

blood pressure waveform and measures the "zero-offset" (also called the "bias" or "DC component" of the waveform. It appears that Marey's device did not satisfy parts 1, 3, and 5 of our definition.

Reference 7 cited by Bruner (O'Rourke *et al.*) does not support his contention that arterial tonometry was invented before 1890. For example, O'Rourke *et al.* state that "His (Marey's) techniques for pulse recording . . . were improved and extended principally in England by Mahomed" (page 6). O'Rourke *et al.* then contrast a modern tonometer with Mahomed's device as follows: "a new instrument . . . unlike Mahomed's instrument depends on the established principle of tonometry" (page viii).

Describing modern arterial tonometry, O'Rourke *et al.* state, "The theoretical basis on which arterial tonometry is founded is solid and has been developed over a period of 20 years. The earliest studies by Pressman and Newgard²⁵ used . . ." (page 26).

We thank Bruner for pointing out our error concerning the Food and Drug Administration's (FDA) name. We do not dispute his description of FDA approval. We agree that FDA approval is not compelling evidence, but neither is it irrelevant.

Bruner's distaste for "proprietary" drugs is understandable. On the other hand, the manufacturing processes used to produce many drugs are proprietary, and physicians have no reservations about using these drugs. We further submit that numerous medical instruments such as imaging devices and analytical instruments use algorithms that are (at least in part) proprietary. Some balance must be made between the medical professional's "need to know" and the legitimate protection of proprietary technology. We are constrained by the equipment vendor's willingness to divulge details of the algorithms.

We point out that the basic strategy and effects of the "proprietary" algorithm are revealed in our paper: "Mean arterial pressure is taken as the cuff pressure at which the amplitude of the cuff pressure oscillations reaches a maximum. The oscillometric measurements then are used to compute two coefficients (essentially a "gain" and "offset") that are used . . . and so on.

Anesthesiology
77:398, 1992

When the Endotracheal Tube Will Not Pass over the Flexible Fiberoptic Bronchoscope

To the Editor:—Katsnelson *et al.*¹ point out that it is often necessary to rotate the tracheal tube to facilitate its passage through the glottis. It is interesting to note that Dogra *et al.*² made similar recommendations for passing a tube over a gum-elastic bougie.

Their letter suggests that they are using preformed tubes. Tubes with a preformed curve do not rotate well and in our experience can cause the fiberoptic bronchoscope to "flick out" of the trachea. Flexometallic tubes, such as those produced by Mallinckrodt, have very little preformed curve and can be rotated through the glottis without risk of displacing the fiberscope. Also, being flexible, they follow the fiberoptic bronchoscope through the curves formed by the glottis and trachea. When passing the tube one should rotate more than push. We find that flexometallic tubes are much easier to pass, and being softer, are kinder both to the tissues and the bronchoscope.

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Machine Wars: Another Cause of Pressure Loss in the Anesthesia Machine

To the Editor:—As requests increase for anesthesia services outside of the operating room, the potential for equipment-related problems also increases. Technologic advances in medicine have created a literal explosion in the use of electronic mechanical equipment, enhancing

We appreciate Bruner's careful reading of our paper. We hope the above comments will satisfy his concerns.

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the chances of inadvertent machine interaction. We report an incident whereby a fluoroscopic machine disabled an anesthesia machine (Modulus II, Ohmeda, Madison, WI) during a vascular procedure performed in the radiology department.

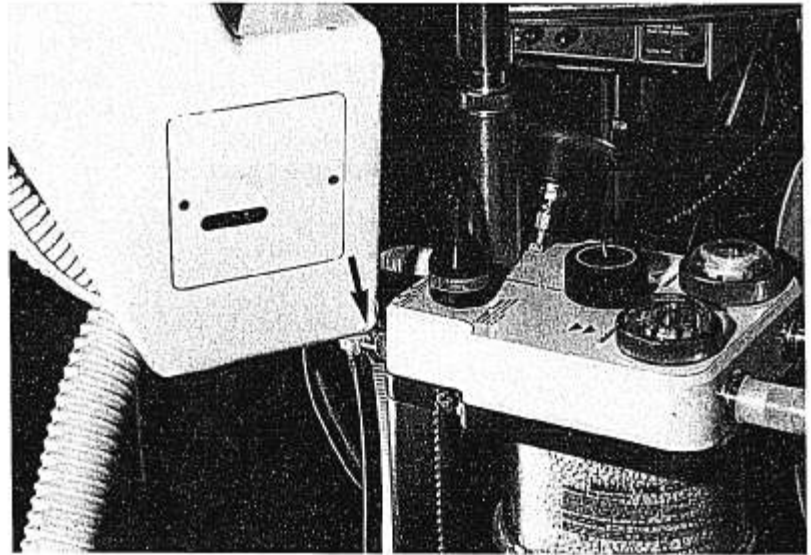


FIG. 1. C-arm of fluoroscope impacting the common gas inlet to the absorber manifold (arrow).

A 5-yr-old girl undergoing arteriography and embolectomy of a facial hemangioma in the angiography suite received a general inhalation anesthetic. During repositioning, the C-arm of the fluoroscope (Angioskop, Siemens, Solna, Sweden) struck the common gas inlet to the absorber manifold of the anesthesia machine and cracked the plastic manifold (fig. 1). The resulting leak prevented application of positive pressure ventilation. The system was disconnected from the patient, and ventilation was resumed with 100% oxygen delivered with a self-inflating bag. Anesthesia was maintained with small units of sodium thiopental. A modified Mapleson D circuit (Vital Signs, Totowa, NJ) was then attached to the anesthesia common gas outlet, and anesthesia was resumed with air/oxygen and halothane. The remainder of the procedure was uneventful and the patient recovered without sequelae.

As shown in figure 1, the fluoroscope's C-arm had apparently cleared the absorber manifold but subsequently impacted the fresh gas inlet connector nipple. Radiology personnel were unaware that the anesthesia machine had been struck by the C-arm, which automatically continued to move into the desired position after the impact. A pressure-limiting sensor on the C-arm might have alerted personnel to the obstruction and avoided damage to the other equipment. Alternatively, protecting exposed plastic parts of the anesthesia machine may offer greater resistance to breakage. The site of damage was identified by noting the time-effect relationship of the C-arm movement and loss of pressure in the breathing system. Anesthesiologists also could be more cognizant of contact with their equipment from any motorized, moving apparatus, as they probably already are with the surgical table.

Equipment failures appear to represent only a small percentage of anesthetic critical incidents.¹ Previous reports involved loss of gas supply, misconnections and disconnections of the anesthesia circuit, breakage of plastic circuit parts, malfunctioning of valves, and loss of

electrical supply.¹ We report another source of equipment failure, that caused by interaction between machines. As technology advances and equipment becomes more sophisticated, the chance of physical, electrical, or magnetic conflict likely will increase. Therefore, our level of vigilance for potential interactions also must increase. We hope this letter will serve as a reminder of the hazards of providing anesthesia services outside the operating room, often in cramped quarters, and the need to ensure the presence of appropriate emergency equipment.

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Design Flaw in an Anesthesia Machine

To the Editor:—Equipment failure has been identified as among the most common causes of preventable anesthetic incidents.¹ We would like to alert readers about a potentially fatal mishap resulting from design of the equipment rather than its malfunction.

The master on/off switch on the Excel 210 Ohmeda anesthesia

machine has recently been redesigned by the manufacturer. Previously the switch was in the shape of a corrugated knob. It now forms a protruding plate, supposedly to facilitate rotation between the on and off position.

During general anesthesia for abdominal surgery, a sudden massive