for the person with epilepsy, but these findings also show that poor adjustment is not inevitable.

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Spinal somatosensory potential monitoring in three cases of neurological deterioration after laminectomy for cervical spondylotic myelopathy

Posterior cervical laminectomy is a widely accepted treatment for multisegmental cervical spondylotic myelopathy, particularly when the condition is associated with a narrow spinal canal.1 After laminectomy, some patients complain of increased weakness and paraesthesiae of the arms. This clinical finding is consistent with segmental damage either at the spinal cord or nerve root level. We report three patients of transient neurological deterioration in whom spinal somatosensory potential monitoring during operation gave useful information on the pathophysiology of the postoperative deficit.

Cervical spinal somatosensory potentials were recorded during operation, before and after laminectomy. The potentials were evoked by electrical stimulation of the median nerve at the wrist. Rectangular pulses (0.5 ms duration and amplitude 4/3 of the motor threshold) were delivered at 1 cycle/s. After exposure of the cervical laminae, the recording electrode (Medtronic Sigma 3483 or Quad 3487A) was placed in the epidural space, medially over the posterior columns. The reference electrode consisted of a 14 G needle inserted into the paraspinal muscles immediately caudal to the skin incision. A total of 50–150 stimuli were applied and averaged; analysis time was 50 ms with a horizontal resolution of 98 μs per point. An open bandpass (2–5000 Hz) was set and the negative upward convention was used. The potentials were analysed for latency, amplitude, duration, and waveform. The single components were labelled according to their polarity and to the expected latency.

Anaesthesia was induced with thiopentone sodium (5 mg/kg) and fentanyl (0.002

Case 1: C3–C7 posterior laminectomy

Before

After

Case 2: C3–C5 posterior laminectomy

Before

After

Case 3: C3–C7 posterior laminectomy

Before

After

Cervical epidural somatosensory potentials evoked by median nerve stimulation at the wrist (0.5 ms, 1 cycle/s, 4/3 of motor threshold) recorded before and after laminectomy for cervical spondylotic myelopathy.
mg/kg). Endotracheal intubation was performed during muscle relaxation with pancuronium (0.1 mg/kg). Anaesthesia was maintained with nitrous oxide, oxygen, and isoflurane (0.7–1.2%).

Case 1 was a 51-year-old man who, since 1986, had a progressive spastic paraparesis, complained of claudication, and had arthritis. Neuro-radiological investigations showed cervical spondylisys with a narrow canal from C3 to C7. The patient underwent a C3-C7 posterior laminectomy. After operation, he reported a pronounced weakness and paraesthesiae in both hands. Motor and sensory functions in the arms were restored after three to four weeks.

Before laminectomy, the potential recorded epidurally at C5 after median nerve stimulation was characterised by a normal P10 followed by an N11 wave with a peak latency of 12.3 ms, and an N13 wave at 13.9 ms. Amplitude (P10-N13: 12.8 μV) and waveform were normal. After laminectomy, the disappearance of the N13 wave was noticed. The P10 and N11 waves were unchanged (figure).

Case 2 was a 56-year-old man who presented in 1984 with progressive spastic tetraparesis and hypoesthesia below C4. An MRI of the cervical spine showed spondylisys of the canal from C3 to C5. He underwent a C3-C5 posterior laminectomy. After operation, he showed a transient (seven days) decrease of motor performance in the distal segments of the arms. Before laminectomy, a potential recorded by median nerve stimulation at C5 consisted of a slightly delayed P10 (peak latency: 11.2 ms), N11 (peak latency: 13.6 ms), N13 (peak latency: 14.0 ms), followed by a slow positive wave (P18 at 25.8 ms). Amplitude (P10-N13: 15 μV) and waveform were normal. After laminectomy a decreased amplitude (P10-N13: 10.7 μV) and a longer duration (11.8 ms v.s. a prelaminectomy value of 4 ms duration) of the main negative wave (N13) were evident (figure).

Case 3 was a 67-year-old man with spastic tetraparesis and hypoesthesia of both hands. Cervical MRI showed a spondylisys from C4 to C7. The patient underwent a C3-C7 posterior laminectomy. After operation a transient (four weeks) tetraparesis and hypoesthesia of upper extremities was evident.

Before laminectomy, the epidural evoked potentials consisted of a slightly delayed P10 (peak latency 11.3 ms) followed by a negative wave peaking at 14 ms. The amplitude was normal from Th1 to C6v (P10-N13: 10 μV), whereas it was decreased above C5v-6 (P10-N13 at C5v-6: 5 μV). After laminectomy a decrease in amplitude or disappearance of the main negative wave (N13) was evident (figure).

