Paraplegia 18 (1980) 351–357 0031-1758/80/0127035 1$02.00

Proceedings of the Annual Scientific Meeting of the International Medical Society of Paraplegia held in Mulhouse, France, 1979

LUMBO-SACRAL SPINAL CORD INJURIES

By M. JESEL,* J. DEVILLER and R. OTTINGER†

* *Electromyographic laboratory—University of Strasbourg* 1, *place de l'Hôpital*—67091 *Strasbourg cedex (F);* † *Department of Rehabilitation—Centre de Réadaptation Fonctionnelle et de Convalescence*—45, *boulevard Clémenceau (F)* 67082 *Strasbourg cedex*

Abstract. Thirty-three cases of spinal cord complications in thoraco-lumbar junction injuries were studied, classified in four groups according to the gravity of the lesion and the clinical and electromyographic neurological signs. An original system of graphic representation was used. The spinal lesion was probably secondary to the interruption of arterial vascularisation in the lumbo-sacral spinal cord in two groups and symptomatic of previous contusions in the others. Finally some correlations were established between types of spinal lesions and functional vesico-recto-sphincter and sexual repercussions.

Key words: Lumbo-sacral spinal cord; Spinal injuries; Electromyography.

Introduction

THE lumbo-sacral enlargement contains motor and sensory tracts, motor neurons innervating the muscles of the lower limbs and parasympathetic centres controlling the automatic function of the bladder, rectum and sex.

In traumatic lesions of the lumbo-sacral spinal segments, a clinical analysis of sensory signs is relatively easy; sensory defects reflect the degree of the interruption of the anterior (spino-thalamic) and/or posterior (Goll and Burdach) spinal pathways. In cases of suspended loss of pain and heat sensation, the traumatic lesion can be localised at the commissural central region of the grey matter.

In the presence of distinct complete upper-motor neuron or lower-motor neuron signs, their clinical assessment is not difficult. Spinal cord lesions involving both the pyramidal tract and the anterior horn cells lead to a paralysis of the 'centro-peripheral' type. In these cases, the EMG is instrumental in the diagnostic procedure. In the majority of our cases, EMG investigations were performed in the lower limbs and the sphincters (Jesel *et al.*, 1973).

Material and Methods

Thirty-three cases of spinal cord injuries at the lumbo-sacral segments are hereafter studied. Twenty-six were males and seven females, their age distribution was as follows: 10–20 years (7), 20–30 years (13), 30–40 years (11) and 40–50 years (2). The aetiology was established in 32 cases: 11 car accidents, 13 cases of fall from a height, seven direct injuries of the dorso-lumbar junction and one plane accident. Various sites and types of injuries were determined: 24 cases of wedge compression-fracture of one vertebra (D12: 4; L1: 18; L2: 2), two cases of wedge compression-fracture of two vertebrae (D11 and L1: 1; D12 and L1: 1), four cases of fracture-dislocation and two cases of inter-vertebral dislocation (D11-D12: 1; L1-L2: one case of seat-belt syndrome). In one case no traumatic vertebral lesion was found.

A graphic representation of the motor and sensory signs was drawn for each

case. A similar system has already been used by one of us (Jesel & Isch, 1974; Meyer, 1976) in a study of 45 cases of lumbo-sacral myelomalacies.

Various types of motor defects were observed (motor testing and EMG):
—complete peripheral paralysis with denervation potentials at rest and no motor unit action potentials on voluntary contraction (1); this complete paralysis may sometimes partially recover (1′),
—incomplete peripheral paralysis with denervation potentials at rest and high frequency motor unit action potentials on voluntary contraction (2),
—centro-peripheral paralysis with no voluntary activity, denervation potentials at rest and reduced automatic and reflex activity; motor unit action potentials may reach high frequencies in the presence of sufficient automatic activity (3),
—centro-peripheral paralysis with reduced voluntary activity; denervation potentials at rest; some low-frequency motor unit action potentials due to central participation; a reduced degree of automatic-reflex activity persists; in presence of sufficient automatic activity, the motor unit action potentials may reach high frequencies (4),
—central paralysis characterised by the absence of voluntary activity, and the preservation of the automatic-reflex activity (5),
—central paralysis with reduced voluntary activity and normal automatic-reflex activity. On voluntary contraction, the motor unit action potentials reach low frequencies due to central participation (6).

