

A NEW METHOD FOR MAMMALIAN DECEREBRATION.

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In the method to be described the brain stem is nearly encircled by a ligature passed about it through suitable openings made in the skull. Its free ends emerge through the roof of the mouth. When the ligature is drawn down tightly against the floor of the skull the brain stem is severed and the vessels at the base of the brain are compressed. The only special instrument required is a drill made from a steel rod, about 2 mm. in diameter and 8 cm. long, mounted in a suitable handle; the end of the rod is flattened to about 3 mm., the edges are ground sharp, and the flattened end is ground down, so that a sharp point, about 1 mm. long is left projecting at the center of the cutting edge, to prevent slipping when the drill is being forced through the bone. A hole, large enough to carry a stout ligature, is drilled through the flattened surface, near the tip.

Procedure for Decerebrating Cats.—The animal is anesthetized with chloroform or ether and both carotids are clamped or tied. Both parietal bones are exposed, and symmetrical trephine openings made, so that the center of each opening is about 1 cm. posterior to the most prominent part of the parietal eminence. The dura is split for a few millimeters on each side, and is separated carefully from the lateral wall of the skull. The drill is threaded with a stout linen ligature and passed directly through the brain substance and falx, low enough to avoid the sagittal sinus and far enough anterior to clear the tentorium. It emerges through the opposite opening in the skull, is freed of the ligature, and withdrawn.

One of the projecting ends of the ligature is again threaded into the drill. It is then introduced between the dura and lateral skull wall, and its point allowed to slip down along the tentorium, in contact with the parietal bone. At the base of the skull it comes to

rest in a natural fossa, and, with the point fixed as far out and as far back as possible, the drill is forced through the base of the skull. It is inclined slightly forward and inward, so that it emerges through the roof of the mouth, slightly anterior to the ramus of the lower jaw. The ligature is removed from the eye of the drill and the drill withdrawn.

The same procedure is repeated on the other side, leaving the ends of the ligature free in the mouth, with a loop around the brain stem, so that all that is necessary to produce the section is to draw the ligature down tightly and tie it in the mouth. The entire operation requires about 15 or 20 minutes, and can readily be performed by one person without assistance.

When done as described, the section passes between the two pairs of corpora quadrigemina, or through the anterior part of the posterior pair; the level of the section is determined by the point at which the ligature passes through the falx, the ligature sliding down along the tentorium when it is drawn tight. The only vessels damaged are the small arteries in the brain stem, and possibly the lateral and petrosal sinuses; hemorrhage is never severe enough to require compression of the vertebrae. The circle of Willis lies below and anterior to the ligature, and is not touched by drill or ligature. The drill penetrates the base of the skull at about the middle of the root of the zygoma, about 5 mm. anterior to the external auditory meatus, the carotid canal lying fully 1 cm. internal, and the foramina rotundum and ovale 5 mm. anterior and internal to this point. The external carotid and its branches, and the external jugular vein, lie, for the most part, external to this point, and should escape damage, though I have always clamped or tied the common carotid in the neck.

As the ligature is passed extradurally, it draws the dura downward and inward, forming a pad which effectually controls bleeding from the sinuses. As a rule, the most severe bleeding encountered in the entire operation comes from the diploe when the trephine openings are made.

Compared to the older methods of decerebration, this one presents certain advantages, particularly for the study of respiration.

In the first place, there is usually no change in breathing when the section is made, and respiration and blood pressure are almost invariably regular and quiet from the start, remaining so indefinitely, while the animal responds very actively to nervous or chemical stimuli to respiration. There is obviously less shock than when the other methods are used, and this, together with the absence of bleeding around the medulla, makes for a more uniformly successful preparation than I have been able to obtain by the "scoop method," or by the decerebrator. Out of some forty preparations, not one has been lost because of faulty decerebration, and there have never been any clots around the medulla on postmortem examination.

Secondly, the blood pressure is usually high, a sustained level of 200 mm. or more being the rule rather than the exception. A high pressure might be expected, because of the slighter degree of hemorrhage, but it is possible that these very high pressures may be the result of other factors, such as increased intracranial pressure, pressure on the pituitary, etc.

Thirdly, while the operation requires a little more time than does the "scoop method," and much more than when the decerebrator is used, no time is lost in waiting for the hemorrhage to cease, or in compression of the vertebrae, so that the total time required for an experiment is usually less than when the older methods are used.

It is advisable to have the animal under fairly deep anesthesia during the operation, because it is necessary to place the fingers well back in the animal's mouth, and if reflexes are present one may be bitten.

I have tried this method in several dogs, with good results. Hemorrhage was not conspicuous, and the animal survived the operation well. The procedure is the same as in the cat, excepting that, since the tentorium is not entirely bony in the dog, more caution is required in passing the drill downward. There is a fossa at the external end of the petrous bone in the dog, as in the cat, and the drill point finds this readily. There is more bleeding than is seen in the cat, but it stops promptly and spontaneously. The anatomical relations of the drill holes correspond closely to those described for the cat, and the method seems desirable for dogs, though I have not had enough experience with these animals to speak with confidence.

The method as above outlined has been employed in the experiments on the action of drugs on respiration described in the two following papers.¹ It has also been used in direct comparison with decerebration by the older methods, in students' experiments in the course in experimental pharmacology in this school. In both of these series of tests its advantages have been apparent.

¹Schmidt, C. F., and Harer, W. B., *J. Exp. Med.*, 1923, xxxvii, 47, 69.