Anesthesiology
68:308, 1988

ASA Award: B. Raymond Fink

To the Editor:—A correction is required in my biographical sketch of B. Raymond Fink, M.D., ASA awardee for Excellence in Research for 1987, which appeared in the October issue of ANESTHESIOLOGY.[1] It was stated that Dr. Fink completed his residency in anesthesiology at the Beth Israel Hospital in Boston. It was, in fact, at the Beth Israel Hospital in New York that Dr. Fink did his clinical training in anesthesiology, under the leadership of Dr. Sol Hershey as Chief of Anesthesiology. Although the incorrect information was derived from a source thought to be reliable, the error is mine in not having checked it directly with Dr. Fink. I can plead only that this was the last period in Ray's life at which I had not yet met him personally, and regret any embarrassment to him or to Dr. Hershey, or confusion among the readers.

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REFERENCE

1. Epstein RM: ASA Award: B. Raymond Fink. ANESTHESIOLOGY 67:456–458, 1987

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Preservation of Pulse Oximeter Sensors

To the Editor:—For those who use the non-disposable pulse oximeter sensors, apply a small strip of self-adhesive Velcro™ to the top of your pulse oximeter case, and its mate to the finger sensor. Then, when not using the oximeter, stick the sensor to the case with the Velcro™. This discourages the sensor from leaping to the floor and self-destructing. At $250 per sensor unit, it can quickly pay for the Velcro™. Furthermore, you can find the little sensor when you look for it.

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Artifactually Low Cardiac Outputs Resulting from a Communication Between the Proximal and Distal Lumens of an Edwards Pacing Thermodilution Swan-Ganz® Catheter

To the Editor:—We experienced an interesting problem while providing anesthesia for a 66-year-old female undergoing CABG. Preoperative cardiac catheterization indicated three-vessel coronary artery disease with a dilated severely hypokinetic left ventricle. The cardiac output at catheterization was 5.0 liters/minute, with a stroke volume of 60 ml, ejection fraction of 32%, and a systemic vascular resistance of 1800 dyne·sec·cm^{-5}. The CVP was 2 mmHg, with a pulmonary artery pressure of 27/14 (18) mmHg, LVEDP of 35 mmHg, and an end-systolic volume of 127 ml.

Intraoperatively, the patient was monitored using a Marquette Electronics® Surgical RA system complete with two simultaneous ECG leads (II, V_5); arterial, pulmonary artery, and central venous pressures, temperature, and cardiac output with hemodynamic calculations. Prior to induction of anesthesia, an Edwards pacing thermodilution Swan-Ganz® catheter was advanced into the pulmonary artery without difficulty, displaying characteristic waveforms, and wedging when the balloon was inflated. The first intraoperative cardiac outputs were in the range of 1.2–1.4 liters/minute using

10 ml of room temperature injectate. Calculated systemic vascular resistances were in the range of 3000–4500 dyne·sec·cm^{-5}. The cardiac output curves, although normally shaped, were extraordinarily large, characteristic of low blood flow. The clinical picture of reasonable filling pressures, stable hemodynamics, unchanged ECG, and adequate urine output, along with direct visualization of the myocardium, was inconsistent with the measured cardiac outputs. A cardiac output simulator connected to the cardiac output module provided correct outputs for two different ranges of the simulator. Software selection of the proper catheter (constants) and injectate volume was verified. The temperature reading from the Swan-Ganz® catheter was within 0.1° C of the esophageal temperature, indicating that the thermistor was functioning correctly. By this time, heparin had been administered and cardiopulmonary bypass was about to begin. At the onset of cardiopulmonary bypass, the arterial pressure was maintained with a pump flow of 4.2 liters/minute. Following bypass the cardiac outputs were measured to be 0.9 liters/minute with the assistance of intra-aortic balloon augmentation, and norepinephrine/phentolamine and sodium nitroprusside infusions. After protamine antagonism of the heparin, and before changing the catheter, the cardiac output was measured to be 1.2 liters/minute. The presumably defective catheter was replaced with a thermal dilution catheter without difficulty. The average of next set of cardiac output measurements obtained from the new catheter was 3.3 liters/minute, more indicative of the patient's clinical status.

Large cardiac output curves could be a result of: 1) a low cardiac output, indicative of a small dilutional mixing volume; 2) the catheter tip positioned in the ventricle so that the thermistor measures the temperature change close to the proximal injection site before adequate mixing; or 3) a direct communication between the proximal and distal lumens that would deliver room temperature injectate directly to the catheter tip, and by conduction through the catheter to the thermistor. In this case, a small volume of injectate delivered in close proximity to the thermistor would produce a large temperature change that would mask the smaller temperature change produced by mixing the injectate with the blood. The larger temperature change detected by the thermistor would be interpreted as a low cardiac output, when, in fact, the cardiac output could be much larger.

Upon inspection of the catheter removed from the patient, it was determined that, for every 10 ml of injectate administered into the proximal port, 0.4–0.5 ml of injectate was recovered from the distal lumen at the catheter tip. The distal 20 cm of the Swan-Ganz® catheter was placed in a 1-liter graduated cylinder with water at 37.5° C, and connected to the standard Marquette cardiac output module. The flow out of the proximal injection site (30 cm) did not enter the cylinder, but the thermistor registered a characteristic thermal dilution curve and indicated a cardiac output of 0.7 liters/minute. The small volume of fluid that passed into the distal lumen was enough to cause conduction of heat away from the thermistor (fig. 1) and create a large thermal curve.

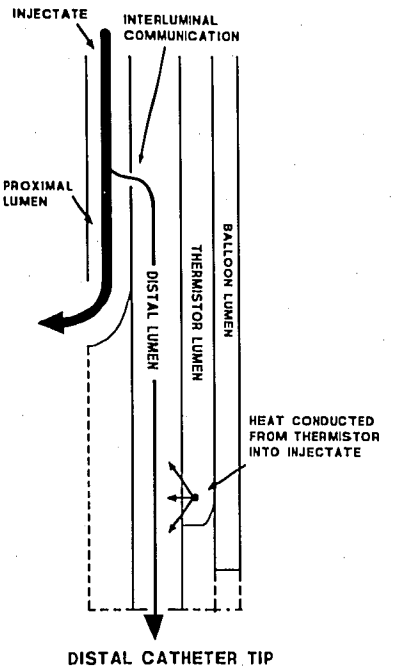

FIG. 1. Schematic diagram of the pacing thermodilution Swan-Ganz® catheter demonstrating the interluminal communication, and the heat transfer from the thermistor into the room temperature injectate present in the distal lumen.

The catheter was modeled in terms of the two lumens having a small communication between them, as illustrated in figure 1. The resistances of each element, including the communication, were determined by pressure and flow measurements from the catheter. The estimated pressure errors resulting from communication between the two lumens were negligible due to the high resistance of the communication. The pulmonary artery pressure was estimated to be falsely low by 0.135%, while the central venous pressure would be artificially elevated by 0.123%.

Once again, this report illustrates that relying on a single routinely measured parameter can be extremely misleading, and that there is no substitute for good clinical judgment that seeks alternative methods when numbers are in doubt.

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