Review of Surgical Treatment of Triple Level Cervical Cord Compression (12 Cases)

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Twelve horses with triple-level cervical spinal-cord compression that had undergone triple-level anterior interbody fusion were split into three treatment groups based on the implant used for the spinal-fusion surgery. The groups consisted of the heterologus bone graft (group 1), the stainless-steel basket (SSB, also known as the Bagby Basket; group 2), and the Kerf Cleaning Cylinder (also known as the Seattle Slew implant; group 3). All patients had pre-operative neurological and myelographic examinations performed by veterinarians. The owners were contacted to determine long-term outcome and general use of each patient. All survivors (92%) improved at least one neurological grade, and 88% improved two neurological grades or more. All horses had decreased range of lateral cervical motion post-operatively. Authors’ addresses: San Luis Rey Equine Hospital, 4211 Holly Lane, Bonsall, CA 92003 (Grant, Huggons); 105 West 8th Avenue, Suite 454, Spokane, WA 99204 (Bagby); Rood and Riddle Equine Hospital, PO Box 12070, Lexington, KY 40511 (Reed); and Department of Anatomy, The Ohio State University, Columbus, OH, 43210 (Robertson); e-mail: grant@slreh.com. © 2007 AAEP. *Presenting author.

1. Introduction

The surgical treatment of equine cervical spinal-cord compression was first described in 1979.¹ Since that time, there have been reports on the improvements in diagnostic procedures,²,³ surgical technique,⁴,⁵ and results.⁶,⁷ A conservative estimate has been made that over 1000 horses have undergone this procedure collectively. The majority of patients have had treatment for either single- or double-level spinal cord compression at C3/C4, C4/C5, and C5/C6. The next most common location is the stenotic lesions at C6/C7. Although a number of ataxic patients have had myelograms that show triple level spinal cord compression, there has only been four reports on successful outcomes from the surgical treatment of triple level spinal cord compression.⁷–⁹ There is currently a reference that does not recommend the procedure based on the results of two cases.¹⁰ The purpose of this review is to provide the clinical signalment and outcomes of 12 horses to allow veterinarians to make an informed decision on their recommendations concerning triple level spinal cord compression.

2. Materials and Methods

All patients had pre-operative neurological examinations, cervical radiographs, and myelograms. Neurological examination revealed moderate to marked ataxia consistent with cervical spinal cord compression. One author (BG) assessed the post-
operative neurological grade in all cases except patient 2 (deceased), patient 6, and patient 7 (both assessed by SMR and JTR). The myelograms all showed compression of the dorsal and ventral dye columns in the flexed position at C3/C4, C4/C5, and C5/C6, except for patients 5 and 11. Patient 5 had compression of both dye columns at C3/C4 and C5/C6, but C4/C5 was fused inadvertently with C3/C4. When the post-operative radiographs showed the misplacement, a second surgery was performed to fuse C5/C6. Patient 11 showed compression at C3/C4, C4/C5, and C6/C7.

3. Surgical Technique

All horses were pre-medicated with procaine penicillin (22,000 IU/kg, IM), gentamicin (6.6 mg/kg, IV), and a non-steroidal anti-inflammatory (phenylbutazone, 4.4 mg/kg, IV or flunixin meglumine, 1.1 mg/kg, IV). The surgical procedure was usually performed at least 4 days after the myelogram. The surgical techniques used for group 1, group 2, and group 3 have previously been described. When performing triple level fusions, the authors’ preference is to start at the most anterior level and proceed caudally unless one level is significantly more compressed than the others. In that case, the most severe level is the first level fused, because anesthetic problems may abort the completion of all three levels. After each implant and bone graft is in place, the longus colli muscle is reapprised using a double level closure with a horizontal mattress pattern followed by oversewing with a simple continuous layer. This step reduces any post-operative hematoma formation. The procedure is then repeated on the next level.