Sensory defects were also analysed. Suspended impairment of pain, heat and cold sensation (7) was noted, localising the lesion at the central region of the grey matter. Below the level of the lesion, there were cases of thermoanaesthesia and analgesia (9) or thermohypoaesthesia and hypoalgesia (8), cases of complete (10) or incomplete (11) global sensory loss and cases of loss of appreciation of posture, movement of the joints and tactile discrimination (12).

Figure 1 shows the graphic system used in our study. The various types of motor defects are shown on two columns representing the two sides of the spinal cord; on either side of these columns sensory signs are represented. The levels of lesion can easily be determined at the inferior dorsal and the lumbo-sacral segments (shown at the left side of the figure).

Disturbances of bladder, rectum and sexual functions were noted and some interesting correlations between the sphincter paralysis and the disturbances of bladder and rectum function were established.

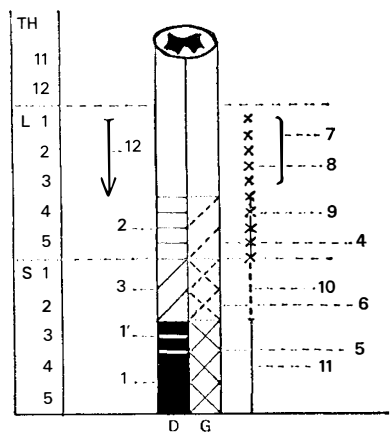
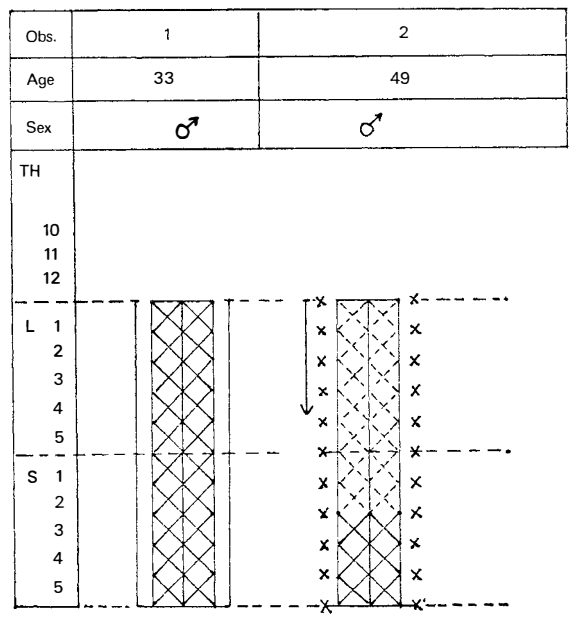


FIG. 1

Results

On the basis of the clinical and EMG data, the patients were classified in four groups of lumbo-sacral spinal cord injuries.

Group I: Two observations of complete (obs. 1: dislocation D11-D12) and incomplete (obs. 2: wedge compression-fracture of L1 and burst fracture of L2) interruption of the spinal cord, are included in this group.



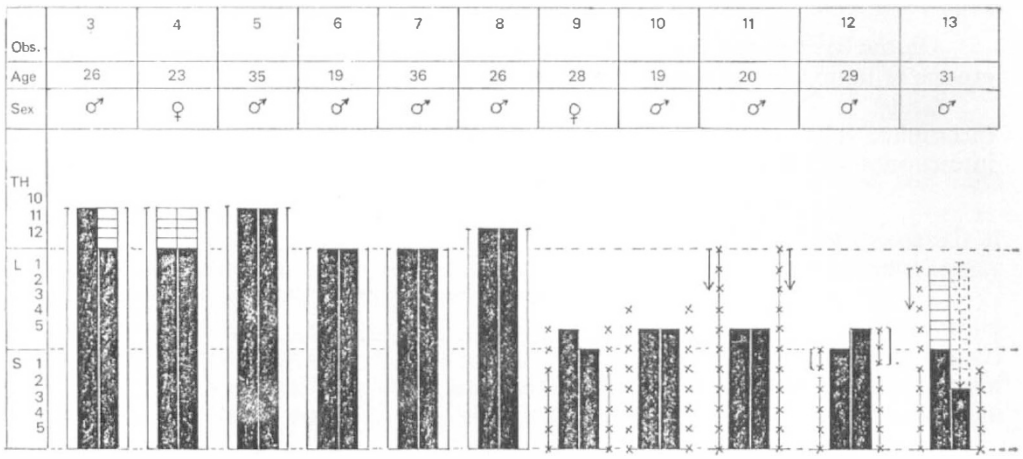
Group I

Below the level of the lesions, the paralysis was of the central type. Sensory loss was global and complete in one case (obs. 1: complete section of the spinal cord), and the second patient presented a thermohypoaesthesia and hypoalgesia with total loss of the sensation of posture and position of joints and tactile discrimination, at the right side. The first patient (obs. 1) is autonomous in wheelchair; the second (obs. 2) is able to walk with walking-sticks and orthesis.

