due to codeine. Caffeine alone in the doses used in this study was not significantly different from placebo. (Supported by a grant from Burroughs, Wellcome & Co., U. S. A., Inc.)

DISPLACEMENT OF RESPONSE CURVE IN MM. HG CARBON DIOXIDE TENSION

	Subject				Mean
	A	B	C	D	
Placebo	.65	2.25	1.4	−.75	.89
Morphine 10 mg.	6.35	15.9	9.05	7.5	9.7
Morphine 10 mg. + Caffeine 62.5 mg.	2.75	10.95	6.5	11.3	7.88
Morphine 10 mg. + Caffeine 125 mg.	3.9	7.1	4.25	5.7	5.24
Codeine 60 mg.	3.2	10.0	4.05	8.7	6.49
Codeine 60 mg. + Caffeine 62.5 mg.	1.35	9.3	5.7	7.35	5.93
Codeine 60 mg. + Caffeine 125 mg.	3.8	6.15	6.0	4.75	5.18
Caffeine 62.5 mg.	−.15	0	−.75	.15	−.19
Caffeine 125 mg.	−.6	2.8	0	−1.6	.15
Caffeine 250 mg.	−.25	2.5	2.8	−1.65	.85

Use of Intracarotid Arterial Procaine During Cranial Arteriography. WILLIAM F. BREHM, M.D., ARTHUR B. KING, M.D., JOHN B. COUGHLIN, M.D., AND JACK YOUNG, M.D., Departments of Anesthesiology and Neurosurgery of the Guthrie Clinic-Robert Packer Hospital, Sayre, Pennsylvania.

RADIOPAQUE contrast media injected into the carotid artery produces some degree of vasospasm, making visualization of cerebral vessels unsatisfactory. Attempts at prevention of spasm by the use of subcutaneous papaverine or by stellate block were unsatisfactory in our hands. To test the effect of intravascular procaine, which is known to release vasospasm, procaine was injected into the carotid arteries of 30 rabbits. We found that 15 mg./kg. could be injected without complications if the rabbits were protected with sleeping doses of pentobarbital. Following these preliminary observations a technique for injecting procaine into the carotid arteries of human patients has been evolved. The present report is on the use of the procedure in 100 patients during carotid cerebral aniography. Percutaneous carotid artery puncture was made through a local anesthetic skin wheal with the patient anesthetized with thiopental-nitrous oxide-oxygen. Ten cubic centimeters of 25 per cent Hypaque was then injected and the first of a stereopair of lateral radiographs was made. Two hundred milligrams of 1 per cent procaine was injected in about a 20-second period, and two minutes later a second radiograph was made with Hypaque.

Pulse and blood pressure remained unchanged in 73 patients and rose in 21 patients. Blood pressure decreased in six patients (the greatest decline was 40 mm. Hg). Sixty-eight patients showed no change in respiration to casual observation. Ten patients demonstrated hypopnea and 22 patients developed apnea within one and one-half minutes, lasting an average of one to three minutes. Respiration was easily assisted.

Ten patients demonstrated cortical irritation manifested by simple contralateral extremity spasticity to mild convulsive movements. The duration of the attacks was short and none was adjudged severe or harmful to the patient. All occurred in patients to whom less than 350 mg. of thiopental had been administered.

Dilatation of the retinal vessels was observed in all the 10 patients in which a retinal examination was made. Dilatation of the ipsilateral pupil occurred within 30 seconds from the start of the procaine injection when the needle was in position for Hypaque to enter the internal carotid artery. The dilated pupil test was correct for needle placement in 96 per cent of the cases. Shifting of the needle could explain three failures of the test and one patient had multiple arteriovenous fistulae.

Comparative evaluation of vessel size on the radiographs was difficult but in 46 patients larger vessels were observed on the second radiograph. In the other 54 cases, the two radiographs were essentially alike. The radiograph after procaine was never poorer than the first. Four patients with central embolism or thrombosis, or both, have been treated in similar manner with what appeared clinically to be better than usual recovery.

We conclude that procaine in 200 mg. doses can be injected into the carotid artery without serious consequences. Theoretically it should prevent or relieve vessel spasm and we believe it did this, but if it has no other value, it is a nearly perfect test for correct placement of the needle before radiopaque media are injected.

The Evaluation of a New and Inexpensive Carbon Dioxide Analyzer.

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The need for a simple clinical method for the measurement of alveolar carbon dioxide tension is obvious. Currently available methods have serious disadvantages (cost, need for repeated calibration) and are largely restricted to use in the research laboratory.

Recently we have had the opportunity of working with a new carbon dioxide analyzer, designed and built by the Dewey and Almy Chemical Company of Cambridge, Massachusetts. This instrument was designed to provide rapid, reasonably accurate measurement of the carbon dioxide concentrations of gas mixtures. It is a nonelectric, mechanical device and should be safe for use with flammable anesthetics. It is of simple design and easy to operate.

In principle a mechanically operated pump draws a 25 ml. sample of expired air through a tube of saturated ammonium sulfate, then forces the gas sample through a tube of soda lime. The ammonium sulfate brings the sample to approximately the same humidity as the soda lime. The soda lime then removes the carbon dioxide. Since there is no moisture exchange, the difference in pressure exerted by the sample before and after passing through the soda lime is a direct measurement of the carbon dioxide tension in the sample. Ammonium sulfate is important in reducing errors that would otherwise be contributed by moisture absorption or release by the soda lime. The ammonium sulfate will contribute moisture if the gas sample is dry and remove it if the gas sample is wetter than the soda lime.

The instrument has been calibrated with known carbon dioxide-oxygen mixtures analyzed by standard Haldane, and a linear response is obtained. The reproducibility is good and for routine use recalibration should not be necessary. With the simple precaution of preliminary washout of the machine to achieve a steady state, accuracy of $\pm$ 0.2 volume per cent has been achieved.

The presence of anesthetic gases increases the opportunity for error, but if precaution is taken to reach a steady state, the error does not appear greater than with carbon dioxide-oxygen mixtures.

The presence of ether introduces a special problem, for ether appears to be absorbed in considerable amounts onto soda lime, thus giving a false high reading; however, saturation is essentially complete after three to four samples. Thereafter, accuracy of carbon dioxide measurement in the presence of ether appears to be as good as with other anesthetics, provided ether levels remain reasonably constant.

Samples were obtained by a syringe technique (modified from Inkster and Reese) [Brit. J. Anaesth. **28**: 37, 1956]. A comparison of the alveolar carbon dioxide tension obtained in this manner and as calculated from arterial *p*H and carbon dioxide has shown close correlation (difference 2 to 6 mm. Hg) unless there is marked depression of respiration or in the presence of pulmonary pathology.

Our experiences with alveolar sampling suggest that reasonably accurate information can be obtained. The instrument may have its greatest value in checking the efficiency