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Combined Brachial Root and Plexus Lesions – Typical Sequelae of Motor-bike Accidents

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Summary. A total of 20 patients with severe post-traumatic arm paralysis was examined using electromyography and sensory neurography to evaluate the type and localization of the lesion; 19 patients had been involved in a motor-bike accident. In more than 80% the brachial roots were involved. In 65% a combined radicular and plexus lesion was found. The poor prognosis of these injuries indicates the need for additional protective devices.

Key words: Motor-bike accidents – Combined brachial root and plexus lesions – Protective devices

High speed and lack of a protective cabin produce special types of motor-bike injuries. Since crash helmets are commonly used the incidence of severe head trauma and death due to direct impact to the skull is dropping [10]. Another typical lesion is the disruption of cervical nerve roots or brachial plexus [3, 6]. To indicate the significance of these injuries data on severe traumatic paralysis of arms seen during the course of 1 year in an electromyographical unit are presented.

Patients and Methods

Between October 1983 and November 1984 20 patients with complete or nearly complete unilateral paralysis of shoulder girdle and arm were examined. In only 1 of these cases was damage caused in a car accident, the remaining were injured on motor-bikes. They were exclusively young males (Fig. 1). The latency between the injury and the first examination varied between 2 weeks and 8 months, and some had been investigated several times. Following a detailed neurological examination including sweat test (Minor's method) electromyography of the deltoideus, biceps brachii, triceps brachii, and abductor digiti minimi muscles, in some cases additional muscles of the shoulder girdle, and regularly cervical paraspinal muscles (M. multifidus) at least of the most severely affected segments, was carried out. Sensory nerve action potentials were measured bilaterally on the median and ulnar nerves following stimulation of an adequate finger.

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Results

On first examination 9 patients exhibited paralysis of all muscles of shoulder and arm which are innervated by the cervical nerve roots C5–C8. Minimal residual function in the serratus anterior and rhomboideus muscles was detected in 7 patients, in the deltoideus muscle in 3 patients, and in the small muscles of the hand in 4 patients. Sweat secretion was normal in 3, partly preserved in 4 patients in the lower segments, and in 8 in the upper segments of the paretic limb. There were no signs of cerebral or spinal involvement. Electromyographical examination of the shoulder and arm muscles supported the clinical findings without exception. In the paraspinal muscles fibrillations and positive sharp waves were missing in only 4 patients. In 80% of all the cases a sensory evoked potential could be measured from the median or ulnar nerve in spite of anesthesia, but in 65% the amplitude was reduced at least by 50% compared to the healthy side (Fig. 2).

Discussion

Criteria for the diagnosis of a radicular lesion are (Fig. 3): (1) signs of acute denervation in the paraspi-

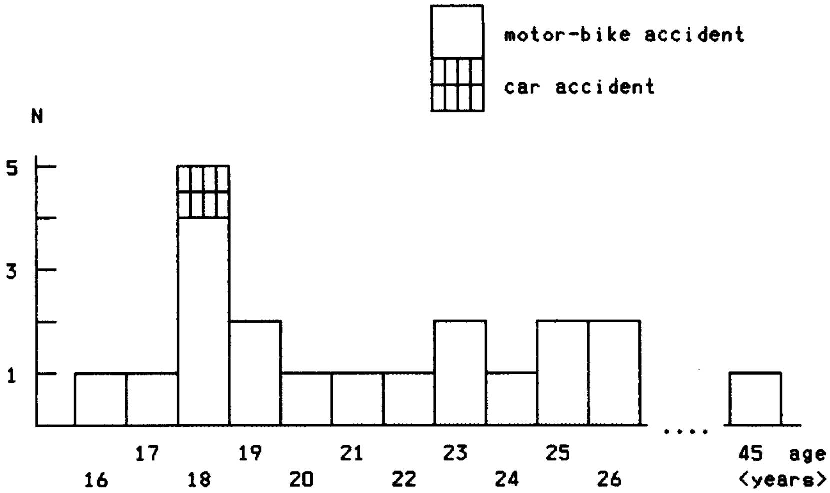

Fig. 1. Age distribution and cause of injury

	sNAP's normal	sNAP's partly preserved	sNAP's missing	
paraspinal denervation	3	11	2	patients
no paraspinal denervation		2	2	patients

Fig. 2. Distribution of electrophysiological findings (sNAP's = sensory nerve action potentials)

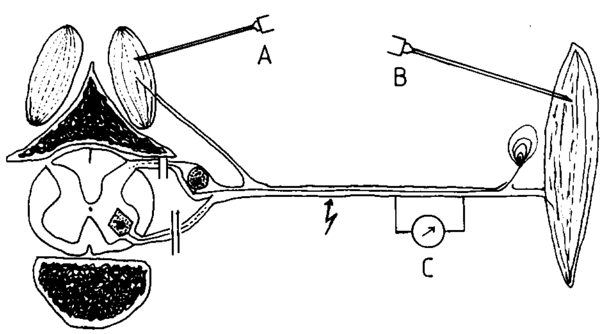

Fig. 3. Principles of electrophysiological investigations. In the case of radicular lesions as indicated in the drawing denervation activity was found in paraspinal (A) as well as in limb muscles (B). The sensory nerve action potential (C) persists despite of anesthesia because the distal axon of the pseudounipolar neuron remains connected to the soma and keeps its normal electrophysiological properties

nal muscles [4], and (2) the persistance of an evoked sensory nerve action potential despite long standing anesthesia [2, 7] without signs of involvement of the CNS. Indicators of an infraganglionar lesion are the reduced amplitude of a sensory evoked potential and vegetative alterations, e.g., the reduction of sweating [12].