Disturbances of the bladder and rectum function were comparable to those of dorsal injuries with satisfactory automatic activity. Sexual function was not determined. A direct trauma of the spinal cord respecting the arterial vascularisation of the lumbo-sacral segments can explain these clinical findings.

Group II: It includes 11 cases of total or partial spinal interruption with complete necrosis of the spinal segments below the traumatic impact.

In the majority of cases, lumbo-sacral myelomalacia is symptomatic of a compression-fracture of the D12 or L1 vertebra (seven cases). Flaccid global peripheral paralysis occurred, extending to the segments L1-L5 in six cases and L5-S5 in five cases. Sensory loss below the level of the lesion was global and complete in six cases: analgesia and thermoanaesthesia were present in four cases (obs. 9, 11, 12, 13) and hypoalgesia and thermohypoaesthesia in one case (obs. 10), indicating an anterior spinal lesion. In one case (obs. 12) a suspended anaesthesia was noted at S1 (right) and L5-S1 (left). In two cases, bilateral (obs. 11) or unilateral (obs. 13) incomplete posterior cordonal sensory loss was found. Four

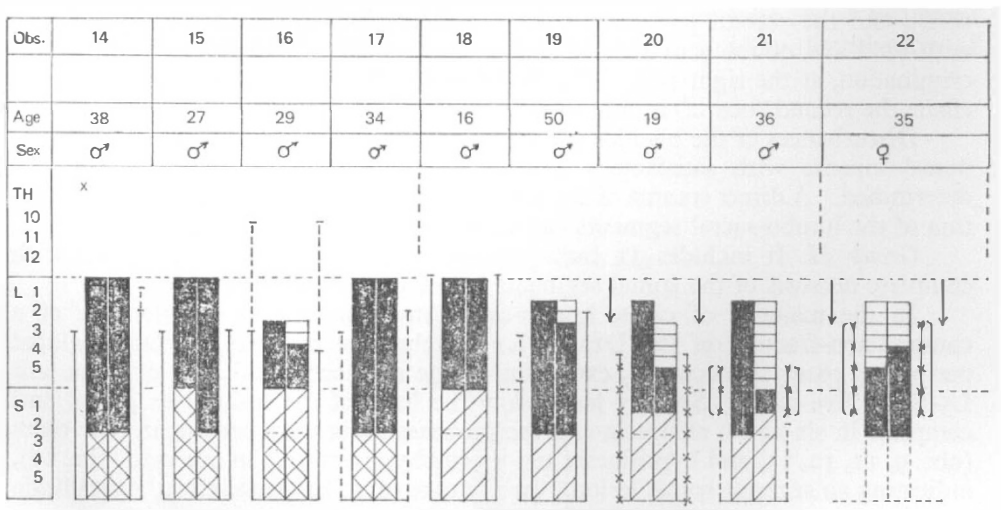


Group II

patients were able to walk with orthesis or walking-sticks (obs. 9, 10, 12, 13). Bladder and rectum were autonomous with a complete paralysis of the sphincters, and all male patients presented sexual impotence. These spinal cord traumatic lesions can only be interpreted by terminal arterial vascular interruption of either the lumbo-sacral spinal cord or its anterior territories.

Group III: Nine cases of lumbo-sacral spinal cord injuries with massive necrosis of the segments below the traumatic site except the distal sacral segments are included in this group.

Vertebral injuries were severe: wedge compression-fracture of D12 (one case) and L1 (six cases), double compression-fracture of D12-L1 (one case: obs. 17), seat-belt syndrome with intervertebral dislocation L1-L2 (obs. 22). Motor flaccid global peripheral paralysis occurred in the territories innervated by lumbar



Group III

or lumbosacral segments just below the site of lesion. At the level of the terminal sacral segments who have regained the automatic and reflex activity the paralysis was either of the 'central' (obs. 14 to 17) or the 'centro-peripheral' type (obs. 18 to 21). Pyramidal tracts were intact in obs. 22, in spite of an important injury of the anterior parts of the spinal cord (as shown by the suspended bilateral anaesthesia L3-S1). The sensory loss below the site of the injury was global: complete in five cases and incomplete in two cases. One patient (obs. 20) showed analgesia and thermoanaesthesia with incomplete impairment of the posterior cordonal sensibility. In obs. 22 a severe interruption of the Goll and Burdach tracts was found. The gait with orthesis was possible in five cases (obs. 16, 17, 18, 21, 22).

