

going certain cardiac surgical procedures such as ligation of a patent ductus arteriosus or formation of an aortico-pulmonary shunt. Our recovery room nurses and technicians have used it in the postoperative monitoring of these patients without any difficulty.

Our feeling is that the measurement of blood pressure by the Doppler technique described greatly enhances the anesthesiologist's monitoring capabilities. The method is simple, non-destructive, and extremely accurate. It is not intended to replace conventional methods, but rather to supplement them in specific instances such as those described. A commercial instrument similar to the units we have used is available at a reasonable cost.<sup>‡</sup> Complete circuitry diagrams and specifications of one of our units are included in a technical report recently published by Ware *et al.*<sup>5</sup>

#### REFERENCES

1. Satomura, S., and Kaneko, Z.: Ultrasonic Blood Rheograph. Third International Conference

<sup>‡</sup> Parks Electronics Laboratory, 419 S. W. First Ave., Beaverton, Oregon 97005.

- on Medical Elect., London, 1960, pp. 254-258.
2. Stegall, H. F., Rushmer, R. F., and Baker, D. W.: A transcutaneous ultrasonic blood-velocity meter, *J. Appl. Physiol.* 21: 707, 1966.
3. Ware, R. W.: New Approaches to the Indirect Measurement of Human Blood Pressure. Third National Biomedical Instrumentation Symposium (ISA BM-65), 1965.
4. Ware, R. W.: Doppler ultrasonic indirect blood pressure measurement. Proceedings of the Symposium on Objective Recording of Blood Pressure, p. 37. (Sponsored by the American Heart Association, USPHS, and the Chicago Heart Association, Chicago, 1966.)
5. Ware, R. W., Laenger, C. J., Heath, C. A., and Crosby, R. D.: Development of Indirect Blood Pressure Sensing Technique for Aerospace Vehicle and Simulator Use. Technical Report AMRL-TR-67-201. Wright-Patterson Air Force Base, Ohio, Aerospace Medical Research Laboratories, 1968.
6. Kemmerer, W. T., Ware, R. W., Stegall, H. F., and Evans, W. E.: Indirect measurement of human blood pressure by the Doppler ultrasonic technique, *Surg. Forum* 18: 163, 1967.
7. Stegall, H. F., Kardon, M. B., and Kemmerer, W. T.: Indirect measurement of arterial blood pressure by Doppler-shifted ultrasound, *J. Appl. Physiol.* (in press).

## Methylphenidate for the Treatment of Hiccups during Anesthesia

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Hiccups in a patient under anesthesia cause problems for both surgeon and anesthetist, since they disrupt the surgical field and may interfere with ventilation. Many methods have been proposed for treatment of hiccups, but none has been entirely satisfactory. Macris *et al.*<sup>1</sup> recently suggested giving 10-20 mg of methylphenidate (Ritalin®) intravenously,

which was found to stop hiccups within three minutes of the injection. In many cases hiccups stopped while the drug was being injected. Vasiloff *et al.*<sup>2</sup> had similar results with similar doses of the drug: hiccups in 12 of their 22 patients stopped during injection of the drug. Our initial experience was that the hiccups stopped before the drug could be mixed and injected. Therefore, we undertook a double-blind study using methylphenidate and a placebo to determine the drug's efficacy in the treatment of this condition.

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TABLE 1. Responses of Patients with Hiccups under Anesthesia to Methylphenidate and Saline Solution

	Methylphenidate	Saline Solution
Cessation of Hiccups (total no.)		
Yes	19	19
No	5	5
Cessation of Hiccups		
First injection	18	15
Second injection	1	4

\* The first two lines are the total numbers responding and not responding; the second two lines are the numbers responding on the first and second injections.

### METHOD

Our pharmacy prepared methylphenidate (10 mg/ml) and a placebo (physiologic saline solution) as unknowns in numbered vials of the same shape and labeling and distributed them randomly to all operating rooms. The contents of the vials were unknown to those involved in the study until it was completed. Staff and resident anesthesiologists were instructed to give 1 ml of the unknown solution intravenously when hiccups occurred, and to repeat the same volume from the same vial two minutes later if they persisted. No change in anesthetic technique or other drug therapy was initiated until the trial of therapy with the unknown was completed.

### RESULTS

During the study 51 cases of hiccups under anesthesia were treated with one or the other of the unknown solutions. Approximately 50 more patients developed the disorder, but it ended before treatment could be instituted.

The groups studied were evenly distributed, i.e., 24 patients received methylphenidate and 27, saline solution (table 1). Eighteen of those who received methylphenidate and 15 who received saline solution responded to the first injection of the unknown and hiccups stopped within three minutes. Five patients who did not respond to the first injection of the unknown responded to the second. Of this latter group, one received methylphenidate; the other four, saline solution. Thirteen patients

failed to respond to either the first or the second injection of unknown (table 1). Five of these patients received methylphenidate; the other eight, saline solution. No correlation could be found between anesthetic technique or surgical procedure and the response to injection of the unknown.

### DISCUSSION

Vasiloff *et al.*<sup>2</sup> postulated that hiccups during anesthesia result from a partially anesthetized inspiratory center which is continuously bombarded by stimuli from the surgical field. This, they felt, caused an abbreviated inspiration that was interpreted as hiccups. They further postulated that the action of methylphenidate was to shift the sensitivity of the center to a less depressed state and allow resumption of normal respiration.

While it is possible that some of the drug crossed into the central nervous system during the time course of their study, due to the high lipid solubility of the drug,<sup>3</sup> our results suggest that the amount of drug crossing into the central nervous system in less than three minutes had little effect on the hiccups, since saline solution was as effective as methylphenidate in relieving this disorder. Cessation of hiccups, therefore, must be due to some other factor, possibly a change in the stimulation causing them.

### SUMMARY

A double-blind study using methylphenidate and saline solution for the treatment of intraoperative hiccups is reported. Equal numbers of "cures" were found in the two groups. A discussion of the past literature is presented.

### REFERENCES

1. Macris, S. G., Macris, G. T., Concouri, A. N., and Karopiperis, S. N.: Intravenously methylphenidate for the treatment of singultus. *Anesth. Analg.* 42: 440, 1963.
2. Vasiloff, N., Cohen, D., and Dillan, J.: Effective treatment of hiccup with intravenous methylphenidate, *Canad. Anaesth. Soc. J.* 12: 306, 1965.
3. Bernhard, K., Bühler, U., and Bickel, H.: Zur biochemischen verhalten eines psychoanaleptikums, des phenyl-piperidyl-ensäure-methyl-ylesters, *Helv. Chemica Acta* 42: 802, 1959.