Patients 1 and 2 had a frozen iliac allograft, patients 3–7 had the original stainless-steel basket (SSB), and patients 8–12 had a Kerf Cleaning Cylinder (KCC, also known as the Seattle Slew implant). Patient 9 had a pediatric-sized, 16-mm KCC. The procedure was performed on all patients by the one author (BG) except patients 2, 6, and 7 and the C6/C7 level on patient 10 (performed by SMR and JTR). Patients 6 and 7 were operated on at The Ohio State University. The operating time for all surgeries lasted between 90 and 120 min (except patient #2).

All patients received post-operative antibiotics for 3 days and non-steroidal anti-inflammatories for ≥2 wk. Post-operative radiographs were obtained 3–5 days after surgery. Patients were confined to stalls for 60 days; at that time, the radiographs were repeated, and a neurological exam was performed to determine if exercise could be safely increased. At 90 days, all patients (except patient 2) could be placed into small paddocks. Significant neurological improvement in the patients was not noted until 120 days after surgery.

![Fig. 1. Four-year post-operative myelogram of patient 8 showing the normal myelogram of all three fused areas (A) and the joints anterior (B) and posterior (C) to the fusions.](image)
Table 1. Signalment, Neurological Assessment, Outcome, and Complications of 12 Patients Having Triple Level Cervical Interbody Fusions.

<table>
<thead>
<tr>
<th>Patient Number</th>
<th>Breed</th>
<th>Age at Time of Surgery (yr)</th>
<th>Sex</th>
<th>Surgical Site (Cervical Vertebrae)</th>
<th>Type of Implant and Group Number</th>
<th>Pre-operative Neurologic Grade</th>
<th>Post-operative Neurologic Grade</th>
<th>Use After Surgery</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tb</td>
<td>1</td>
<td>M</td>
<td>3/4, 4/5, 5/6</td>
<td>Frozen allograft (1)</td>
<td>3/5</td>
<td>&lt;1</td>
<td>Raced, won, sire</td>
<td>Stiff neck</td>
</tr>
<tr>
<td>2</td>
<td>Tb</td>
<td>1</td>
<td>M</td>
<td>3/4, 4/5, 5/6</td>
<td>Frozen allograft (1)</td>
<td>3/5</td>
<td>Euthanized</td>
<td>Deceased</td>
<td>Complete dehiscence</td>
</tr>
<tr>
<td>3</td>
<td>Tb</td>
<td>1</td>
<td>M</td>
<td>3/4, 4/5, 5/6</td>
<td>SSB (2)</td>
<td>3/5</td>
<td>1/5</td>
<td>Sire</td>
<td>Pain in cervical area for 1 yr</td>
</tr>
<tr>
<td>4</td>
<td>QH</td>
<td>1</td>
<td>M (c)</td>
<td>3/4, 4/5, 5/6</td>
<td>SSB (2)</td>
<td>3/5</td>
<td>1/5</td>
<td>Pasture</td>
<td>Euthanized 2 yr after surgery</td>
</tr>
<tr>
<td>5</td>
<td>QH</td>
<td>1</td>
<td>M (c)</td>
<td>3/4, 4/5, 5/6</td>
<td>SSB (2)</td>
<td>3/5</td>
<td>1/5</td>
<td>Raced and won a stake</td>
<td>Stiff neck</td>
</tr>
<tr>
<td>6</td>
<td>ASB</td>
<td>1</td>
<td>M</td>
<td>3/4, 4/5, 5/6</td>
<td>SSB (2)</td>
<td>3/5</td>
<td>2/5</td>
<td>Teaser stallion for 5 years</td>
<td>Unable to be an athlete</td>
</tr>
<tr>
<td>7</td>
<td>Tb</td>
<td>1</td>
<td>M (c)</td>
<td>3/4, 4/5, 6/7</td>
<td>SSB (2)</td>
<td>3/5</td>
<td>2/5</td>
<td>Trained did not race</td>
<td>Had two sites operated and after 1 yr had the third site</td>
</tr>
<tr>
<td>8</td>
<td>TW</td>
<td>4</td>
<td>M (c)</td>
<td>3/4, 4/5, 5/6</td>
<td>Seattle Slew (3)</td>
<td>3/5</td>
<td>1/5</td>
<td>Pleasure</td>
<td>Stiff neck</td>
</tr>
<tr>
<td>9</td>
<td>MFT</td>
<td>1</td>
<td>M (c)</td>
<td>3/4, 4/5, 5/6</td>
<td>Seattle Slew (small) (3)</td>
<td>3/5</td>
<td>1/5</td>
<td>Entering show training</td>
<td>Stiff neck</td>
</tr>
<tr>
<td>10</td>
<td>WB</td>
<td>2</td>
<td>M (c)</td>
<td>3/4, 4/5, 5/6</td>
<td>Seattle Slew (3)</td>
<td>3/5</td>
<td>1/5</td>
<td>Pleasure</td>
<td>Mild deficits with sharp turns</td>
</tr>
<tr>
<td>11</td>
<td>Arab</td>
<td>6</td>
<td>M (c)</td>
<td>3/4, 4/5, 5/6</td>
<td>Seattle Slew (3)</td>
<td>3/5</td>
<td>1/5</td>
<td>Pleasure</td>
<td>Occasional stumbling at walk</td>
</tr>
<tr>
<td>12</td>
<td>Tb</td>
<td>8</td>
<td>M (c)</td>
<td>3/4, 4/5, 6/7</td>
<td>Seattle Slew (3)</td>
<td>2/5</td>
<td>1/5</td>
<td>Pleasure</td>
<td>Stiff neck</td>
</tr>
</tbody>
</table>

