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JOINT SECTION ON DISORDERS OF THE
SPINE AND PERIPHERAL NERVES

SPINE SECTION NEWSLETTER

American Association of Neurological Surgeons
Congress of Neurological Surgeons

Nancy E. Epstein, MD, Editor

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Chairman's Message

SIXTH SECTION MEETING APPROACHES

by Edward S. Connolly, MD

Your Joint Section continues to grow and represent the neurosurgical community in the field of spinal disorders and peripheral nerves. With your help, we hope to continue this active commitment to spinal care in the United States.

I would like to encourage all of you to attend the Sixth Annual Meeting of the Joint Section on Disorders of the Spine and Peripheral Nerves which will be held at the South Seas Plantation in Captiva Island, Florida, February 7 - 11, 1990. This year we will be honoring Dr. Ralph Cloward for his lifetime contributions to spinal surgery.

The membership has shown a great deal of interest in spinal surgery fellowships but, unfortunately, the Spine Section and the parent organizations (AANS and CNS) have no information as to how many spinal fellowships are available in the United States, their locations, or their content and requirements. This past summer you should have received in the mail a survey to answer these questions. I would petition you to answer the survey and return it so that the Spine Section can develop a list of the fellowships, their locations, and their content to provide a reservoir of information to neurosurgeons interested in special training in spinal surgery.

I would like to wish you a healthy and prosperous year and hope to see you all at the Congress Meeting in Atlanta, Georgia this fall.

MORBIDITY/MORTALITY REPORT

Responses regarding surgical complications have been few and far between. I would like to ask the readership to please send cases along with appropriate radiographic studies so that the M&M report next year may prove fruitful. I have included excerpts from two reports for this second newsletter. Please send to:

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CASE 1

A 26 year old was transferred from another hospital after the sudden onset of paraplegia from the T8 level down. The CT, MRI scan, and myelogram showed an intradural extramedullary lesion between the T7-T9 levels. The patient recovered from her initial bout of paralysis and was observed for a few days. However, when several

hours after the myelogram she again deteriorated, emergency surgery was performed. At surgery, a meningioma/schwannoma with acute hemorrhage was discovered. Following the initial surgery performed on July 28th, she demonstrated progressive motor and sensory improvement.

Nevertheless, on the 6-7th of August she once again showed signs of deterioration. Another myelogram was done which showed a block about two segments above the previous laminectomy which appeared consistent with an epidural semiliquid hematoma. At the second surgery, a small stitch abscess on the skin was debrided while the more cephalad extradural hematoma was evacuated. There was no evidence of infection deep within the wound itself.

Following the second operation, the patient once again became paretic. A third myelogram was done which showed no abnormality in the cervical or upper thoracic region, although there was some constriction to flow at the T4 level. It was determined that the patient had sustained some type of ischemic damage to the cord or an untoward reaction to the contrast material. Again the wound was explored in the Intensive Care Unit and probed to look for any sign of infection. No pus was found. The motor and sensory paralysis continued to extend to the C2 level. She was placed on a respirator, and only very slowly was weaned off the respirator after having a tracheostomy and feeding gastrostomy. At this point, she also began to develop some return of function in the hands, indicating the descent of cord injury. At that point she was transferred to a rehabilitation service.

Notes From The Author

1. It should be noted that the patient had a brief cardiorespiratory arrest during the third myelogram (August 19th). She was also found to have a bleeding time of 19 minutes. Hematology evaluated the patient but found no specific etiology for this abnormality.

2. The patient was seen by the infectious disease consultants on numerous occasions. She had some pustular skin lesions which were biopsied.
3. The official pathology report showed meningioma with some features of schwannoma.
4. Prolonged bleeding time of uncertain etiology.
5. CSF by Lumbar Puncture done on the 12th of August after the Myelogram and cardiorespiratory arrest showed a glucose of 17, protein of 1200, 230 WBC, 23,000 RBC. Gram stain: no organisms.

In Summary

It is possible that the patient had a chemical meningitis with subsequent vasospasm involving the anterior spinal artery which then accounted for the ascending sensory and motor paralysis to the C2 level.

Diagnosis

Meningioma T6-T8
Epidural Hematoma (delayed)
Chemical Meningitis
Ascending spinal cord lesion secondary to vasospasm/ischemia

CASE 2

A 34 year old Caucasian male was hit in the head while playing Rugby in October of 1988. Immediately following the impact, he fell to the ground complaining of numbness and the inability to move from the neck down. After several minutes, he noted the gradual return of sensation and strength, so that by the time he was admitted to the hospital, only his hands and forearms were numb and weak.

