tem examination revealed no definite distention or discoloration of the bowel. Adequate collateral circulation had been quickly established to permit of return of the portal blood by other routes.

Experimental peritonitis was produced in 6 dogs by introducing liver, liver anaerobes or bile into the peritoneal cavity and by hepatic artery ligation. Death occurred in 13 to 48 hours (average 19 hours).

Results. X-ray films of the dogs with obstructed loops usually revealed some evidence of gas in the obstructed loop at the end of 8 or 10 hours, but the appearance of definite gaseous distention was an inconstant finding, occurring as early as 8 hours but in some cases not being definite after more than 100 hours. Fluid levels were demonstrable in some of the loops.

After mesenteric vein ligation, X-rays were negative in the 2 dogs dying early and in the animal that recovered gaseous distention was variable, being seen best at 23 hours, 72 hours, and 5 days.

Gaseous shadows were observed early (1 to 11.5 hrs.) in 4 cases of peritonitis but could not be satisfactorily demonstrated in 2 dogs dying at 13 and 20 hours.

From the experiments one may conclude that although X-ray evidence of gaseous distention is an early and valuable sign of simple intestinal obstruction it is distinctly of less value in strangulation obstruction or in stasis due to mesenteric vein occlusion. Gas shadows are also observed early as a rule in peritonitis.

5306

Technique of Spinal Anesthesia in the Dog.

HAROLD DVORAK AND M. H. MANSON. (Introduced by O. H. Wangensteen.)

From the Department of Surgery, University of Minnesota.

Lumbar puncture of the spinal canal of the dog has been practiced in the Laboratory of Experimental Surgery for the administration of regional anesthesia as well as during the course of other experiments. In the literature, however, it is generally conceded to be virtually impossible to perform successful lumbar puncture upon the dog.[1] We are describing the technique of the method in the hope that it may be of value to others. Out of 45 successive dogs upon which lumbar puncture has been attempted, 37 were suc-

[1] Ochsner, A., Gage, I. M., Cutting, R. A., *Arch. Surg.*, 1930, **20**, 802.

cessful; the failures were obtained in the earlier attempts when the technique was being elaborated.

The dog has 7 lumbar vertebrae. The spinous processes of these vertebrae in contrast to the human point cephalad. The vertebrae and their processes are closely united in the living animal, especially in the mid-line, and it is virtually impossible to pass a spinal puncture needle between them at this point, except between the last lumbar vertebra and the sacrum. Injection of anesthetics at this point does not ordinarily allow for diffusion to a level sufficiently high to induce true spinal anesthesia, and usually results only in sacral anesthesia. Laterally, however, there is a very definite interspinous aperture between the superior and inferior surfaces of any 2 adjacent lumbar vertebrae. Upon arching the spine of the animal, the aperture attains a diameter of about 2 to 3 mm., is about 2 to 3 mm. deep and connects directly with the dura. The axis of this canal in the sagittal plane is about 10 degrees with the frontal plane in the upper lumbar region, and about 45 degrees in the lower lumbar region. In the frontal plane, the axis of this canal is about 5 degrees with the sagittal plane.

In carrying out the procedure, morphine or some hypnotic such as sodium barbital, may be administered to make the animal lie more quietly. The dog is placed on his side with his hind legs tied closely to his fore legs, the head being tied closely to these.

In the performance of spinal puncture it is usually a good plan to aim the point and barrel of the needle in the direction of the spinal aperture, much as one shoots with a gun at a target. Because of the slight variations in the position and direction of this canal in the various levels of the lumbar spine, and the individual variations in different dogs, however, it has been found most convenient to follow closely the lateral surface of the spinous process down to the posterior arch; then with a slight probing motion the tip of the needle is directed downward, forward and medialward until it strikes the non-resisting tissues of the aperture. Spinal fluid is usually obtained at a distance of about 3 cm. from the tip of the spinous process.

The position of the needle in this aperture after trial puncture at post mortem has been carefully checked by numerous dissections of dogs' spines. The rate of flow of spinal fluid varies considerably in individual animals, ranging from a presentation of the fluid in the hilt of the needle, alternately receding with respirations, to an adequate flow of 20 to 25 drops a minute. As in spinal punctures on the human where no fluid is obtained, the flow may frequently

be started by slight manipulation of the needle, either rotatory or by slight withdrawal. A definite flow of spinal fluid was obtained in 34 instances of 37 successful punctures.

