

Concentration of ACTH in Cavernous Sinus and Peripheral Blood Collected from Unanesthetized Sheep.* (25587)

L. Z. MCFARLAND, M. T. CLEGG AND W. F. GANONG (Introduced by H. H. Cole)

*University of California, Depts. of Vet. Medicine and of Animal Husbandry, Davis, and
Dept. of Physiology, San Francisco*

Anatomical location of the pituitary and abrupt termination of its effluent veins into the cavernous sinus makes direct collection of venous blood from this gland impossible. Ganong and Hume(1) reasoned that since effluent veins of the pituitary emptied directly into the cavernous sinus in the dog, samples of blood from this site should contain high concentrations of pituitary hormones. They used a stereotaxic instrument to position a needle within the cavernous sinus and demonstrated that blood collected from this site contained a significantly higher concentration of ACTH than peripheral arterial blood. Sheep, another species in which pituitary veins empty into the cavernous sinus(2), would be an ideal experimental animal. Their docility permits easy manual restraint, and their large size is conducive to removal of a considerable volume of blood. This paper describes a simple method of puncturing the cavernous sinus in the unanesthetized sheep and presents evidence that concentration of ACTH is greater in cavernous sinus blood than in peripheral blood.

Methods. Vinylite corrosion casts of 4 sheep heads were examined to determine extent of the cavernous sinus and its connections. The cavernous sinus is a large, paired structure lying on the basisphenoid. An extensive rete mirabile cerebri is embedded within it. Effluent veins of the pituitary and ophthalmic veins enter the sinus. A small intercavernous sinus is located anteriorly and a large intercavernous sinus posteriorly. Large radicles pass from the cavernous sinus out through the foramen lacerum to connect with the internal maxillary vein of the systemic venous system. Small radicles connect with the basilar sinus, and no emissary veins are present. The cavernous sinus extends pos-

teriorly beyond the foramen ovale, which is very large in sheep. The large size of this foramen suggested an approach to the cavernous sinus from the exterior. More than 20 sheep were used to verify that the cavernous sinus could be punctured through this foramen and that blood could be collected. Sheep were manually restrained in either a standing or a lateral recumbent position. A 4 inch by 15 or 16 gauge hypodermic needle attached to 50 ml syringe was inserted through the skin in the parotid region approximately 2 inches below the external auditory meatus and just caudal to the posterior border of the ramus of the mandible (Fig. 1). The needle was gently inserted toward the opposite eye in an antero-dorsal direction. When the needle entered the foramen ovale, its penetration of the mandibular division of the trigeminal nerve caused the animal to struggle. After the needle had passed through the outer layer of the dura mater which covers the cavernous sinus, tissue resistance was no longer encountered and blood from the sinus entered the syringe. Four rams were used to verify that blood from this source contained a higher concentration of ACTH than from a peripheral source. To stimulate ACTH release, the rams were subjected for 1 minute to intermittent electrical shocks applied 5 minutes before collecting the blood. Fifty milliliters of blood from the cavernous sinus and from the recurrent tarsal vein were collected simultaneously. These samples were placed in heparinized tubes and centrifuged 5 minutes. The plasma was decanted into glass containers and frozen immediately on dry ice. Plasma ACTH concentrations were determined according to the method of Nelson and Hume(3).

The *results* (Table I) indicate that plasma samples from the cavernous sinus consistently show a higher concentration of ACTH than plasma samples from the peripheral venous source.

* This work supported in part by U.S.P.H.S. research grant C-3685 and by grant from Commonwealth Fund.

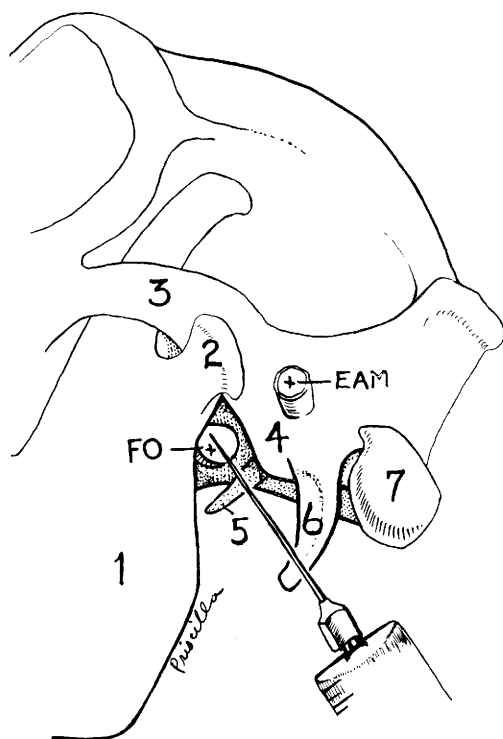


FIG. 1. Anatomical illustration of sheep skull showing site of puncturing the cavernous sinus (greater cornu of hyoid bone is removed). 1—ramus of mandible; 2—condyle of mandible; 3—zygomatic arch; 4—temporal bone; 5—muscular process; 6—paramastoid process; 7—occipital condyle; EAM—external auditory meatus, and FO—foramen ovale.

Concentration of ACTH ranged from 54 to 123 milliunits % in sinus plasma compared to 0.6 to 59 milliunits % in peripheral plasma. In any individual animal the difference between the 2 samples was greater than 2-fold. These results confirm those of Ganong and Hume(1) that pituitary ACTH is present in its highest concentration in cavernous sinus blood.

Some precautions in the use of this technic should be observed. Some dilution of cavernous sinus sample may occur if the rete mirabile cerebri is ruptured. Arterial contamination is indicated by increased redness of blood

TABLE I. Concentration of ACTH in Samples of Blood Withdrawn Simultaneously from Cavernous Sinus and from Recurrent Tarsal Vein in 4 Rams.

ACTH content, milliunits/100 ml plasma	
Cavernous sinus	Recurrent tarsal vein
54	0.6
60	14
78	34
123	59

entering the syringe. This seldom occurred. If the needle is inserted too far it may damage the pituitary or penetrate the diaphragm sellae and enter the brain. The proper depth is reached when blood freely enters the syringe. If the needle is directed too far ventral, it may damage the external maxillary vein or artery causing hemorrhage. This is not serious. Following removal of blood and release of animal, no ill-effects were observed in spite of repeated samplings and sampling from either side.

Thus far blood obtained from the cavernous sinus has been examined for ACTH concentration only. It is probable that high concentrations of other pituitary hormones are also present. Studies on concentration of gonadotrophins are now in progress.

Summary. A simple technic for puncturing the cavernous sinus of unanesthetized sheep through the foramen ovale has been described. Cavernous sinus plasma showed at least a 2-fold greater concentration of ACTH than peripheral plasma collected simultaneously from the recurrent tarsal vein.

The authors are indebted to Priscilla Tippet and to Angela Boryczka, Roy Shackelford, and Vina Sera for technical assistance.

1. Ganong, W. F., Hume, D. M., *Proc. Soc. Exp. Biol. and Med.*, 1956, v92, 621.

2. Daniel, P. M., Pritchard, M. M. L., *Quart. J. Exp. Physiol.*, 1957, v42, 237.

3. Nelson, D. H., Hume, D. M., *Endocrinology*, 1955, v57, 184.

Received January 4, 1960. P.S.E.B.M., 1960, v103.