Breed — Tb, Thoroughbred; QH, Quarter horse; ASB, American Saddlebred; TWH, Tennessee walking horse; MFT, Missouri Fox Trotter; WB, warmblood; Sex — M, male; (c), castrated.

4. Results

All patients were able to recover from surgery. Only patient 2 had a major problem with primary healing, and this horse was later euthanized because of incisional dehiscence. The surviving patients (92%) improved at least one neurological grade, and 75% improved more than two neurological grades 1 yr after surgery. Of the 4 survivors that were intended to be racehorses, 2 horses were able to train, race, and win (patient 5 won a stake race). Patient 4 died in a paddock accident from an unknown cause 2 yr after surgery before it was to be placed into training. Of the survivors intended to be ridden as pleasure or show animals, three horses have been ridden or shown, and two horses are entering training. There was no statistical difference noted with the neurological improvement or the clinical outcome between the three treatment groups.

One patient had a myelogram performed 4 yr after surgery (Fig. 1; Table 1), and no compression was noted at the operative sites or the articulations anterior and posterior to the fusions.

5. Discussion

Currently, there are recommendations that ventral interbody fusion be performed only on patients that have spinal cord compression at a maximum of two sites.10 Horses that do not receive therapy have a poor prognosis because of the continuous damage done to the cervical spinal cord. Insurance adjusters will often comply with a request for humane destruction in such cases. The triple level patients are subject to a life of impaired performance and are most often humanely destroyed. In humans, triple level anterior interbody fusions are not commonly performed with single cages, because the small size of the body of the human vertebra does not permit implantation. Smaller dual Bagby and Kuslich (BAK) cages could be used, but the indications are not common. The condition is most often treated with a combination of laminectomy and external fixators.6 Equine cervical vertebral anatomy allows for the placement of ventral implants to be positioned surgically at consecutive levels, which allows double and triple level vertebral stabilization at consecutive cervical vertebrae. Our results indicate that clinical improvement is possible. Additionally, the affected patients can live productive and/or competitive lives with no danger to themselves or their handlers, and they do not require daily medications.

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References and Footnotes


*GentaFuse, Butler Animal Health Supply, Dublin, OH 43017-7545.
*Phenylbute Injection 20%, Phoenix Pharmaceutical, St. Joseph, MO 64507.
*Prevail, VetOne, Meridian, ID, 83643.
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