now a much blander uniformity in this machinery which has become so sophisticated in an attempt to minimise faults and errors. Anaesthetic audit studies continue to highlight human error or ignorance as the major cause of morbidity and mortality and there is a danger that our machines are evolving in the wrong direction in the hands of industry rather than in our own. (1)

Pharmacological muscle paralysis necessitates the use of artificial ventilation, making the patient dependent on the anaesthetist and his equipment for the fundamental functions of oxygenation and excretion of carbon dioxide. Equipment failures during anaesthesia probably could have led (if not discovered or corrected in time) or did lead to an undesirable outcome. The majority of critical incidents are caused by human errors, which often comprise failure to use the equipment properly, failure to use available monitors and alarms, and failure to develop appropriate algorithms in response to the alarms and monitors. (2)

Aside from the obvious human errors involving misuse of or unfamiliarity with the equipment, when the rare equipment failure does occur, the defect appears to be almost always due to lack of or incorrect service and maintenance. These issues became the focus of anaesthesia practice management efforts because confusion or even dispute about who precisely is responsible for maintaining the anaesthesia equipment often arise the facility itself or the practitioners. (3)

No matter how rote the task or how vigilant the anaesthesiologist, “slips” and other errors represent expected aspects of human performance. Evaluation and subsequent improvement of standard checkout procedures promises to increase patient safety in the peri-operative period by removing more of the “human factors” so often implicated in anaesthesia adverse events. The use of pre-flight checklists has been considered a key method in improving airline safety, largely due to regular systematization of complex procedures, and improvement of team dynamics through authority-neutral tasks. (4)

A checklist system has been proposed as part of routine pre-anaesthesia care, with the American Society of Anaesthesiologists and the US Food and Drug Administration (FDA) issuing general guidelines supporting checklists in 1986.Subsequently, anaesthesia professional societies in Great Britain and Europe adopted similar standards. (4)

Aim of the work

The anaesthesia machine is that component of the anaesthesia delivery system that receives medical gases (oxygen, nitrous oxide, air, heliox) under pressure and controls the flow of each gas individually. It creates a gas mixture of known composition at a known flow rate and delivers it to the common gas outlet of the machine. From here, the fresh gas flow is conducted to the anaesthesia circle breathing system. This review will discuss:

- The storage of compressed oxygen and nitrous oxide and how these gases arrive to a generic anaesthesia machine.
- The paths taken by these gases as they flow through the generic machine will be described.

- The important components used to create the precisely controlled fresh gas mixture.
- The **safety** features of the **machine** as regard:
    - Prevention of delivery of hypoxic mixture.
    - Prevention and early detect disconnection.
    - Prevention of the increase of intra-thoracic pressure.
    - Prevention of over-dosage.

CHAPTER 1