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Posterior Fossa Approach: Microneurosurgical Training Model in Cadaveric Sheep

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ABSTRACT

We designed a microneurosurgical training model for residents in neurosurgery to practice the basic steps of the posterior fossa approach. The training material consisted of a fresh cadaveric sheep cranium. A four-step approach was designed to open the cisterna magna, access the fourth ventricle, identify the Sylvian aqueduct, and perform microdissection of the lower cranial nerves. We conclude that the use of the cadaveric sheep cranium represents a useful method to accustom residents of neurosurgery as it simulates well the steps of standard microneurosurgery for posterior fossa approach in infants and children.

KEY WORDS: Sheep cranium, surgical training, microneurosurgery, posterior fossa.

INTRODUCTION

Training in the laboratory to gain familiarity with the techniques of surgery and to acquire skills in handling microinstruments is fundamental. Residents of neurosurgery need many years to develop neurosurgical skills, and laboratory training models are essential for developing and refining surgical skills before the clinical application of neurosurgery (1). Several models have been developed to help neurosurgery residents, as well as neurosurgeons, to gain experience with neurosurgical and microsurgical procedures (1, 3, 4, 5, 6, 8). Our aim is to present the sheep cranium as a practical model that we use in our microneurosurgery laboratory for training residents on the basic microneurosurgical procedures used on infants and children with posterior fossa pathologies.

TECHNICAL CONSIDERATIONS

The model presented in this report is a part of the residency training program of the Department of Neurosurgery (3, 4). Trainees are second year residents. The material consists of a one-year-old sheep cranium with the scalp removed, obtained from a local butcher. The cranium is kept in a refrigerator at 4°C for six hours after it was obtained.

The cranium is placed vertically simulating a patient placed in the prone position with the head flexed in the neutral position. A moderate sized box (12x20x40 cm) with an opened hole (14 cm in diameter) in the upper surface that enables keeping the cranium vertically was designed for this study. In the final position, the nasal and buccal parts of the cranium were placed vertically through the hole to keep the occipital squama placed horizontally. The cranium is then secured with the self-retaining retractor (Budde® Halo Retractor, Codman, USA) system (Figure 1). A four-step approach is designed to simulate standard

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techniques for the basic posterior fossa approach via a median suboccipital craniectomy (Figure 2). The preparation of the procedure consists of performing a craniectomy, and opening the dura in Y-fashion (Figure 3). Then, the microneurosurgical steps begin under the operating microscope (OpMi 99 Zeiss Inc., Germany) with magnifications of X6 to X10. The first step consists of opening the arachnoid membrane of the cisterna magna (Figure 4) and access to the fourth ventricle by retracting the vermis upward using a self-retaining retractor (Figure 5). The second step consists of visualizing the floor of the fourth ventricle and identification of neural structures in and around the fourth ventricle, and the third step consists of visualization of the Sylvian aqueduct (Figure 6). The fourth step consists of performing fine microneurosurgical dissection training within the bundle of lower cranial nerves bilaterally around the brain stem (Figure 7) with the use of microsurgical instruments (bipolar tip, arachnoid knife, microscissors and the tip of a suction tube).

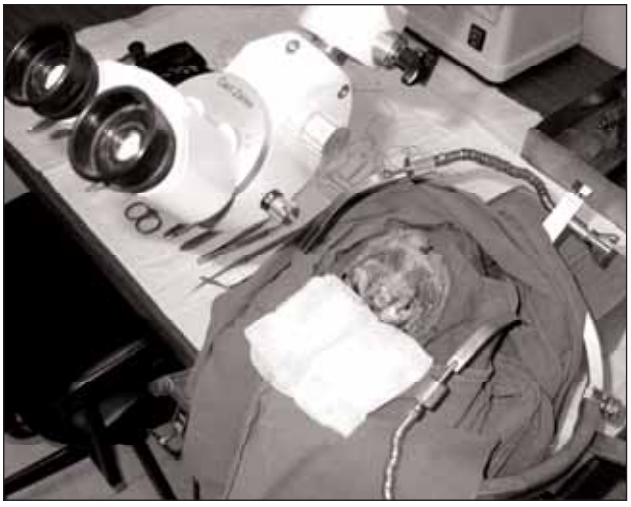

Figure 1: Preparation and stabilization of the sheep cranium training model with the use of a self-retaining retractor system.