In the emergency room, he was immobilized in a Philadelphia collar and given 4mg of dexamethasone. The examination revealed 3-4/5 weakness of the right forearm and hand, and a 2-3/5 deficit in the left hand. Motor function in the legs had already returned to normal, although deep tendon reflexes remained hyperactive with a transient left Babinski response.

Plain X-rays demonstrated absolute (AP diameter, 10mm) cervical spinal stenosis between the C3-C7 levels, while the non contrast CT scan and MRI study showed ventral extradural defects at C3-C4, C4-C5, C5-C6, and C6-C7. The cord was compressed at each of these levels, while the exiting nerve roots were compromised as they exited in the respective foramina.

Median nerve somatosensory evoked potentials were abnormal and poorly reproducible, indicating the presence of a central cord injury, whereas the posterior tibial responses were normal.

The patient was observed over the next four months and continued to demonstrate weakness (3-4/5) and numbness of the left hand. When the neurological work up was repeated, the MRI, myelogram, and the Myelo CT scan confirmed continued multi-level impingement on the cervical spinal cord (C3-C4, C4-C5, C5-C6, C6-C7) and nerve roots. The AP diameter of the spinal canal was reduced to 7mm opposite the C4-C5, and C5-C6 levels. The EMG study also showed mild radicular changes in the left C6 and C7 distributions.

The surgical procedure chosen was a cervical laminectomy since the patient had multi-level stenosis and spondylosis. The patient was brought to the operating room in a Philadelphia collar, and intubated awake. The operation, performed in the sitting position, was then monitored with SSEP's, a doppler, an end Tidal CO2 monitor, an Arterial line, and pulse oximeter. The surgical procedure included a laminectomy from C3-C7 with more extensive medial facetectomies and foramenotomies on the left at C4-C5, C5-C6, and C6-C7. There were no intraoperative anesthetic complications (i.e. hypotension, arrhythmias etc.).

Immediately following surgery, as part of the routine, the anesthesia was reversed with the patient still on the operating room table. However, when he failed to move the left side adequately, he was immediately re-anesthetized and reopened. At the second operation, when no clot was found, the laminectomy was extended over the upper-dorsal level to afford longer decompression of the cord.

The patient's motor strength improved further on the left and over the next three months, he exhibited minimal residual weakness of the left hand (4/5), and he could ambulate without assistance.

This case was instructive for the following reasons:

1. It is essential to intubate these patients awake with immobilization in a hard collar.
2. Electrophysiological testing may be helpful but false negatives may occur. Monitoring was switched from the posterior tibial responses to the median nerve potentials after the C7 laminectomy had been completed (this was the first level removed). In the future, split screen arrays allowing continued monitoring of the posterior tibial responses on one side and the median nerve potentials on the other should be employed, and sides should be switched during the surgery. Since posterior tibial responses were absent at the beginning of the second operation, they would likely have picked up the neurological insult during the first procedure.
3. Patients with central cord injuries and stenotic canals may prove poor candidates for future surgical intervention, irrespective of the delay between the inciting trauma and subsequent surgery no matter how carefully performed contrary to recent reports recommending delayed decompression.

CASE 3

A 65 year old Caucasian male presented with an acute T10 paraplegia and evidence of an epidural spinal abscess between T3-L2 on MRI study. An emergency laminectomy was performed in the knee chest position, between the T7-T10 levels. At surgery, a red rubber catheter was readily passed proximally and distally for the equivalent of five segments in each direction. The organism, Staph Aureus, was sensitive to Nafcillin.

Although postoperatively the movement of the lower extremities was grossly improved, the patient acutely exhibited numbness and weakness of both hands, although the right hand was more affected (1-2/5) than the left (3-4/5). A central injury of the cervical spinal cord was suspected and first investigated with plain X-rays. Multiple spondylotic ridges, most prominent at the C5-C6 and C6-C7 levels were shown to narrow the canal to under 10mm in AP diameter. Two cervical MRI scans taken 1 day and 4 days following surgery, failed to confirm intrinsic changes indicating the presence of a central cord contusion. Nevertheless, the patient's neurological findings and rapid response to steroids confirmed the clinical suspicion of a central cord syndrome which ultimately resolved. Also of interest was the complete resolution of the epidural collection on the thoracic MRI scan taken one week following surgery.

