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**SPINAL CORD LESIONS AFTER DIAGNOSTIC AND
THERAPEUTIC PROCEDURES**

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Abstract. This paper is dealing with spinal cord lesions following diagnostic and therapeutic procedures according to the literature and some personal observations. It becomes quite clear what prices have to be paid using modern methods. There are not only surgical procedures involved. Spinal cord lesions following medical activities cannot be judged as malpractice in any case. Some of these accidents can be avoided by strong indications and sophisticated performance of any procedure.

Key words: Spinal cord lesions; Diagnostics; Therapy; Malpractice; Literature review.

Introduction

THIS is an attempt to review the literature about the different diagnostic or therapeutic measures, which may result in spinal cord lesions. Related publications are largely scattered over the literature and often hidden in the papers (Meinecke, 1976). Although this review may not claim to be complete, it may serve as survey for the today's main topic. We shall see, there are not only surgical procedures involved. It should become quite clear what prices have to be paid to use modern methods of assessment as well as of treatment. In consequence it is mandatory to be as much critical as possible with regard to the indications of special methods as well as to their performance. It is not the aim of this presentation to accuse anyone. We want to show the risks inherent in some medical practice. It's not malpractice in any case, where such a severe complication as tetra- or paraplegia is the result of the physician's management. Aggravation of a pre-existing paralysis will not be included in this paper as it would break its frame. Although such events are not very rare.

Traumatology

There are certain types of injuries very often combined with fractures of the spinal column and/or spinal cord lesions, such as falls, crushes, head injuries or diving into shallow water. This must be kept in mind during first aid, rescue and transport. Rescue and transport should be careful and safe, with continuous head-traction in cases with cervical-spine lesions (Meinecke, 1974). Spinal

injuries are often overlooked, if incomplete or insufficient radiographs are accepted by physicians, especially in case of injuries of the lower cervical spine. We ourselves have learned of those cases, which were described by Botterell *et al* (1975), Braakman & Penning (1971, 1976), Guttman (1973) and Sussman (1977). Four of 100 cases are mentioned by Paakkala *et al.* (1978). These failures can be avoided by special techniques of focussing or tomograms. They can be repeated after some weeks. Scher (1977) describes a tetraplegia after a previously missed fracture of the odontoid process after internal fixation of a leg fracture in a patient with multiple injuries.

Positioning of the cervical spine only may be hazardous to the spinal cord in cases with great instability of the spine, with marked spondylosis, with ankylosing spondylitis or pre-existing anomalies of the cervical and cranial vessels. Among others this is reported by Klems (1977) and Leslie (1977). No previous trauma is essential under such circumstances. One case with moderate degenerative changes of the cervical spine and a second one with bilateral stenosis of a severe degree in the proximal parts of the vertebral arteries is described by Fogelholm and Karli (1975).

Overtraction of the cervical spine in cases of disrupted ligaments may lead to tetraplegia, this may occur even in treatment with so-called 'normal' head-traction. This has been confirmed by Braakman and Penning (1971 and 1976), Burke (1971), Fiebrand (1964), Fielding and Hawkins (1977), Fried (1974), Guttman (1971) and Rogers (1957).

Following these experiences one cannot agree with Paakala *et al.* (1978) recommendation to confirm the diagnosis in recent cases by functional radiographs, when in doubt about a spinal lesion.

Braakman and Penning (1971, 1976) and Rogers (1957) give reports about cervical spinal lesions following reduction manoeuvres of a displaced vertebra.

Botterell *et al.* (1975), Geisler *et al.* (1966), Rogers (1957) and Sussman (1977), are dealing in their rather impressive papers with spinal cord injuries either starting or increasing after first aid, diagnostic and acute care. Three to 67 per cent got worse. In 10 per cent reported by Rogers there are dislocations of the cervical spine only.