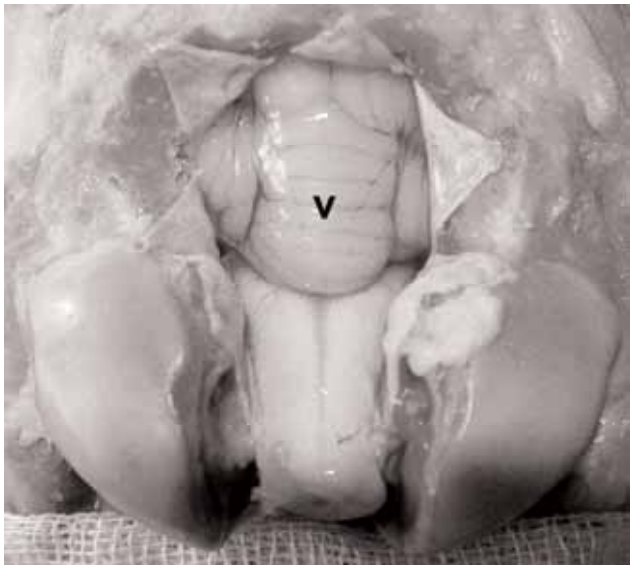

Figure 3: Median suboccipital craniectomy and opening of the dura in Y-fashion. Posterior fossa structures as they appear at the beginning of microsurgery. (v: vermis)

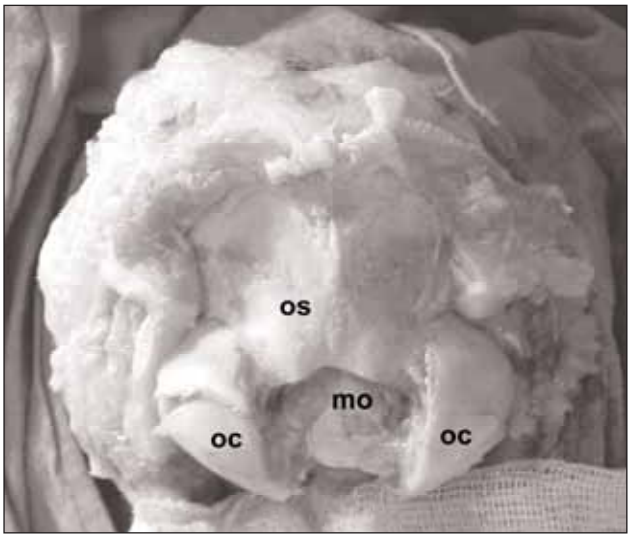

Figure 2: Vertical positioning of the cranium and appearance of the surgical field at the beginning of the procedure. (os: occipital squama; oc: occipital condyle; mo: medulla oblongata)

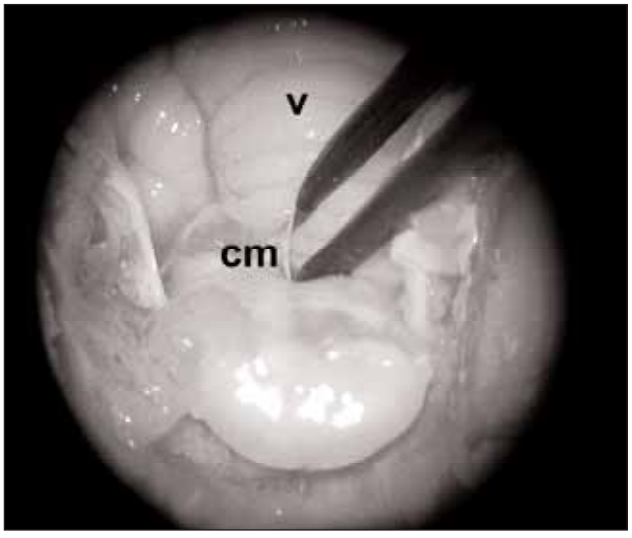

Figure 4: Microneurosurgical practice on the sheep posterior fossa specimen under the operating microscope. Opening the arachnoid membrane of the cisterna magna. (v: vermis; cm: cisterna magna)