The author suggested two points for discussion:

1. The risk of injury to the cervical spine in the knee chest position is significant particularly in older individuals with attendant spondylotic changes. It is therefore suggested, that older patients prophylactically be placed in Philadelphia collars prior to positioning, avoiding rotation and hyperextension.
2. There remains a question whether the red rubber catheter contributed to the degree of cervical spinal cord trauma observed. The risks versus complications of passing this catheter (avoiding multiple levels of additional laminectomy vs. trauma to the cord) may be argued.

**CERVICAL SPINE RESEARCH
SOCIETY: EUROPEAN SECTION**

Summary of Abstracts from the 6th Annual Meeting June 28 - July 1, 1989 in St. Gallen, Switzerland

President: Prof. Rene Louis
President Elect: PD Dr. Friedrich Magerl

I. TOPIC: CERVICAL SPINE TRAUMA

A. *Magnetic Resonance Imaging of Acute Cervical Spine Trauma; Correlation with Severity of Neurological Injury:*

Northrup, BE; Schaefer, D;
Jewell, L; Osterholm, L

1. MRI findings which correlated with greater neurological deficits included intramedullary hematomas and cord contusions with attendant edema which extended over more than one spinal segment.
2. Findings associated with lesser degrees of injury included:
 - normal signal on MRI within the cord itself
 - intramedullary contusion which extended over less than one segment.

II. TOPIC: EVOKED POTENTIAL MONITORING OF CERVICAL CORD FUNCTION

A. *Neurophysiological Evaluation of Cervical Spinal Cord Function*

D'Alpha, F; Denaro, VC; Garaffo, G; Grasso, A

Median and ulnar nerve somatosensory evoked potentials were monitored in patients with disc disease, cervical trauma, or stenosis. One hundred patients were studied. The incidence of false negatives was small, while no false positives were found. Neurophysiological findings most closely correlated with:

- Radiographic rather than clinical findings
- SEP alterations better reflected posterior spinal pathology (i.e. sensory vs. motor changes.)
- Preoperative and postoperative examinations were of value in assessing the need for spinal surgery.
- Minor changes in the conduction times were thought more significant than waveform or amplitude alterations.

B. SEP's Monitoring During Cervical Cord Surgery

Denaro, V; D'Alpha, F; Iuvare, G;
Grasso, A

SEPs were monitored during cervical spine surgery. Two techniques were employed consisting of (a) short latency cervical and cortical responses and (b) middle and long-latency cortical responses.

Problems encountered in the operating room included:

1. the type of montage used
2. time required for obtaining averaged responses
3. short latency responses are better for surgical monitoring and are more readily compared with pre and postoperative recordings
4. critical maneuvers such as reduction of a dislocation may cause a short term alteration in the response which should return quickly

C. Evaluation of the Cortico-Spinal Pathways by Transcranial Magnetic Stimulation of the Cortex

Dvorak, J; Herdmann, J; Theiler, R; Grob, D

Transcranial magnetic stimulation was performed in 40 normal adults to establish baseline central motor latencies (CML) within the upper extremities. Plexus motor latencies (PML), the conduction time between C7 and the plexus, were also established. Subsequently, 75 patients with cervical myelopathy or root compromise were evaluated. A delay of Central motor latency was encountered in the largest number of these individuals.

The motor evoked potentials elicited utilizing the transcranial magnetic technique were reliable, reproducible, and painless, and proved to be an excellent monitoring technique in the presence of spinal cord or root compression.

III. COMPLICATIONS OF CERVICAL SURGERY

A. Tetraplegia Following Cervical Spinal Fusion

Ruffin, G; Jeanneret, B; Magerl, F

Complications of cervical surgery may include increased neurological deficit whether surgery is performed anteriorly or posteriorly. Although direct neurological trauma may be invoked, vascular syndromes involving the anterior spinal artery must be considered. The authors suggested the use of the CT or MRI scans on admission, immediacy prior to surgery, while stressing that these procedures be done under SSEP monitoring or with intraoperative myelography.

IV. SPINAL INSTRUMENTATION

A. Transarticular Screw Fixation for Atlanto-axial Instability

Greenfield, G; Jeanneret, B; Magerl, F

Between 1978-1984, 51 individuals with atlanto-axial instability were managed with trans-articular screw fixation of the C1-C2 facet with attendant bony fusion. This procedure offered immediate stability and no patient suffered from increased postoperative disability. Only one screw broke following surgery, but this proved to be of no clinical relevance.

