

acid is formed in the kidney under the conditions of the experiment, they do not constitute evidence to the contrary. It remains for studies based upon a different experimental approach to demonstrate that in the dog, the kidney is concerned in the formation of citric acid from sodium malate administered intravenously. If the dog should prove to resemble the rat in this respect, the present study would indicate that the kidney is highly efficient, inasmuch as it removes the citric acid it has formed without returning a detectable amount to the systemic blood, even when one kidney is required to carry the entire burden (Dogs B and D) of synthesis and excretion.

The data might be interpreted as suggesting that citric acid may be formed elsewhere in the body. This point is supported by the work of Martensson¹¹ who worked with anesthetized fasting cats and found increases in citric acid in arterial blood over that in renal venous blood of magnitudes which may be significant. Furthermore, the gradual increase in the citric acid content of liver, blood and muscle after bilateral nephrectomy and injection of sodium chloride and sodium malate⁸ also supports this point. The fact that Orten and Smith⁸ state that "there *may* be an extra-renal source of citric acid" appears to have escaped the attention of Martius¹² who attributes to them the statement that citric acid originates only in the kidneys.

Summary. A comparison has been made of the citric acid content of renal venous blood with arterial (femoral) blood in dogs with an exteriorized kidney after the injection of d1-sodium malate. The venous blood was found to contain no more than or, perhaps, somewhat less citrate than arterial blood.

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Effect of Spinal Anesthesia on Intestinal Activity.

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Clinicians have long had the impression that spinal anesthesia causes increased intestinal contractions by release of the sympathetic inhibition of the intestines. This conception with the favorable re-

¹¹ Martensson, J., *Skand. Arch. Physiol.*, 1938, **88**, 303.

¹² Martius, C., *Angew. Chemie*, 1939, **52**, 223.

sults obtained in the treatment of megacolon and obstinate constipation by spinal anesthesia has been reviewed by Stabins, *et al.*¹ Markowitz and Campbell² noted the relief of experimental ileus following spinal anesthesia by directly observing the intestines after celiotomy or by observing changes in intestinal activity under the fluoroscope in animals under general anesthesia. Others³ have reported the relief of ileus by splanchnic anesthesia in dogs anesthetized with barbital or ether. A more direct approach was the experimental one by Domenech Alsina^{4, 5} whose work, however, was likewise performed on dogs under general anesthesia. Since different anesthetic agents were shown^{6, 7, 8} to have different effects upon intestinal contractions it was deemed desirable to study the effect of spinal anesthesia upon the normal, unmedicated animal, *i. e.*, animals without previous medication and without general anesthesia. Accordingly, experiments were conducted on dogs previously prepared with Thiry-Vella fistulas of the jejunum and ileum.

Six dogs weighing from 12 to 16 kg were used. Intestinal movements were recorded by inserting a balloon, connected to a water manometer as described by Jackson⁹ into the lumen of the proximal end of the Thiry-Vella loop. No morphine or other medication was administered prior to the spinal injection. One hundred mg of procaine dissolved in 2 cc of normal saline was injected intrathecally in 4 to 5 seconds at the fifth or sixth lumbar interspace. By this technic anesthesia invariably occurred extending up to the fourth or sixth thoracic segment and lasting about an hour.

All the animals showed uniform results consisting of a marked increase of intestinal contractions (Fig. 1). This effect was maintained for at least 30 minutes after sensory and motor somatic activity had returned.

The result is to be expected since the innervation to the intestinal musculature by the sympathetic nervous system has an inhibitory action. There are convincing evidences to show that the same increase of tone and peristalsis also occurs in clinical spinal anesthesia.

¹ Stabins, S. J., Morton, J. J., and Scott, W. J., *Am. J. Surg.*, 1935, **27**, 107.

² Markowitz, J., and Campbell, W. R., *Am. J. Physiol.*, 1927, **81**, 101.

³ Ochsner, A., Gage, I. M., and Cutting, R. A., *J. A. M. A.*, 1928, **90**, 1847.

⁴ Alsina, F. D., *Revista Med. de Barcelona*, 1927, **7**, 132.

⁵ Alsina, F. D., *Presse Med.*, 1929, **37**, 66.

⁶ Burstein, C. L., *PROC. SOC. EXP. BIOL. AND MED.*, 1938, **38**, 530.

⁷ Burstein, C. L., *PROC. SOC. EXP. BIOL. AND MED.*, 1938, **39**, 396.

⁸ Burstein, C. L., *PROC. SOC. EXP. BIOL. AND MED.*, 1939, **40**, 122.

⁹ Jackson, D. E., *Experimental Pharmacology*, C. V. Mosby, St. Louis, 1917, p. 278.

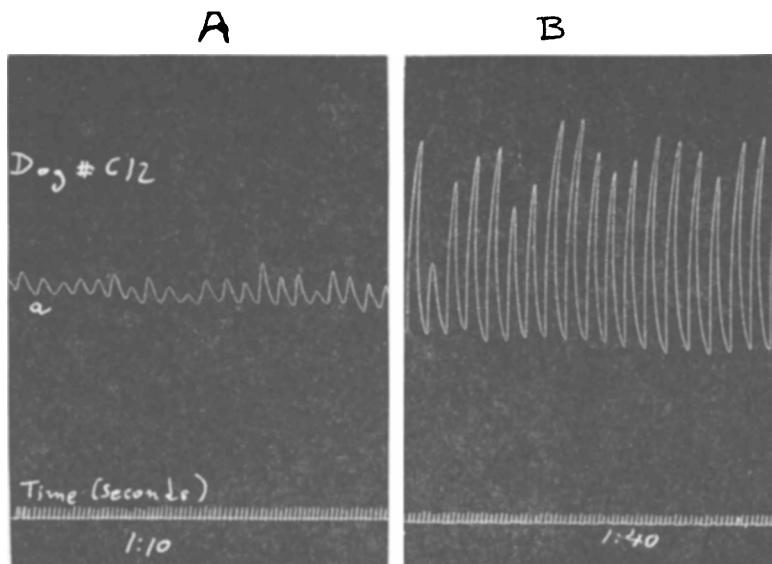


FIG. 1.

Effect of spinal anesthesia on intestinal activity of dog *in vivo*. Upper record (a), intestinal contractions. Time in second intervals. Spinal anesthesia was performed between A and B.

Surgeons have spoken of the "quiet belly" during this form of anesthesia due to the retraction of the abdominal contents. This increase in tone and peristalsis may lead to a rupture of a weakened segment of intestine, as actually happened in 2 cases of intestinal obstruction which were given spinal anesthesia at our clinic in Bellevue Hospital.

Conclusion. Spinal anesthesia causes an increase of intestinal contractions in the normal, unmedicated, dog.

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Uterine Effects from Single Treatments of Stilboestrol and Ethinyl-Estradiol in Monkeys.*

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This report deals with the bleeding interval of estrogen-withdrawal in monkeys, following a single administration of an estrogen. Diethyl-stilboestrol and ethinyl-estradiol were used.†

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† The stilboestrol used in this study was diethyl-stilboestrol, for which we are greatly indebted to Dr. J. A. Morrell of E. R. Squibb & Sons. The ethinyl-estradiol was furnished through the courtesy of Mr. Robert Mautner of the Ciba Corporation.