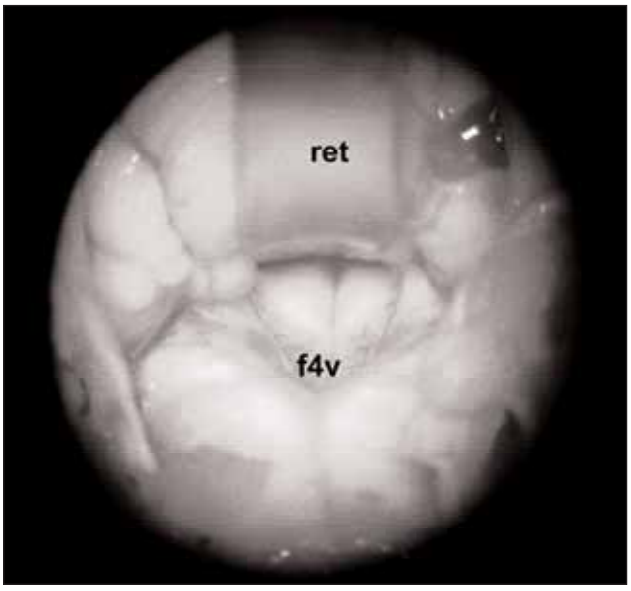

Figure 5: Access to the forth ventricle and visualization of the floor of the forth ventricle. (ret: retractor; f4v: floor of the 4th ventricle)

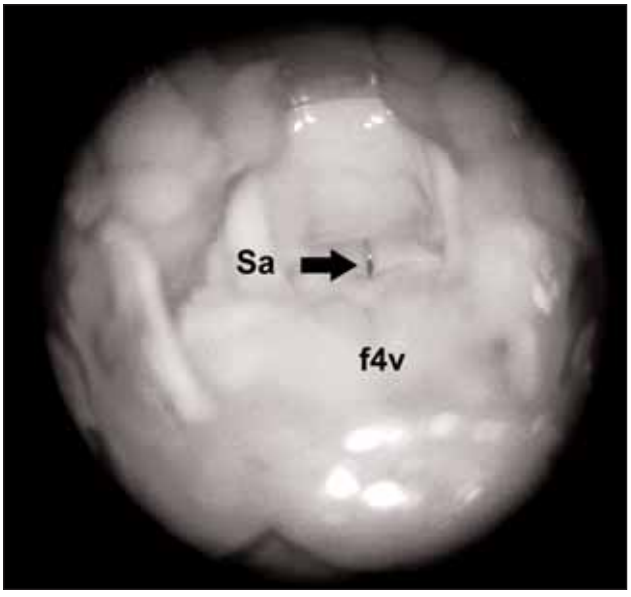

Figure 6: Visualization of the Sylvian aqueduct (Sa). (Note: This is not an anatomic study in the context of veterinary medicine. Definitions and localizations of actual animal anatomy are beyond the scope of this study)

DISCUSSION

Residents of neurosurgery need many years to develop the requisite neurosurgical skills, and laboratory training models are essential for developing and refining surgical skills before the clinical application of neurosurgery (1). Several models have been developed to help residents gain experience with neurosurgical and microsurgical