Reports about birth injuries as a cause of spinal cord injuries are presented by Abroms *et al.* (1973), Allen (1976), Aufdermaur (1974), Burke (1976), Eimer (1972), Fontan *et al.* (1964), Franken (1975), Huke (1974), Rüdiger and Wöckel (1972), Towbin (1964) and Weber *et al.* (1974). There are particular risks in pelvic and breech presentations. It is felt, that traction in combination with ante- or retroflexion and simultaneous rotation of the cervical spine are the main causes for the impairment of the stretched and twisted spinal cord.

As a prophylactic measure caesarean section is recommended. However there are also descriptions by Allen (1976) and Towbin (1964) about birth injuries in vertex presentation after vaginal delivery.

Braakman and Penning (1971) and Rogers (1957) give communications about cervical cord injuries following intubation in recent spinal injured patients.

The question of late sequelae is still under discussion. Responsibility is given to missed fractures in particular at the odontoid process of C2, continuous displacement, malalignment, instability and posttraumatic stenosis of the spinal canal. They may lead to mechanical irritation and vascular disturbance of the cord. The intervals may extend from a few months to many years (Braakman & Penning, 1971, 1976; Lausberg, 1969; Rogers, 1957; Verbiest, 1969). As a prophylactic method proper reduction even with surgery is recommended by Lausberg (1969).

General methods

There are methods of examination or treatment which may result in spinal cord lesions without any preceding trauma. Some of them are also used in traumatology. That may increase the risks.

McLaughlin *et al.* (1976) gives a report about an anterior cord syndrome after a needle biopsy done because of a suspected inflammation of an intervertebral disk.

In angiographies of the vertebral arteries Seitz and Hintze (1976) feel that vaso- or neurotoxic reactions, injections of the contrast medium in the wrong place and anomalies of the vessels are the main causes of following spinal cord lesions. Artery-malformations or variations are described by Kunert (1970) in 41 per cent, by Mehalic and Farhat (1974) in 92 per cent of the population. Moseley and Trees (1977) report about a paraplegia after intramedullary and subarachnoid extravasation during angiography, caused by a sudden rise in intraluminal pressure resulting in rupture of the pathological vessels of a haemangioblastoma. According to McAfee (1957) paraplegia occurs in 0.2 per cent after lumbar aortography. Killen and Foster (1966) collected 60 cases from the literature in 1960. Belan *et al.* (1969) consider the disadvantages of lumbar aortographies as a consequence of the danger of touching the lumbar arteries. In their experience there are no serious complications with high translumbar aortography. Dux *et al.* (1972) report that the use of catheters has less risks in aortography. Hughes and Brownell (1965) explain, as well as other authors, that the complication ratio is closely related to the kind of contrast medium that has been used. In a single case they found like other observers no evidence of trauma or thrombosis in either the aorta, the intercostal or lumbar arteries or the spinal cord vessels. If there are premonitoring signs, the use of 5 mg of Diazepam through the catheter is recommended by Broy (1971). A review of the literature was given in 1967 by DiChiro (1967) with 84 cases of paraplegia following thoracic or lumbar aortography and selective angiography of the bronchial arteries.

According to Labadie (1974) a tetraplegia occurred in a patient treated for pain reasons with 325 mg of Aspirin three times a day for three days. This was caused by an epidural haematoma at the C6/7 level. Kohli *et al.* (1974) describe an epi- and subdural and subpial haematoma 49 hours after a regular treatment with 6,000 I.U. of Heparin every 4–6 hours, resulting in a T10–12 level paraplegia. An epidural haematoma of 7 cm of length was according to Schicke and Seitz (1970) the result of a 5-years' treatment with Dicumarol, resulting in an incomplete paraplegia. Their paper deals with 14 other cases from the literature. Langohr (1975) feels in his survey of the literature, that there may be probably some additional factors such as unknown impairment of the vessels. The risks will increase in elderly patients or when combining the anticoagulant therapy with antibiotics or laxatives.