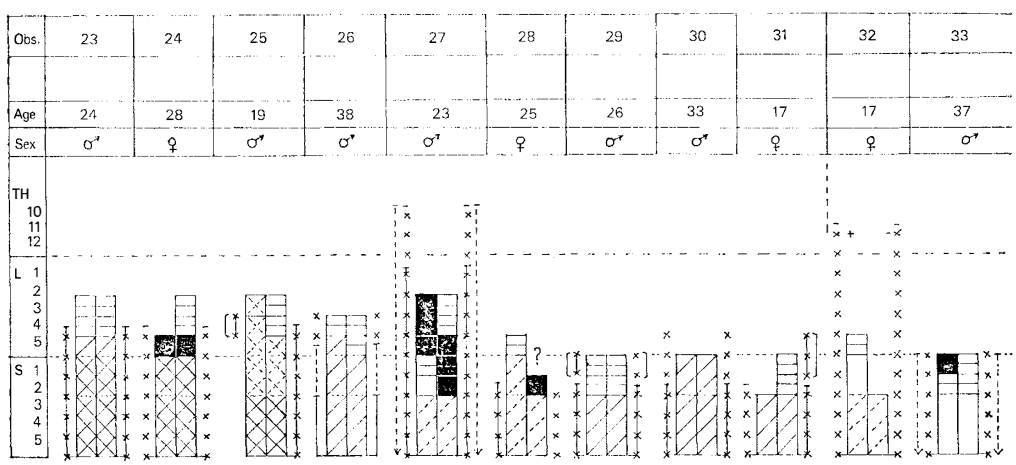
The repercussions on the bladder, rectum and sexual functions were severe: a satisfactory automatic bladder functioning was observed in four cases (obs. 14, 17, 18, 21); the automatic bladder function was reduced in two cases (obs. 15, 16) and autonomous bladder was noted in two cases (obs. 19, 20). Constipation was observed in five cases (obs. 14, 16, 18, 19, 21). Short erections were possible in six male patients. The rapid recovery of the bladder and rectum functions and their voluntary control in obs. 22 may be explained by the integrity of the anterior bundles of the spinal cord.

The clinical pictures of obs. 14–21 can be interpreted by the existence of arterial afferent vessels irrigating the conus terminalis underlying the level of the injury. Posterior spinal interruption is predominant in obs. 22 (dislocation L1-L2) resulting in ataxia which aggravates the motor defects of the lower limbs.

Group IV: This group consists of 11 observations of localised traumatic lesions of the lumbo-sacral spinal cord.

With the exception of one case (obs. 26) the lesions were localised at the anterior part of the spinal cord. They were symptomatic of wedge compression-fractures D12 (two cases), the one being associated with D11-D12 sub-dislocation and L1 (eight cases, one of them being associated with a fracture D11).

Motor signs were variable: in the territories corresponding to segmental innervation of the lower limbs (L3-S2) a lower motor neuron paralysis was noted; uni- or bilateral (symmetrical or not), complete or incomplete. In some cases the peripheral signs were masked by the upper neuron paralysis. Paralysis was of the central or the centro-peripheral type in the inferior sacral segments. In two cases,



Group IV

the voluntary control of the sphincters was preserved (obs. 32 and 33). A suspended uni- or bilateral loss of sensation of heat and pain was noted in three cases (obs. 25, 29, 31). With the exception of the obs. 26 (where sensory impairment was global below the level of the lesion), all the other cases presented a loss of pain and heat sensations uni- or bilateral, complete or incomplete with recovery in two cases (obs. 27 and 33). This group showed better functional performances in the lower limbs: walking was possible, without sticks in seven cases and with sticks and orthopaedic shoes in three cases. Disturbances of bladder and rectum function were severe: bladder functioning was satisfactory in five cases (obs. 23, 24, 27, 32, 33), diminished in three (25, 26, 30) and abolished in three cases (28, 29, 31). Constipation was observed in seven cases. Only two males could have sexual relations; procreation was possible in one case (obs. 25). Two patients (obs. 23 and 29) could have erection and ejaculation and two (obs. 27 and 30) were impotent.

