Video Article

Anterior Cervical Discectomy and Fusion in the Ovine Model

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Abstract

Anterior cervical discectomy and fusion (ACDF) is the most common surgical operation for cervical radiculopathy and/or myelopathy in patients who have failed conservative treatment[1,5]. Since the operation was first described by Cloward[2] and Smith and Robinson[6] in 1958, a variety refinements in technique, graft material and implants have been made[3]. In particular, there is a need for safe osteoinductive agents that could benefit selected patients. The ovine model has been shown to have anatomical, biomechanical, bone density and radiological properties that are similar to the human counterpart, the most similar level being C3/4[4]. It is therefore an ideal model in which preclinical studies can be performed. In particular this methodology may be useful to researchers interested in evaluating different devices and biologics, including stem cells, for potential application in human spinal surgery.

Video Link

The video component of this article can be found at http://www.jove.com/video/1548/

Protocol

1. The sheep is fasted for 24 hours but allowed water ad libitum
2. The sheep is weighed.
3. Anaestheisa is induced by intravenous injection of thiopentone (20mg/kg).
4. Prophylactic intravenous antibiotics may be given.
5. Endotracheal intubation is performed using a sized 7 to 9 cuffed endotracheal tube.
6. Anaesthesia is maintainted with isoflurane, 1–3%, in 100% oxygen at a flow rate of 2L per minute.
7. Observations are made and the level of anaesthesia monitored continuously.
8. The surgical tools needed for this operation include: Toothed forceps, non toothed forceps, Metzenbaum scissors, Mayo scissors, needle holders, scalpel handle (long and short), Kerrison rongeurs, pituitary rongeurs, pneumatic surgical drill, drill bits and guards, nerve hooks (blunt and micro hook), elevator (ie, Watson Cheyne), insulated mono polar and bipolar electrosurgical forceps, vertebral body distractor (ie 16mm Caspar pins), distraction pin drill and drill sleeve, 2-0, and 3-0 angled curettes, Size 7 and 10 French sucker and suction tubing,

   Langenback retractors and self-retaining cervical retractors.
9. The neck region is shaved and washed with a betadine detergent solution.
10. The animal is then placed in the supine position onto the operating table and the neck gently extended.
11. The skin is marked with a needle and an x-ray is taken to confirm the C3/4 level.
12. The neck is then prepped using alcoholic chlorhexidine, alcoholic iodine and 70% ethanol in water.
13. A fenestrated square drape is used for the surgical site and a large square drape for the overhead table.
14. An operating microscope, or Loupe magnification and headlight, are used for the surgical procedure.
15. The incision is made using a scalpel at the site previously identified using the x-ray
16. Next, dissection through the investing layers is performed using scissors and a plane developed medial to the carotid sheath and lateral to the trachea and oesophagus.
17. Haemostasis is maintained through the procedure using diathermy
18. Once the vertebral column is located, the midline should be palpated and care should be taken to ensure that retraction is medial to the carotid artery and lateral to trachea and oesophagus.
19. A bayoneted needle is then inserted into the disc (this prevents inadvertent advancement which could risk damaging the spinal cord). A square drape is used to cover the surgical site. Before an intraoperative xray is taken to confirm the C3/4 disc level.
20. Casper distraction pins are then inserted in C3 and C4 respectively.
21. The disc is incised with a 15-scalpel blade.
22. The distractor is then inserted and the disc space gently distracted apart.
23. A discectomy is then performed using rongeurs and Kerrison rongeurs. A drill and curettes may also be of assistance.

24. The endplates are then prepared using the drill and curettes until bleeding bone visualized.
25. The posterior longitudinal ligament may be opened at this point, depending on experimental design. A blunt hook and 1mm Kerrison are best used for this procedure.
26. The wound is then irrigated with normal saline, prior to insertion of the interbody cage or test material.
27. The distraction is relaxed ad the device checked to ensure that it is securely in place.
28. The distraction pins are then removed and bone wax may be inserted to achieve haemostasis in the bone holes.
29. The longus coli muscle is closed with Vicryl. Layered closure is then performed, preferably with a subcuticular suture to avoid the need for suture removal.
30. Xylocaine is infiltrated around the surgical site
31. The anaestheitc gas is switched off and, when spontaneous breathing occurs and signs of swallowing are evident, the endotracheal tube is removed.
32. The animal is then allowed to recover in a metabolic cage under constant observation.
33. It is important that the animal is positioned upright with legs tucked under it, to prevent regurgitation.
34. Once the animal is standing (usually within 1 hour) food and water may be reintroduced.
35. Close monitored is performed for 24 hours and continued for 1 week.
36. Analgesia is maintained with a Fentanyl patch for 3 days following the operation.

Discussion

There are some sources of variability to consider while planning and performing anterior cervical discectomy and fusion. Therefore, for consistency of the model, the animals should be of the same age and breed. We prefer two year old, crossbred Leicester Merino sheep. If performed correctly, there will be minimal complications such as bleeding, infection, or mortality. Bleeding should be controlled throughout the procedure and haemosatsis checked before closing. Prophylactic antiobiotics are given at induction to minimse infection risk. Advice and help from the Clinical Veterinarians is invaluable and should be sought early. The procedure is generally well tolerated.

Monitoring of progression of fusion can be performed with regular x-rays.

Conclusion

In conclusion, we have demonstrated techniques and hardware and a simple and reproducible method for studying novel therapies for anterior cervical discectomy and fusion.

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References

1. Angevine, PD., Arons, RR., McCormick, PC. National and regional rates and variation of cervical discectomy with and without anterior fusion, 1990-1999. **Spine, 28,** 931-939. discussion 940, (2003).
2. Cloward, RB. The anterior approach for removal of ruptured cervical disks. **J Neurosurg, 15,** 602-617, (1958).
3. Jacobs, WC., Anderson, PG., Limbeek, J., Willems, PC., Pavlov, P. Single or double-level anterior interbody fusion techniques for cervical degenerative disc disease. **Cochrane Database Syst Rev,** CD004958, (2004).
4. Kandziora, F., Pflugmacher, R., Scholz, M., Schnake, K., Lucke, M., Schröder, R., et al: Comparison between sheep and human cervical spines: an anatomic, radiographic, bone mineral density, and biomechanical study. **Spine 26,** 1028-1037, (2001).
5. Patil, PG., Turner, DA., Pietrobon, R. National trends in surgical procedures for degenerative cervical spine disease: 1990-2000. **Neurosurgery, 57,** 753-758. discussion 753-758, (2005).
6. Smith, GW., Robinson, RA. The treatment of certain cervical-spine disorders by anterior removal of the intervertebral disc and interbody fusion. **J Bone Joint Surg Am, 40-A,** 607-624, (1958).

