Assessment of spinal cord blood flow and function in sheep following antero-lateral cervical interbody fusion in animals with and without spinal cord injuries

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1. SUMMARY OF FINDINGS

The early management of cervical fractures and fracture-dislocations with or without neurological deficit has been the subject of considerable controversy for many years. Some clinicians advocate closed reduction and early surgical stabilisation, while others believe closed reduction followed by skeletal traction and postural nursing gives the patient the best chance of recovery.

Not only is there controversy related to the indications for operative intervention in these injuries, but also controversy in relation to the operative approach that should be used.

This study set out to evaluate the effect of an anterior surgical approach and antero-lateral inter-body fusion of the cervical spine on spinal cord blood flow and electrical function, using a sheep model.

The anatomy of the cervical spine and spinal cord of the sheep was studied by macro and micro-dissection, and vascular casting with both latex and methyl-methacrylate. The findings of this study were then compared with the anatomy of the spinal circulation in man. This comparison indicated the sheep was suitable to be used as a model of spinal cord injury.

The effect of an anterior approach and antero-lateral cervical fusion was evaluated using three groups of sheep. The first group was used to study the effect of surgery on the intact spinal cord. Spinal cord blood flow was monitored before, immediately after, and one hour after the surgery. The electrical function of the spinal cord was

monitored continuously using motor and sensory evoked potentials and recorded every fifteen minutes.

There was no difference in either the spinal cord blood flow or electrical function immediately after, or one hour after completion of the surgery when compared to the base line measurements. This result did not support the supposition that anterior exposure of the vertebral column, and antero-lateral cervical fusion adversely affected spinal cord blood flow or function.

The presence of a spinal cord injury may alter the response or sensitivity of the cord to fluctuations in its local environment. In the second and third groups of sheep the effect of an antero-lateral cervical fusion was evaluated in the presence of an incomplete spinal cord injury. Both groups were given a spinal cord injury and the third group went on to have an antero-lateral cervical fusion.

Twelve sheep were used in this part of the study and the incomplete spinal cord injury was inflicted by the instantaneous inflation of a Fogarty balloon catheter in the extradural space at the level of the C4/5 inter-vertebral disc. Half of these sheep went on to have an antero-lateral cervical fusion. The electrical function of the spinal cord was monitored every fifteen minutes by both motor and sensory evoked potentials, as for the first group of sheep. The spinal cord blood flow measurements were made four times; once the sheep were physiologically stable as a base-line. Immediately following inflation of the balloon in the extradural space. Fifteen minutes after deflation of the balloon in group given a cord injury and not proceeding to cervical fusion or immediately after completion of the surgery in the remaining sheep (the surgery was usually completed

within 15 minutes of deflating the balloon). Final measurements were made one hour after the third blood flow measurement in both groups.

The spinal cord injury had a marked, and significant effect on both the spinal cord blood flow and electrical function in all twelve sheep. The spinal cord blood flow at the level of the injury decreased by more than 50% as did the amplitude of the evoked potential. The latencies of the evoked potentials also increased significantly (by more than 10%) in all sheep. Release of the balloon resulted in a reactive hyperaemia which was evident in all segments of the cervical spinal cord studied. This hyperaemia was most marked at the level of the spinal cord injury, and had nearly returned to the baseline levels by the time of the final blood flow measurement.

Similarly the sensory evoked potential returned to near pre-injury levels following deflation of the balloon. The motor evoked potential response which became unrecordable at the instant the injury was produced did not recover prior to completion of the study in any of the twelve animals.

Analysis of the results failed to demonstrate a significant difference between the two groups in the degree of recovery of spinal cord blood flow or electrical function that could be related to the antero-lateral cervical fusion (ANOVAR).

It is accepted that the shortcomings of an experimental spinal cord injury model are numerous. An experimental spinal cord injury will not have the mechanical instability and associated patho-physiological changes that are a feature of these injuries clinically. However every effort was made to establish that the model was

anatomically valid to assess the hypothesis. The inability in this study to observe the neurological function and recovery of the animals, and the limited time and facilities available to observe the anaesthetised sheep may have reduced the opportunity to demonstrate a difference between the groups. It is unlikely however that the function of either group would have been modified by extending the period of observation.

The hypothesis that anterior stabilisation of the cervical spine adversely affects spinal cord blood flow and function could not be supported by the results of this study.