Neurological signs and symptoms indicate a direct lesion of the spinal cord by the wedge compression-fracture of D12 or L1. In the majority of cases, the injury affects the anterior part of the spinal cord, predominating at the distal part of the sacral segments. This explains the severity of the bladder, rectum and sexual repercussions. In cases 25, 29 and 31 an associated arterial lesion can be suspected, localised in the territory of the sulco-commissural artery.

Discussion and conclusions

In cases of spinal injuries of the thoraco-lumbar junction, the site of the spinal cord lesion and the mechanism of action of the causative trauma can be determined by clinical and EMG examinations. A parallelism between the degree of the lesions of the anterior horncells of segments S2-S4 and the sacral parasympathetic centres (controlling bladder, rectum and sexual functions) can be established by means of EMG of the sphincters.

In group II, with complete paralysis of the sphincters and destruction of the parasympathetic centres in most cases, the function of the bladder and rectum, and the sexual function are abolished. In cases of central of centro-peripheral paralysis of the sphincters variable degrees of regain of the automatic function of the bladder remains possible, but other causes of bladder or/and sphincter dysfunction should be borne in mind. With the exception of two cases (obs. 22 and 33) 11 of our patients of groups I, III and IV showed satisfactory bladder function. It was diminished in six cases and abolished in five. Constipation was frequently noted.

Information concerning the sexual function was difficult to obtain. Complete impotence was present in group II. In groups III and IV only two male patients could have sexual relations, and procreation was possible in one case. Thus repercussions on sexual function seem severe.

The mechanism of action of the injury on the lumbo-sacral spinal cord can be elucidated on the basis of the site of lesions. Direct or secondary to arterial interruption lesions can be determined. In groups II and III, the latter mechanism led to myelomalacia. Ischaemic necrosis may result from the interruption of lumbo-sacral terminal arteries (Group II). In the presence of underlying afferent vessels, the distal part of the conus may be totally or partially preserved (Group III). In groups I and IV, spinal lesions resulted from direct injury caused by fracture or dislocation of the thoraco-lumbar junction. In these cases, section of the cord was found in only one case (obs. 1). Anterior spinal contusions were

more frequent. Small necrotic areas in the central part of the grey matter may result from lesions of the sulco-commissural artery.

RÉSUMÉ

13 cas d'atteintes de la moëlle lombo-sacrée par traumatisme de la charnière dorso-lombaire ont été étudiés. Les cas ont été répartis en 4 groupes, compte tenu de la gravité des lésions médullaires et des caractéristiques cliniques et électromyographiques des déficits neurologiques. Un système original de représentation graphique des déficits moteurs et sensitifs a été utilisé. L'atteinte de la moëlle était vraisemblablement secondaire à une interruption de la vascularisation artérielle médullaire lombo-sacrée dans 2 groupes et symptomatique d'une contusion médullaire surtout antérieure dans deux autres. Enfin,des corrélations ont été établies entre les types de lésion médullaire et les répercussions fonctionnelles vésico- et recto-sphinctériennes et sexuelles.

ZUSAMMENFASSUNG

Diese Arbeit betrifft 13 Fälle traumatischer läsionen des lumbo-sacral spinal cord. Sie sind in vier Gruppen aufgeteilt in Bezug auf ihre schwere und ihre klinischen und electromyographischen Besonderheiten. Die motorischen und sensiblen Ausfälle sind mittels einer originalen graphischen Method dargestellt. Der Medullaschaden erklärt sich in den zwei ersten Gruppen durch eine Unterbrechung der arteriellen lumbosacralen Vascularisation; in den zwei letzten Gruppen durch eine hauptsächlich vordere Medulla contusion. Schliesslich werden die Beziehungen zwischen den verschiedenen Arten der Spinal cord läsionen und ihre jeweiligen Auswirkungen auf das vesico-rectale und sexuelle Gebiet erörtert.

REFERENCES

JESEL, M., ISCH-TREUSSARD, C. & ISCH, F. (1973). Electromyography of striated muscle of anal and urethral sphincters. In S. KARGER (ed), *New Development in Electromyography and Clinical Neurophysiology*. Bâle, 2, 406–420.

JESEL, M. & ISCH, F. (1974). Myélomalacies lombosacrées. Répercussions sur la motricité des membres inférieurs et sur le fonctionnement vésical. *Ann. Méd. Phys.*, **17**, 358–367.

MEYER, C. (1976). Formes anatomo-cliniques des myélomalacies lombosacrées; à propos de 45 cas. Thèse méd, Strasbourg, no. 106.