V. CERVICAL SPONDYLOTIC MYELOPATHY/CERVICAL STENOSIS

A. Current Anterior Canal Enlargement for Cervical Spondylotic Myelopathy

Okada, K

Thirty-seven patients were treated with anterior decompressions for cervical myeloradiculopathy. Enlargement of the spinal canal was attained with removal of one-third of the cephalad and caudal vertebral bodies accompanied by excision of the osteophytes and anteromedial pedicles. Interbody fusions, subtotal corpectomies and grafts, or floating grafts were then performed. Forty-nine percent of patients had excellent, 32% good, 14% fair, and 5% poor responses to surgery. Poorer results correlated with older age, longer duration of symptoms, spinal cord atrophy (identified on preoperative myelography and Myelo CT studies), and severe preoperative motor disturbance in the lower extremities.

B. Long Term Results of Microsurgical Removal of Cervical Discs by Anterior Route Without Graft

Husag, L; Arau, K

One hundred seventy-eight patients with myeloradiculopathy and cervical disc disease were treated with anteromedial microsurgical disectomy without interbody fusion. Using Odoms criteria, excellent results were achieved in 52% of patients, good responses in 32%, fair responses in 12%, and poor results in 4%. Radiculopathy was more responsive to surgery than myelopathy. The degree of posterior longitudinal ligament resection over single or multiple levels did not correlate with outcome.

Instability, consisting of laxity on functional X-ray studies, was noted in only 8% of patients over the six to eight week postoperative period. Bony fusion was completed in 62% of cases after six to twelve months with 38% showing segmental fibrous union.

C. Developmental Narrowing of the Cervical Canal: A Major Cause of Recurrences After Simple Anterior Disectomy

Bertalanffy, H; Eggert, HR

When myelopathy occurs in conjunction with cervical spinal stenosis and disc disease, surgery should simultaneously address disc disease at all pathological levels. The multiple levels of involvement seen with C3-C7 stenosis, serve as contraindications to anterior disectomy without fusion.

D. The FAN Procedure; Ventral Decompression of Cervical Stenosis Hughes, JEO; DIGiacinto, GV; Sundaresan, N

Cervical stenosis may be treated using a central 4mm channel taken back to the posterior longitudinal ligament over the number of cervical spinal levels to be decompressed. The central defect is then filled with a single strut graft.

VI. CERVICAL STENOSIS/ LAMINOPLASTY TECHNIQUES

A. Clinical Results Following Open-door Laminoplasty in Cervical Myeloradiculopathy

Nakano, N; Nakano, T; Nakano, K

Ninety-eight patients were evaluated following open door laminoplasties for the treatment of cervical myeloradiculopathy. Follow up included 95 cases over a six month to ten month period. Improvement following surgery was attributed both to the degree of canal enlargement as well as to the improved circulatory status of the cord and roots within the spinal canal.

B. Laminoplasty by Longitudinal Splitting of Spinous Processes for Stenosis of the Cervical Spine: A Nine Year Clinical Experience in 110 Patients.

Kurokawa, T

One hundred ten patients with spinal stenosis were treated with a technique of laminoplasty which included longitudinal splitting of the spinous processes over the spinal levels to be decompressed. Bone grafts were wired between the halves of the spinous processes in order to maintain the enlargement of the spinal canal. The follow up studies documented the same or better neurological results without the attendant alterations in spinal alignment encountered after wide laminectomy.

C. Unilateral Laminectomy in Cervical Spondylotic Myelopathy

Savini, R DiSilvestre, M Gargiulo, G Bettini, N;

Unilateral laminectomy was performed in 182 patients with cervical myeloradiculopathy associated with cervical stenosis. This technique requires unilateral exposure and removal of the C3-C7 lamina, resection being carried out between the spinous processes medially and the facet joints laterally. Laminectomy of the atlas and axis is also completed where indicated. This procedure, which facilitates posterior migration of the spinal cord was documented to increase the AP diameter of the spinal canal by an average of 5mm based on postoperative CT scans. Certainly, the surgical results were comparable to those encountered in other series where routine laminectomy or laminoplasty had been completed, as 84% improved, 11% remained unchanged, and only 5% were worse. The potential benefit of this method is its allowance for enlargement of the cervical spinal canal while limiting damage to the posterior elements.