Anesthesiology
68:477, 1988

In Reply:—Doctor Moore can be commended in this attempt to further educate personnel regarding the continuing dangers of lidocaine concentrates "for dilution only." The purpose of my initial correspondence was to emphasize this danger, to increase reporting of any such occurrences, and, hopefully, to induce removal of the 20% preparations from the market. The morbidity and, especially, mortality of inadvertent injection of concentrated solutions *can* be prevented by use of the now available safer alternative formulations. The use of 4% solutions in bottles to constitute lidocaine infusions (should self-constitution be required) was proposed because of the inherent margin of safety: use as if it were the 2% solution results in dosing only two, instead of ten, times the intended dose, and would probably be better tolerated by the patient. Drawing up a solution into a syringe also provides extra interaction time in which to prevent a mistake, and this preparation has been found to have a good track record of safety *via* FDA reports.*

Very recently, International Medication Systems LTD, So. El Monte, CA, has begun to market 1 gm lidocaine sterile powder for constitution in a formulation similar to the familiar Anectine Flo-Pac® under the trade name Bag-A-Mix®. Lidocaine *powder* would be extremely difficult to inject, and can now be highly recommended, should the need to constitute a lidocaine infusion persist. The "protective-needle-housing" on ready-to-use syringes in no way precludes direct iv injection. Alternatively, if these ready-to-use syringes were not armed with needles, but with ¼ inch diameter spikes similar to those on common infusion administration sets, lidocaine concentrates could be physically introduced *via* the administration set port on the bag. At the same time, a spike of this type *cannot* physically find access to an iv tubing set, and direct injection becomes impossible. Furthermore, an infusion constituted in this manner cannot be returned unmarked to the shelf for subsequent use as a crystaloid infusion, because the removal of the ¼ inch spike-tip would cause the solution to run out. Toxic inadvertant 20% lidocaine injections could be eliminated without any inconvenience to the medical profession, and these principles could be applied to other drugs as well (*i.e.*, KCl additives).

Vigilance is the foundation of sound anesthetic practice in particular, basic to medicine in general, and cannot be overemphasized. When specific problems are recognized, they should be addressed as soon as possible in the interests of the safety of our patients and out of basic medical ethical concerns. We live daily with fail-safe principles: Pin and Diameter Index Systems and color coding for medical gasses; the fluted oxygen knob and ratiometers, and multiple alarms on the anesthesia machine; Agent-Specific Filling Devices for volatile anesthetics, etc. We, as professionals, cannot afford to disregard this problem, where the solution costs nothing and is at hand.

PAUL M. KEMPEN, M.D.
Staff Anesthesiologist
Magee-Womens Hospital
Instructor of Anesthesiology
University of Pittsburgh
School of Medicine
Forbes Avenue and Halket Street
Pittsburgh, Pennsylvania 15213

(Accepted for publication November 20, 1987.)

* Graham CF: Report to the anesthesia and life support advisory committee. Food and Drug Administration, Rockville, Maryland, October 24, 1984

Anesthesiology
68:477–478, 1988

Life-threatening ECG Artifact during Extracorporeal Shock Wave Lithotripsy

To the Editor:—Intraoperative dysrhythmias during extracorporeal shock wave lithotripsy (ESWL) have been recently reported.[1] We describe a case during which ECG anomalies with potentially serious consequences were observed.

A 68-yr-old woman with nephrolithiasis and controlled hypertension was admitted for ESWL. Prior general anesthetics had been uneventful. She denied angina pectoris, palpitations, or known cardiac abnormalities. Electrolytes and 12-lead ECG were within normal limits.

Pre-induction blood pressure was 130/75 and heart rate was 70. Intravenous induction with thiopental, 450 mg, and fentanyl, 50 μg, was followed by succinyldicho-

line, 100 mg, facilitating easy oral intubation with a 7.5 endotracheal tube. Anesthesia was maintained with N_2O 60% in O_2 with enflurane 0.75–1.5%. Lithotripter water bath was 37° C. ECG-synchronized lithotripsy was begun; vital signs were stable.

During the procedure, a lithotripter technician began rhythmically slapping a panel of styrofoam from a lithotripter spark plug case against his thigh. Impact coincided with significant distortion spikes on the ECG monitor trace, which caused the lithotripter to fire at a rate greater than the patient's sinus rate. At the end of the procedure, the patient emerged from anesthesia without incident. The ECG appeared entirely normal, and the patient was taken to the recovery room in excellent condition.

Following the case, equipment dysfunction and ground fault were ruled out. The high amplitude distortion spikes and resultant lithotripter overdrive were easily reproducible during ECG monitoring of one of the authors by slapping the styrofoam panel nearby. It was found that a static electrical charge on the styrofoam was the culprit, rather than the acoustic noise of the impact. Brisk impact against the styrofoam created waves on the monitor even from a distance of 6 feet. These waves were not produced by other materials at hand, such as a clipboard. Silently waving the styrofoam in front of the cables caused a large sinusoidal tracing. The same results were obtained outside the ESWL suite and with other monitors and cables.

Transient ECG interference, in most situations, is of little concern. During ESWL, however, baseline distortion can trigger the lithotripter during the cardiac cycle initiating ventricular dysrhythmias.[1]

The Dornier lithotripter can fire at a maximum rate of 120 beats/min. The machine triggers when its internal Schmidt trigger receives an impulse from an ECG monitor. A Vitatek 511® monitor with a square wave signal output triggers a shock wave each time an R wave is detected. To discriminate between noise and actual cardiac spikes, the Vitatek® monitor employs amplitude and slope criteria in assessing the waveform. The styrofoam-induced ESWL artifact was able to meet the Vitatek®'s criteria for an R wave. The monitor is grounded as is the lithotripter tank, and the lithotripter suite is electrically isolated.

In most operating rooms, ECG noise is fairly common and of little consequence. Movement of ECG connections or cables is often responsible for gross interference. Sixty hertz AC noise can also cause a much finer baseline distortion. In the case reported here, however, ECG artifact represents a potential danger to the patient. The artifactual spikes caused untimely shock waves.

Pioneering work with the lithotripter demonstrated that shock waves delivered at random with respect to the patient's ECG led to ventricular dysrhythmias with an incidence of up to 80%.[1] By contrast, an R wave synchronized lithotripter system demonstrated "transient arrhythmias" in only five of 352 patients (1.4%).[2]

During ESWL, ECG monitor trace artifact may trigger the lithotripter at a moment of the cardiac cycle at which risk of initiating ventricular dysrhythmias is greatest. We report an easily preventable means of generating such artifact, and suggest that objects with significant static electrical charge be kept from close proximity to ECG monitors in the lithotripter suite.

ERIC C. SCHILLER, M.D.
Clinical Fellow in Anesthesia

PAUL HEERDT, M.D., PH.D.
Clinical Fellow in Anesthesia

JAMES ROBERTS, M.D.
Assistant Professor

Harvard Medical School
Massachusetts General Hospital
Boston, Massachusetts 02114

REFERENCES

1. Chaussy C, Schüller J, Schmiedt E, Brandl H, Jocham D, Liedl B: Extracorporeal shock-wave lithotripsy (ESWL) for treatment of urolithiasis. Urology 23:59–66, 1984
2. Charig C, Webb DR, Payne SR, Wickham JC: Comparison of treatment of renal calculi by open surgery, percutaneous nephrolithotomy, and extracorporeal shockwave lithotripsy. Br Med J 292:879–882, 1986

(Accepted for publication December 3, 1987.)