Tönnis and Bischof (1967) reviewed the literature and found 31 cases with spinal cord lesions after spinal anaesthesia and 15 additional cases after paravertebral blockage. To their opinion the lack of the a. radicularis magna or a generalised collapse are the main reasons for the disturbed blood supply of the spinal cord. Abdulla *et al.* (1976) and Stöhr and Mayer (1976) do not mention intended spinal or peridural anaesthesias as a cause of spinal cord lesions. A case following a spinal anaesthesia immediately is described by Schwarz and Bevilacqua (1964). These questions are discussed in detail by Erbslöh and Puzik (1959). They report about intradural administration of unsuitable drugs. There is a

close relation to successful or unsuccessful lumbar punctures. They are reported by Dulac *et al.* (1975), Guttermann (1977), Kirkpatrick and Goodman (1975), Messer *et al.* (1976) and Rengachary and Murphy (1974). We saw a similar case. The spinal cord lesion is mostly due to sub- or epidural haematomas.

There are many reports on spinal cord injuries following spinal manipulations. When the cervical spinal cord is affected, mostly there is a combination with brain stem injury. Even deaths are reported. Special publications have been given by Adams (1976), Baker (1977), Gutmann (1954), Hensell (1976), Hipp (1961), Hirschmann (1978), Hooper (1973), Kuhlendahl (1957), Lewitt (1977), Livingston (1971), Lorenz and Vogelsang (1972), Lyness and Wagman (1974), Maigne (1969), Mehlic and Farhat (1974), Mueller and Sahs (1976), Rageot (1976), Rinsky *et al.* (1976), Schlegel (1968), Schmitt (1976), Simeone and Lyness (1976) and Smith and Estridge (1962). In the cervical region malformations of the vessels or bone, mechanical or spastic disturbances of the vessels, sudden retroflexion of the spine with simultaneous rotation are said to be responsible for the spinal cord lesions. A decrease of blood circulation is well known within the physiological limits of head movements also. This is likely only one factor in this very complex system. In the lumbar region it is felt that an incomplete intervertebral disk prolapse will become complete by manipulations in particular in combination with general anaesthesia. Hensell (1976) and Kuhlendahl (1957) estimate such a procedure under general anaesthesia as malpractice. Bäker (1977) doesn't agree with that. Errors in diagnostic conclusions are dealt with, in particular missed tumours, as a cause of spinal cord injuries after manipulations. Many non-medical people are using this method. There is a great number of unknown cases. In the cervical spine Maigne (1969) and some other authors recommend a retroflexion and rotation as an attempt before the manipulation is started. In his opinion, there will never occur an accident if there is a proper indication and a regular performance of the manipulation. We cannot entirely agree with that. The whole problem is a very complex one, particularly in the upper cervical spine (Meinecke, 1977). We ourselves remember one case with brain stem and spinal cord lesion and another one with paraparesis after manipulations at the cervical and the lumbar spine respectively.

Reports about secondary myelopathy due to radiation therapy of tumours near to the spinal cord at the hypopharynx, oesophagus, thyroid gland, bronchi and lungs are given by Bhavilai (1975), Critsotakis *et al.* (1974), Fogelholm *et al.* (1975), Noetzel and Weber (1974), Palmer (1976), Reinhold *et al.* (1976), Rivett (1971), Sewchand *et al.* (1978) and Sutherland and Myers (1976). The latency period is between 3 months and 4 years with an average time of 17 month (Palmer, 1976). There is a particular risk in the overlapping areas of irradiation fields. According to Palmer (1976), the incidence is 1.9 of 100 cases. According to Weber (1974) and Noetzel (1974) the causes of myelopathy are vessel impairment, immunologic reactions due to catabolic products of myelin and impairment of the vasomotor nerves. For prophylactic reasons changes of the conus' direction are recommended by Sewchand *et al.* (1978).

