Sheep

The brain of sheep has primarily been used in neuroscience as an animal model because of its similarity to the human brain, in particular, if compared to othermodels such as the lissencephalic rodent brain. Their brain size also makes sheep an ideal model for the development of neurosurgical techniques using conventional clinical CT/MRI scanners, and stereotactic systems for neurosurgery.

Methods: In this study, they present the design and validation of a new CT/MRI compatible head frame for the ovine model and software, with its assessment under two real clinical scenarios.

Results: Ex-vivo and in-vivo trial results report an average linear displacement of the ovine head frame during conventional surgical procedures of 0.81mm for ex-Vivo trials and 0.68mm for in-vivo tests, respectively.

These trial results demonstrate the robustness of the head frame system and its suitability to be employed within a real clinical setting [1)].

In the previous series of fetal sheep experiments, Meuli et al. demonstrated that midgestational exposure of the normal spinal cord to the amniotic space leads to a myelomeningocele (MMC) at birth that closely resembles human MMC phenotypes in terms of morphology and functional deficit.

A study tested whether delayed in utero repair of such evolving experimental MMC lesions spares neurological function. In 12 sheep fetuses, a spina bifida-type lesion with exposure of the lumbar spinal cord was created at 75 days' gestation (full-term, 150 days). Four weeks later, the developing MMC lesions were repaired in utero for seven fetuses (five fetuses died before this time). Of those that had repaired, three were delivered near term by cesarean section, and four died in utero or were aborted. All survivors had healed skin wounds and near-normal neurological function. Despite mild paraparesis, they were able to stand, walk, and perform demanding motor tests. The sensory function of the hindlimbs was present clinically and confirmed electrophysiologically. No signs of incontinence were detected. Histologically, the exposed and then covered spinal cord showed significant deformation, but the anatomic hallmarks, as well as the cytoarchitecture of the spinal cord, essentially were preserved. These findings show that timely in utero repair of developing experimental MMC stops the otherwise ongoing process of spinal cord destruction and “rescues” neurological function by the time of birth. Because there is evidence that similar secondary damage to the exposed neural tissue also occurs in human MMC, Meuli et al. propose that in utero repair of selected human fetuses might reduce the neurological disaster commonly encountered after birth [2)].

1)
Trovatelli M, Brizzola S, Zani DD, Castellano A, Mangili P, Riva M, Woolley M, Johnson D, Rodriguez Y Baena F, Bello L, Falini A, Secoli R. Development and in-vivo Assessment of a Novel MRI-Compatible Headframe System for the Ovine Animal Model. Int J Med Robot. 2021 Apr 4. doi: 10.1002/rcs.2257. Epub ahead of print. PMID: 33817973.
2)
Meuli M, Meuli-Simmen C, Yingling CD, Hutchins GM, Timmel GB, Harrison MR, Adzick NS. In utero repair of experimental myelomeningocele saves neurological function at birth. J Pediatr Surg. 1996 Mar;31(3):397-402. PubMed PMID: 8708911.