In these three cases, laminectomy was followed by an alteration in the post-synaptic component (N13) of the median nerve evoked potential, whereas the root component (N11) was unchanged. 2 This is consistent with grey matter damage. The genesis of this lesion is probably a vascular insult in an already hyperperfused area. 4 Indeed, in cervical spondylitic myelopathy the osteophytic process may impinge on the anterior spinal artery and cause hypo-perfusion of the haemodynamic autoregulation in the spinal cord watershed areas. 5 The decomposition by posterior laminectomy may increase the blood supply, but as a consequence of the previously mentioned loss of haemodynamic autoregulation, it may cause haemorrhages in these areas and produce the localised effect of further ischaemia. Other mechanisms of damage such as cervical spine instability, a local concussion of the cord, or a temporary oedema caused by mechanical interference, cannot be excluded.

In conclusion, this neurophysiological study shows that neurological deterioration after posterior laminectomy in these patients was due to grey matter damage and not to retraction stretching. It is important to stress that the damage reversed spontaneously.

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Different criteria in the assessment of visuospatial neglect

The classic manifestations of visuospatial neglect are (1) a certain minimal number of omissions in conventional neglect tests, and (2) a defective performance more pronounced at the side opposite the brain lesion. 1, 2 The procedure for assigning patients to a neglect group typically includes a measure of the number of omissions in tests such as target cancellation, figure copying, and frehand drawing. A measure of the asymmetry of omissions is, however, not always included as a criterion for spatial neglect. 3, 5 Unless this is done, patients showing the typical pattern of visuospatial neglect may be mixed with patients showing no laterality in the defective performance.

The aim of this study was to compare the accuracy of the assignment of patients to a neglect group when using three different criteria for visuospatial neglect. A consecutive series of 60 right-handed patients, mean (SD) age 60-25 (12-58); range 21-77 years with a single right hemispheric stroke were assessed one to eight weeks after stroke (mean (SD) 2.5 (1-53) weeks) using seven subtests from a shortened and slightly modified version of the behavioural inattention test. (The behavioural inattention test was introduced by Wilson et al to offer a standardised test battery of unilateral visual neglect.) Thirty four neurological healthy age and hand matched right handed subjects served as controls.

The cut off level for defective numbers of omissions in each subtest and in the total number of subtests was set at the first score below the normative range obtained from the control group. The asymmetry of defective performance was measured in the tests with scores at or below the cut off level. To avoid correlation of laterally and laterally located omissions, only the latter parts of the test material were included in this measurement. 3 The number of detected targets at the contralesional side was divided by the total number of detected targets and then represented by a percentage measurement. The classification of asymmetry of omissions was based on the range of laterality scores found in the control group (44-56%). It was classified as contralesional asymmetry if a laterality score below 44% was found in at least one of the tests and if no test was found with a score above 56%.

An assessment of hemianopia (by standard confrontational techniques) was included to analyse the influence of hemianopia on the asymmetry. The performance of the contralesional asymmetry as well as hemianopia were exclusively found in patients with neurological deficits remaining three weeks after stroke (in patients showing a major stroke, n=9). No association between the presence of hemianopia (n=15) and contralesional asymmetry (n=18) was found in this group (z=2.49, P=0.011).

The present study compared three different criteria for assigning patients to the visuospatial neglect group, which are similar to criteria applied in recent studies of visual neglect 13-16: (1) a score at or below the individual cut off score in any of the seven subtests; (2) a total score at or below the aggregate cut off score for the seven subtests in the battery; (3) a score at or below the cut off level at least one of the subtests and a contralesional asymmetry in the defective performance (as defined earlier). A significant difference was obtained between the proportions of patients defined as having visuospatial neglect with the three criteria for neglect (Q=19, df=2, p<0.001, Cochran Q test). The proportions were 45% (27/60), 23% (14/60), and 30% (18/60) respectively.

The criterion of individual cut off scores was the most generous method for classifying patients as having neglect. The use of this criterion resulted in nine patients (Nos 12, 15, 19-21, and 24-27) who were misidentified as having visuospatial neglect, although no contralesional asymmetry was found in the defective tests (table). These results show that visual inattention in a conventional test battery of neglect might be present with no contralesional asymmetry in the inattentive behaviour. The findings emphasise the importance of including not only visual inattention as a criterion by the visual neglect, but also the asymmetry of the inattentive behaviour.

The aggregate cut off criterion was the most restrictive method for classifying patients as having neglect. The present study shows that five patients (Nos 16-18,22, and 23) were classified as non-neglect patients, although the traditional neglect pattern with a defective number of omissions and a
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