comprehensive history of arterial tonometry appears in the opening chapter of a just-published text by Michael O'Rourke and colleagues.[6]

The Kemmotsu *et al.*[1] go on to disclose that the tonometric artifact is calibrated against an oscillometric blood pressure measurement system and that the oscillometric blood pressure module has been "certified by the Federal Drug Administration." There is no such thing as a "Federal Drug Administration." There *is* a Food and Drug Administration (FDA), which has authority only to determine whether a drug or device sold across state lines is safe and effective for the uses listed on the label of the product. Whether the FDA does or does not "approve" a drug or device is irrelevant to scientific medical practice (although such "approval" can be a highly charged political issue because of reimbursement considerations).

For evaluation of blood pressure–measuring devices, the FDA depends on the manufacturer to provide assurance that a particular blood pressure device has been tested (by the manufacturer) in accordance with a consensus standard drawn up by a committee of the Association for the Advancement of Medical Instrumentation.† The documentation filed with the FDA is available to the interested professional only through exercise of the Freedom of Information Act. An article in a respected scientific journal should not be based on distant and opaque bibliographic resources.

For their final indignity, the authors reveal that their calibration system "uses proprietary algorithms to determine systolic and diastolic pressures." This—"proprietary algorithm"—in a scientific journal? Surely you would not think of publishing in ANESTHESIOLOGY an article on the induction of anesthesia using a "proprietary" drug!

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(Accepted for publication April 17, 1992.)

* Exhibition and catalog on Etienne Jules Marey implemented by Medtronic France S.A., presented at the VIII European Congress of Cardiology, June, 1980. Catalog and reprint from Medical Heritage, 1986, kindly supplied by Albert W. Kuhfeld, Ph.D., the Bakken Library and Museum, Minneapolis, Minnesota.

† Personal communication: Don Dahms, Division of Cardiovascular, Respiratory, and Neurological Devices, Food and Drug Administration, November 7, 1991, and James Cheng, December 2, 1991.

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In Reply:—It is our routine practice to use a 22-G Teflon cannula for the radial artery to minimize vascular damage. We can usually obtain good pressure waveforms by 22-G cannulas in the radial artery, as one can see in figure 4 of our paper.[1] Presumably, Japanese people have smaller radial arteries than Americans. Use of an 18G cannula, almost never seen in Japan, would have resulted in a highly underdamped system, requiring use of an external damping device to avoid overestimation of the systolic blood pressure. The advantages of a small arterial cannula include the following: 1) it reduces the incidence of vascular complications; 2) by preventing occlusion of the artery, it helps to keep the point of wave reflection distal to the site of pressure monitoring; and 3) it tends to dampen the naturally underdamped catheter-extension tube system so that there is less "ringing" in the pressure wave, and systolic pressure is measured more accurately.[2]

Allen's test may be a fetish of defensive medicine and has no established predictive innocuousness of arterial cannulation. There are publications, as cited by Bruner, that decry the importance of this test, but our use of the test has no bearing on the scientific content of the paper and can scarcely have decreased patient safety. However, we still think it advisable, especially from a medicolegal standpoint, to avoid cannulating the radial artery if Allen's test is abnormal. We are aware that there is no guarantee of risk-free cannulation even if a normal Allen's test is obtained before cannulation.[3]

Although arterial cannulation seems to be a remarkably low-risk or benign procedure, major complications are not unknown. We should do our best to avoid complications associated with arterial cannulations even if an overall incidence of severe vascular compromise due to radial artery cannulation is only 0.01%. We agree that major complications are uncommon but remain convinced that a noninvasive procedure, if it can give the same information, would be preferred by most anesthesiologists. A recent report concluded that rates of arterial catheter-associated infections are low.[4] However, nosocominal infection with methicillin-resistant *Staphylococcus aurens* is now becoming a major problem not only in Japan but also in other countries. Safety considerations related to acquired immunodeficiency syndrome and hepatitis, which are becoming a serious problem in the perception of medical personnel, also favor use of noninvasive methods.

We see little value in disputing the inventorship of tonometry in this forum. Still, we would call Bruner's attention to United States Patent 3,219,035. This patent was granted in 1965 and indicates that the U.S. Patent Office was persuaded that tonometric blood pressure measurement was invented by Pressman, Newgard, and Eige sometime before the filing date, May 6, 1963. Perhaps Bruner's assertion that arterial tonometry was invented before 1890 arises from a disagreement about semantics, rather than history. Briefly, we define arterial tonometry as follows: 1) It uses an arterial rider that is smaller than the artery; 2) the artery is partially flattened, but not occluded; 3) the rider is supported rigidly so that it does not move significantly due to the arterial pulse; 4) the force exerted by the rider is measured, and this force is proportional to the arterial pressure; and 5) it measures the

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 Newgard[23] 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.

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

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(Accepted for publication April 17, 1992.)

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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(Accepted for publication April 17, 1992.)

Anesthesiology
77:398–399, 1992

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 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.