

References

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Murphy's Law and the anaesthetic machine

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Murphy's Law: if anything can go wrong, it will.

The anaesthetic gas machine provides a daily reminder of the validity of Murphy's Law. A catalogue of the problems which have been reported with anaesthetic machines is beyond the scope of this presentation and is available elsewhere.¹⁻⁴ The interaction of human factors, particularly training and vigilance,⁵⁻⁸ with the apparatus design and safety features, must be recognised when considering the role of the anaesthetic machine in anaesthetic mishaps.

Publication of the Canadian Standards Association Standard Z168.3, as a preliminary standard in 1978 and as a final standard in 1980,⁹ can be viewed as the end result of careful consideration of the many design and operational problems which had been recognized with earlier anaesthetic machine models. Table I lists the essential requirements of this standard. Compliance with CSA standard Z168.3 has not been uniform across Canada. While in one province (Manitoba) every anaesthetic

TABLE I Components of Canadian anaesthetic machine standard (Z168.3)

O ₂ Right
O ₂ Downstream
O ₂ Knob-touch coded
O ₂ Supply failure device
O ₂ Supply failure alarm
O ₂ Flush valve
/ Single purpose
— Non-locking
\ Protected
O ₂ Reserve supply
Standard, single common gas outlet
Pipeline inlets
Pipeline gauges
Backflow check valves
Cylinder yokes-pin indexed
Colour coding
Vapourizers - design/performance
Vapourizers - keyed filling devices
Hypoxic mixture alarm*

*Recommended in Preface but not mandatory part of standard.

machine met the basic requirements (excluding vaporizer section) as early as 1980,¹⁰ similar universal solutions have not been the case in the other provinces.

The most significant requirements of CSA standard Z168.3 concern oxygen delivery, in particular the position of the oxygen flow meter to the right of the bank of flow meters. Accommodation of this requirement eliminates the previous, unacceptable and hazardous situation whereby units of American origin (oxygen right) and of British origin (oxygen left) were found, not only in the same country but also in the same hospital.

Safe use of the anaesthetic gas machine requires the following:

a. Equipment meeting current standards: Accommodation of standards is possible either with appropriate upgrading of selected existing equipment or the acquisition of new equipment certified to meet the relevant standard or standards.

b. Institution of an effective preventive maintenance program, using either in-house or contracted services.

c. Appropriate pre-use equipment check procedures: The components of a check list for the anaesthetic machine are summarized in Table II. Specific details of the individual procedures can be found in current textbooks¹¹ or from the manufacturer's information provided with the equipment.

TABLE II Components of pre-use anaesthetic machine checklist

Reserve cylinders
High pressure leak
Pipeline connections
Pipeline pressures
Gas flows (flowmeters)
O ₂ Pressure failure device and alarm
- During cylinder operation
- During pipeline operation
Machine circuit leak test
- Vapourizers on
- Vapourizers off
Vapourizers - confirm off
O ₂ Flush valve
Scavenging system
Breathing Circuit
Monitors/alarms

d. Operator training and operator vigilance: These are likely the most important factors.

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Monitoring anaesthetic practice

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Of the many methods of studying morbidity/mortality in anaesthesia, and thus monitoring anaesthetic practice, six will be described.

Anecdotal tales are usually reports of anaesthetic rarities, occurring at a rate of "1/?", and often bearing little relevance to day-to-day practice, e.g., "blue jumpers and pink trousers."¹ However, these reports may lead to more detailed studies once a problem has been identified.

In-hospital audit involves review of the written anaesthetic record, the making and keeping of which is mandatory in most parts of the world. Review is facilitated by computerisation, allowing quantification of the rates of death and other major complications although, even in the best regulated institutions, records may be incomplete or missing. Also, the low incidence of untoward events² re-