Kraus and Stauffer (1975), give a report about three cases of tetraplegia after cervical spine fusion of their own and seven additional similar cases from the literature. They suppose a relation between surgical intervention within the spinal canal and the occurrence of spinal cord lesion. Bonnett *et al.* (1975) describe a transection of the left hemicord in 1 per cent of patients operated upon in order to reduce a paralytic scoliosis. Paraplegia after using Harrington-rods in patients with scoliosis is reported by Dickinson (1977), Labelle *et al.* (1976), Letts and

Hollenberg (1977) and McNeil *et al.* (1974), mostly due to overstretching of the spinal cord. Laschner (1973) gives a figure of only one case with incomplete paraplegia after 157 spinal fusions with bone grafts according to Matzen in scoliotic patients, Seyfarth (1960) deals with a similar case. Laminectomies followed by spinal cord lesions are reported by Bette and Engelhardt (1955), Breitenfelder (1973), Dastur *et al.* and Maxwell and Kahn (1967). As Dastur *et al.* feel, sudden decompression of a long-standing venous congestion has its particular risks. Bäker (1977) deals with seven cases who became wheelchair-dependent after surgical removal of intervertebral disks. Winter (1976) gives a report about paraplegia after hemivertebroectomy.

Spinal cord injuries after surgery at the aorta are reported by Grace and Mattox (1977) and described by Gump (1970) after clamping the aorta infrarenal, by Piza (1973) after supra-renal clamping.

Paraplegia after intrathoracic surgery such as interventions at the aorta, the ductus Botalli, the enucleation of the oesophagus, tracheobronchoplasty, bilateral thoracolumbar sympathectomy, thoracoplasty combined with rib resection, extra-pleural decortication and transthoracic cardia- and oesophagus resection with oesophagogastrostomy is mentioned by Römer (1971). This is confirmed by observations of Bikfalvi and Caltayud-Maldonado (1967). The main reason is to be found in the several variations of the blood supply of the cord with many irregularities and the blind attempts to stop a haemorrhage, electrical or by compression. In contrast Winter (1976) doesn't believe that vessel ligation may be dangerous to the cord. We can contribute one observation of paraplegia after intrathoracic surgery.

Piscot (1967) describes one case of tetraplegia after radicolysis with electrical coagulation of a ramus spinalis in a patient with severe cervical osteochondrosis.

Paraplegia due to catheterisation of the umbilical artery in newborn infants has been described by Dulac and Aicardi (1975) and Krishnamoorthy *et al.* (1976). It is felt that this method leads to thromboembolism in the spinal vessels descending from the aorta. Therefore the catheter should be left in place as short as possible.

Finally a hemiplegia has to be mentioned due to a subarachnoidal implanted stimulator for pain relief at the C4/5 level. That caused a haematoma with spinal cord compression according to Grillo *et al.* (1974) report. An erosion of the pial vessels is supposed due to mobility of the cervical spine.

Conclusions

Although one may conclude that complications we dealt with are rare, they cannot be neglected. First of all physicians are entitled to give advantages to the patients and not to do harm to them. In any case it would be wrong to forget this fundamental rule 'nil nocere' or 'do not do harm'. May we remember the fundamental article written by Sir Ludwig Guttmann in 1978 at this point. Professional legal liability is a secondary question with regard to the importance of the physicians' responsibility to offer the best chances to the patient. Although the treatment seems to be without any risk, one has to be aware of its dangers, in order to set the advantages for the patient against the disadvantages in a realistic way. Mature considerations, without any hurry, shouldn't start for the first time when anyone has to justify his action. This should be done already at a time when there are probably still other methods available to achieve one's object.

RÉSUMÉ

Des observations personnelles et un sommaire de la littérature montrent quels prix il faut payer pour l'emploi de méthodes d'examen et de thérapie modernes. Cela ne concerne pas seulement le traitement opératoire. On ne peut pas parler d'une faute professionnelle médicale en tout cas de lésion de moelle épinière succédants. Ici, indication et exécution soigneuses sont la meilleure prophylaxie.

ZUSAMMENFASSUNG

Eigene Beobachtungen und eine Literaturübersicht zeigen, welch hoher Preis für die Anwendung moderner Untersuchungs- und Behandlungsverfahren gezahlt werden muß. Das betrifft nicht nur die operativen Fächer. Nicht jede nachfolgende Rückenmarksschädigung ist auch gleichzeitig ein Kunstfehler. Kritische Indikationsstellungen und subtilste Ausführung der Verfahren sind die beste Prophylaxe.

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