

TITLE: COMPUTER-CONTROLLED INFUSION
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A new PID (proportional-integral-derivative) controller for atracurium delivery was tested in 32 patients, with 8 patients each receiving either halothane, enflurane, isoflurane at 1 MAC or N₂O/narcotic anesthesia.

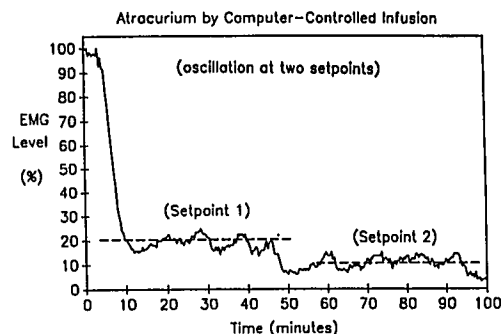
After induction of anesthesia with sodium thiopental, 3-5 mg·kg⁻¹, and obtaining a 100% EMG reference, atracurium, 0.2 mg·kg⁻¹, was delivered by the controller, followed by an infusion calculated by the controller to maintain the EMG at setpoints of 80% and 90% block. (See figure.) Overshoot for the controller was 3.6%, with a steady-state error of 2.9%. Mean infusion rates to maintain 80% and 90% block were calculated for each anesthetic group.

Infusion rates (μg·kg⁻¹·min⁻¹) for N₂O/narcotic, halothane 0.8%, enflurane 1.7%, and isoflurane 1.4% were, respectively, 5.6 ± 0.55, 3.7 ± 0.3, 3.3 ± 0.4, and 2.9 ± 0.3, (for 80% blockade) and 5.7 ± 0.6, 4.9 ± 0.3, 3.5 ± 0.3, and 4.1 ± 0.5, (for 90% blockade), (mean ± S.E.). Our infusion rate for atracurium at

90% block under N₂O/narcotic anesthesia is in agreement with the previously reported values of approximately 6 μg·kg⁻¹·min⁻¹. The other infusion rates at 80% and 90% blockade have not been reported previously, but correspond to the known effects of the inhalation anesthetics on neuromuscular blockade. This controller is at least as accurate as previous controllers^{2,3}, with small degrees of overshoot and steady-state error, and is adaptable for use with other muscle relaxants.

REFERENCES:

1. *Anesthesiology* 64:72-86, 1986.
2. *Ann Biomed Eng* 13:3-15, 1985.
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A415

TITLE: RELIABILITY OF A NEW GENERATION
TRANSESOPHAGEAL DOPPLER DEVICE
FOR CARDIAC OUTPUT MONITORINGAUTHORS: E.R. Schmid, M.D., D.R. Spahn, M.D.,
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Transesophageal Doppler ultrasound (TED) has been reported by us¹ and others² to unreliably assess absolute cardiac output (CO) values and to inaccurately track CO changes as compared to thermodilution (TD) in anesthetized patients. It was the aim of the present study to determine the reliability of a newly developed second generation Doppler device (Accucom 2, Datascope) which incorporates a real time display of blood flow velocity.

With informed patient consent and institutional approval, 140 simultaneous CO measurement sets were carried out in 16 anesthetized adults early after coronary artery bypass surgery. CO by TED and TD were computed as the average of 5 single determinations. TED was calibrated by suprasternal Doppler ultrasound in the ascending aorta, using the nomogram-derived aortic diameter. Reliability of TD (Edwards 9520A) as gold standard reference was confirmed in a previous study¹. Absolute values as well as relative changes between serial measurements were compared by linear regression, and the error and absolute error were calculated to determine bias and precision.

Absolute CO values showed an unsatisfactory correlation between TED and TD (fig A). The error was -0.37 ± 1.7 l/min (mean ± SD) and the absolute error was 1.46 ± 0.93 l/min. In contrast, agreement of relative CO changes (% of preceding

value) (fig B) was acceptable and similar to the previously reported correlation between two invasive standard techniques¹. Error and absolute error were -0.66 ± 9.75 % and 6.8 ± 6.96 %, respectively. CO changes in opposite directions occurred in 8 of 124 situations.

In contrast to the results obtained with the Accucom 1 in postcardiosurgical patients¹, the second generation TED device (Accucom 2) reliably assessed relative CO changes provided that the blood flow velocity signal was stable and free from disturbances. Absolute TED values, however, still showed an unacceptable scatter as compared to TD, reflecting unresolved methodological problems, in particular improper sampling of aortic blood flow velocities during suprasternal Doppler calibration.

References

1. *J Cardiothorac Anesth* 4:46-59, 1990
2. *J Cardiothorac Anesth* 2:590-595, 1988