On these criteria at least 65% of the patients examined had combined injuries of infra- and supra ganglionar structures (Fig. 2). Besides this, only sensory nerve potentials with respect to the lower brachial plexus of the arm were measured, thereby lesions of other fascicles were omitted using this method. In a few cases poorly relaxed patients made the recording of spontaneous activity in paraspinal muscles impossible. Therefore the portion of combined and extended lesions may have been even higher. Denervation signs in paraspinal muscles indicate a severe defect, in at least some patients, an avulsion of nerve roots. Incomplete radicular injuries have a worse prognosis concerning functional improvement if combined with an additional distal lesion. In 11 of our patients signs of reinnervation were shown electromyographically on repeated examination, but regularly it was confined to single muscles, only in 2 cases did voluntary muscular contraction became visible, and in none of our patients was the reinnervation sufficient for any useful function of the damaged arm. The time of observation in most cases is too short for final conclusions, but without doubt the prognosis for functional recovery is very poor.

Severe posttraumatic paralytic lesions of arms are epidemiologically, etiologically, concerning their severity, and concerning their prognosis, an uniform group. Besides head trauma and fractures of extremities these injuries are typical for motor-bike accidents. The younger age group has a special affinity for motor-bikes and little driving experience. The introduction of the protective helmet is a great progress in the prevention of often fatal head trauma [10], but the structures of shoulder and neck are still exposed to direct or indirect impact. Lesions of the brachial plexus and the cervical roots including avulsion can be caused by traction of these structures [8, 11]. The forces acting on the cervical nervous tissue result from falls at high speeds [5]; the deceleration of head and body is not usually simultaneous, but either the head or the shoulder strikes the ground, the crash-barrier, or something else first whilst movement of the other parts is still in the primary direction for a short time. Using helmets does not increase the rate of neck injuries [1], nevertheless a helmet enlarges the mass of the head, therefore the forces acting on the neck and adjacent structures during an acceleration or deceleration increase. Computer simulations, made for acceleration/deceleration in anterior/posterior direction have shown that head angular rotation and head angular velocity after sudden horizontal deceleration increase with the weight of the helmet [9].

The persisting paralysis of an arm causes serious consequences for the individual manner of living, but also in the social context, and results in a great financial burden on the victim and involved insurance companies. Therefore strong efforts should be made to decrease these aftermaths of motor-bike accidents. Additional protective devices are necessary for prevention. Computer simulations indicate that the use of helmet restraining collars could reduce the hazard of neck injury in deceleration trauma [9]. Other solutions of the problem might be possible. The basic principle in the pathogenesis of combined radicular and plexus lesions is the dissociation of movements of head and body, any device capable of preventing this mechanism should be tested regarding its practicability. Lastly its introduction will depend on European standards concerning protective helmets with regard to the described type of injury.

References

1. Balcerak JC (1978) Moped, minibike and motorcycle accidents. N Y State J Med 78:628–633
2. Benecke R, Conrad B (1980) The distal sensory nerve action potential as a diagnostic tool for the differentiation of lesions in dorsal roots and peripheral nerves. J Neurol 223:231–239
3. Bonney G (1959) Prognosis in traction lesions of the brachial plexus. J Bone Joint Surg 1:4–35
4. Bufalini C, Pescatori G (1969) Posterior cervical electromyography in the diagnosis and prognosis of brachial plexus injuries. J Bone Joint Surg 51:627–631
5. Eichenberger M (1982) in Mumenthaler M, Schliack H (eds) Läsionen peripherer Nerven, 4. Aufl. Thieme, Stuttgart, pp 163–168
6. Fasshauer K, Huffmann G (1976) Armplexusschäden durch Motorradunfälle – Katamnesen. Rehabilitation 15: 103–107
7. Fincham RW, Cape CA (1968) Sensory nerve conduction in syringomyelia. Neurology 18:200–201
8. Frykholm R (1952) The mechanism of cervical radicular lesions resulting from friction or forceful traction. Acta Chir Scand 102:93–98
9. Huston RL, Sears J (1981) Effect of protective helmet mass an head/neck dynamics. J Biochem Eng 103:18–23
10. Muller A (1980) Evaluation of the costs and benefits of the motorcycle helmet laws. Am J Public Health 70:586–592
11. Sunderland S (1974) Mechanisms of cervical root avulsion in injuries of the neck and shoulder. J Neurosurg 41:705–714
12. Swash M (1986) Diagnosis of brachial root and plexus lesions. J Neurol 233:131–135

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