The injection of an anesthetic agent (novocaine) into the spinal canal was practiced in 16 of the 37 lumbar punctures, and was invariably successful, anesthesia to a high level being obtained. Two hundred milligrams of novocaine were used in large dogs, and 100 mg. in small dogs. Criteria for a high anesthesia were insensibility to pain to the intercostal angle (operations lasting two and a half hours, such as gastro-enterostomy and jejunal anastomosis, have been done), flaccid paralysis of the hind legs, relaxation of anal

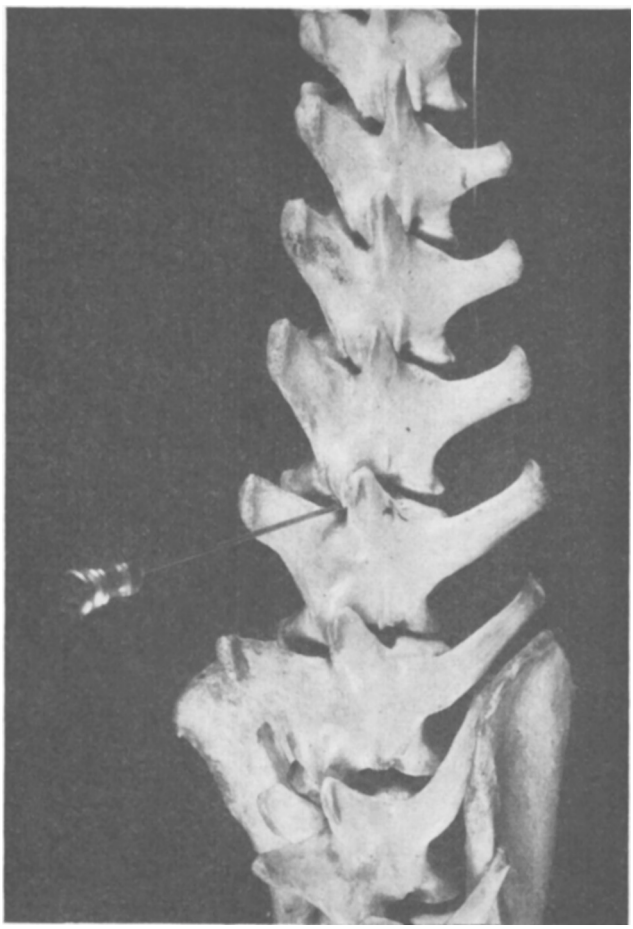

FIG. 1.

Lateral view of lumbar spine. Needle in space between 3-4 L vertebrae.

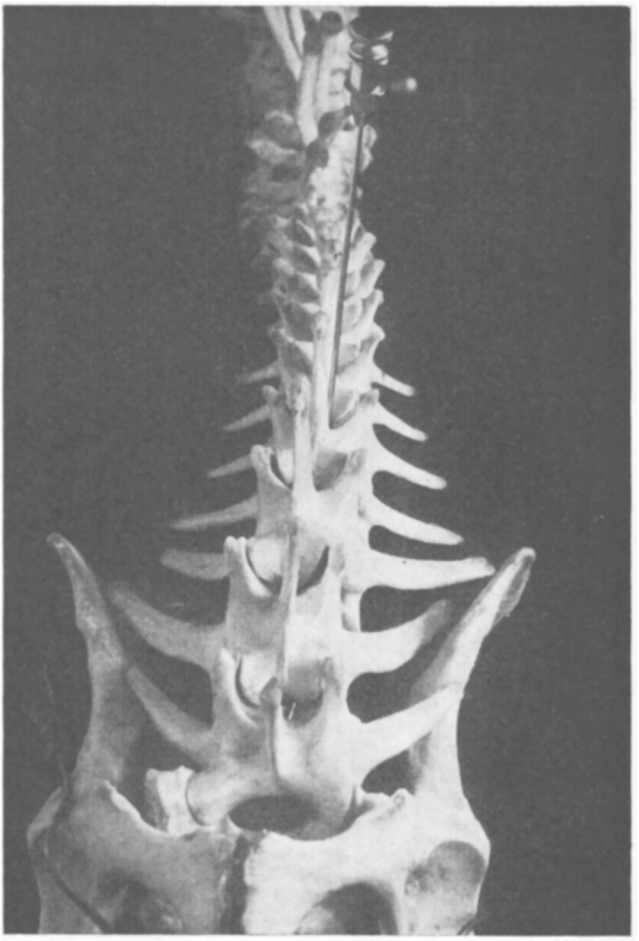

FIG. 2.
Spine from behind and above.

and urinary sphincters, increased intestinal tone, and characteristic immediate drop in blood pressure as evidenced by kymographic tracings.