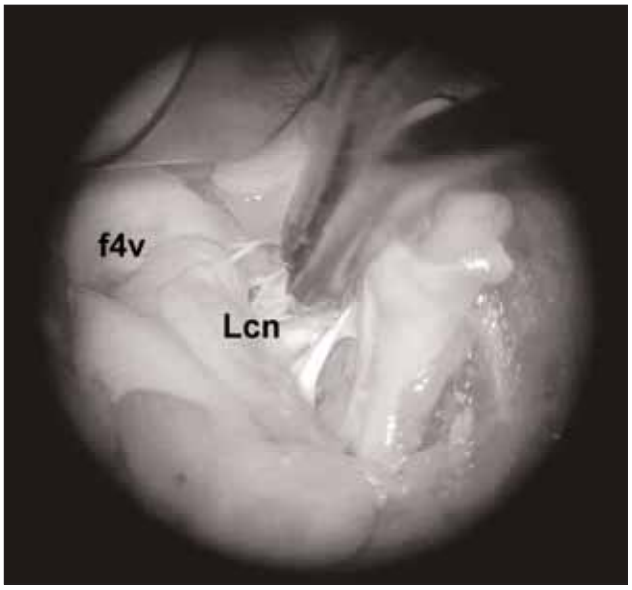

Figure 7: Performing fine microneurosurgical dissection training within the bundle of lower cranial nerves and vessels around the brain stem. (f4v: floor of the 4th ventricle; Lcn: lower cranial nerves IX-X-XI complex)

procedures; the majority use tissue of cadaveric or animal origin, or synthetic materials (1, 3, 4, 5, 6, 8).

The sheep cranium is an alternative to human cadavers. The practice on the cadaveric sheep cranium described here has several advantages: Junior residents can practice microsurgery on fresh organic tissue in the early residency period. They learn how to use microneurosurgical instruments (bipolar cauter, hook, suction tube, microscissors, etc.) under the operating microscope in a three dimensional surgical field simulating real-live surgery. The posterior fossa structures are quite similar to those of humans (7, 9). The material is very cheap and can be easily obtained. The model is simple and cost-effective. Sophisticated instrumentation and techniques, a specific facility for maintaining living animals and anesthesia are unnecessary. The use of cadaveric sheep material raises no ethical objections.

The most important deficiency in the model is the absence of bleeding. The reader should remember that the real-life surgery in infants and children carries a risk of bleeding. The medical risk of contracting animal diseases is low, but training on a sheep cranium is not theoretically exempt from a risk of transmissible spongiform encephalopathies (2). It is advised that the specimen should be provided from a known source, and from animals under veterinary control. All sterilization measures should

certainly be absolutely rigorous. The cadaveric sheep model is intended for laboratory training for residents of neurosurgery to gain familiarity with posterior fossa surgery. However, training on sheep cadavers should not be substituted for other training, especially that on live animal models; it should serve only as a complementary microneurosurgery training model for beginners.

In conclusion, this biological model of a fresh cadaveric sheep cranium represents a fairly useful method to accustom the residents of neurosurgery to the performance of basic steps in standard posterior fossa surgery, simulating real-life posterior fossa exposure performed on infants and children.

REFERENCES

1. Aboud E, Al-Mefty O, Yasargil MG: New laboratory model for neurosurgical training that simulates live surgery. J Neurosurg 97; 1367-1372, 2002
2. Griest EP: Transmissible spongiform encephalopathy risk assessment: the UK experience. Risk Anal 25; 519-532, 2005
3. Hiçdönmez T, Hamamcıoğlu MK, Tiryaki M, Çukur Z, Çobanoğlu S: Microneurosurgical training model in fresh cadaveric cow brain: a laboratory study simulating the approach to the circle of Willis. Surg Neurol doi:10.1016/j.surneu.2005.09.027, 2005
4. Hiçdönmez T, Hamamcıoğlu MK, Parsak T, Çukur Z, Çobanoğlu S: A laboratory training model for interhemispheric-transcallosal approach to the lateral ventricle. Neurosurg Rev DOI 10.1007/s10143-005-0014-4, 2005
5. Hino A: Training in microvascular surgery using a chicken wing artery. Neurosurgery 52; 1495-1498, 2003
6. Kalayci M, Cagavi F, Gul S, Cagavi Z, Acikgoz B: A training model for lumbar discectomy. J Clin Neurosci 12; 673-675, 2005
7. Popesko P: Atlas der topographischen Anatomie der Haustiere. Band I: Kopf und Hals, Stuttgart: Ferdinand Enke, 1989: 44-45
8. Reid JE, Maekin JR, Robins SP, Skakle JW, Hukins DW: Sheep lumbar intervertebral discs as model for human disc. Clin Biomech 17; 312-314, 2002
9. Rhoton AL: Cerebellum and forth ventricle. Neurosurgery 47(supp); 7-27, 2000