SURGICAL PROCEDURES IN GENERAL PRACTICE

This is one of a series of articles contributed by invitation

FRACTURES AND DISLOCATIONS OF THE SPINE

BY

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Mechanism of Spinal Injuries

The majority of fractures and dislocations of the spine occur at the three levels of greatest mobility: (a) in the upper cervical region (atlas, axis); (b) in the lower cervical region (fifth, sixth, and seventh cervical vertebrae); and (c) in the dorso-lumbar region (eleventh and twelfth dorsal and first and second lumbar vertebrae). A brief consideration of the effects on the spine of certain forces is essential to a clear understanding of the principles of treatment.

Vertical Compression.—This mechanism is chiefly responsible for the crush fracture of a vertebral body produced by a fall from a height on to the buttocks or heels. The force is transmitted through the anterior column of the spine, and is expended on a single vertebral body, usually the twelfth dorsal or first lumbar, which collapses and becomes wedge-shaped (Fig. 1, A). If the

FIG. 1.—A: Compression fracture—wedge deformity. B: Hyperflexion fracture—comminution. C: Hyperflexion fracture-dislocation.

force is more widely diffused slighter degrees of wedging may be seen in the vertebrae immediately above and below the site of the main crush. Another well-known but uncommon clinical type of compression injury is the fracture of the posterior arch of the atlas produced by a blow on the top of the head.

Hyperflexion.—In this mechanism the spine is suddenly bent forwards by violence applied either to the upper part of the back and shoulders or to the head. The crush fracture of the coal-miner produced by a fallen roof is the most familiar example of this type of injury. Hyperflexion fractures take one of the following forms: (a) collapse of a single vertebral body, often with comminution and rupture of the underlying intervertebral disk (Fig. 1, B); (b) the classical fracture-dislocation of the lower cervical or dorso-lumbar region in which the pedicles are broken or, less frequently, a dislocation takes place at the intervertebral joints. This is followed at once by forward displacement of the vertebral body and a narrowing of the spinal canal immediately below (Fig. 1, C). In a certain proportion of cases the displacement

undergoes spontaneous recoil. In fracture-dislocations accompanied by cord injury the violence is often unusually severe, and well-marked bony displacement is the rule. The neural lesion is coincident with the bony injury and may be a simple contusion or a complete transection of the cord. Where bony displacement persists the cord becomes attenuated at the site of the protrusion.

Rotation.—Rotation, combined with flexion, is the force producing subluxations or dislocations of the cervical spine unaccompanied by fracture. These uncommon injuries, of which several types are described, may result from comparatively trivial violence. The best-known type is the unilateral forward subluxation at the level of the fifth or sixth cervical. Involvement of the cord or nerve roots is rare, except in the bilateral dislocations, which may be immediately fatal.

Hyperextension.—Hyperextension fractures of the spine are exceedingly rare. In this type of injury the compression force falls on the posterior part of the anterior column. If the broken vertebral body is comminuted the risk of protrusion of a fragment into the spinal canal is considerable.

Hyperextension of the head combined with vertical compression is the mechanism concerned in fractures of the odontoid process of the axis.

First-aid Treatment of Spinal Fractures

Although the treatment of fractures and dislocations of the spine demands all the resources of the modern fracture clinic the fate of the injured individual may be influenced for good or ill by methods used in administering first aid or during the transport of the patient to hospital. A study of the mechanics of spinal fractures suggests that a movement or posture which tends to perpetuate the crushing force in a compression fracture, or to increase the displacement in a fracture-dislocation, will be harmful or even disastrous. In the great majority of spinal fractures the dangerous movement is forward flexion of the trunk or neck. It is important, therefore, to lay down certain rules of conduct for the guidance of those who may find themselves responsible for the emergency treatment and transport of an individual with a suspected or proved fracture of the spine.

1. The public should be taught that an injured person who has lost the use of his arms and/or legs should not be lifted or carried before the arrival of a doctor or trained ambulance worker.

2. In a fracture of the dorso-lumbar region the patient should be carefully rolled over on to his face and a pillow placed under the upper part of the chest. This manœuvre alone may be sufficient to reduce a fracture-dislocation. In lifting him on to the stretcher the position of extension of the spine should be maintained. If no stretcher is available at the site of the accident—as at the seam-face in a coal-mine—the victim should be carried to the first-aid post in the prone position.

3. When a spinal fracture is accompanied by a severe chest injury, a head injury, or by fractures of the lower limbs, the prone position may be impracticable or dangerous. In such circumstances the spine should be extended by placing

a firm support under the back at the level of the injury. During transfer to the stretcher care must again be taken to avoid any movement of flexion.

4. In a fracture of the cervical spine the prone position is also contraindicated. Extension should be temporarily obtained by placing a small pad underneath the neck. It should be remembered that lifting the head to enable the patient to drink from a cup is a dangerous action. When a patient with a high spinal fracture is moved, firm traction should be applied to both the head and the lower limbs.

5. On arrival at hospital, if the patient is not severely shocked, radiographs should be obtained without delay. All films should be taken without altering the position of extension for a single moment.

Recent Crush Fractures

The exact anatomy of a spinal fracture should be clearly defined in both antero-posterior and lateral radiographs

FIG. 2.—Davis (a) and Watson-Jones (b) methods of reduction of crush fractures by postural hyperextension.

before deliberate reduction is attempted. The deformity of a crush fracture should be corrected in all patients who are young or in the prime of life, and who may reasonably be expected to return to arduous occupations. Reduction aims at restoring the full vertical height of the wedged or comminuted body.

In the case of compression and hyperflexion fractures in the dorso-lumbar and lower dorsal regions reduction is achieved by hyperextending the spine to its limit, utilizing the tension of the intact anterior common ligament as an aid to reduction and as an internal splint to maintain reduction. The simplest and most effective methods of reduction are those devised by Davis and Watson-Jones. In the Davis method the patient, lying prone, is slung by the heels (Fig. 2, a). In the Watson-Jones technique the patient is suspended between two tables with the trunk unsupported, a position which allows the lumbar spine to sag into the maximum degree of hyperextension (Fig. 2, b). For the reduction of recent fractures no anaesthesia is required. When the maximum hyperextension has been obtained a closely fitting plaster jacket is applied over a layer of stockinet. The jacket extends in front from the pubis and groins to the clavicles and is cut out behind over the upper part of the dorsal spine (Fig. 3). In this way the

hyperextended position is continuously maintained and forward flexion of the spine is impossible. The accuracy of the reduction should be confirmed in radiographs taken in two planes. A second jacket should be applied some three weeks later when the original jacket has become less close-fitting. At this stage a check lateral radiograph should be obtained.

It is generally agreed that early ambulatory activity should be encouraged in crush fractures of the spine. Much depends on the age, temperament, and physical condition of the patient. The younger individuals should be allowed to sit up after a few days and to walk at the end of a week. Elderly patients—and more especially those with fractures in the mid-dorsal region, where complete anatomical reduction is rarely, if ever, achieved—can with advantage be kept in bed or on a couch for the first three or four weeks.

The position of hyperextension should be maintained until there is clinical and radiographic evidence of consolidation of the fracture. This will generally mean that the spine must be immobilized and protected for not less than four months from the time of the injury. During the latter part of this period many patients are able to engage in light duties. After the final removal of the jacket a rehabilitation programme is arranged. The functional and anatomical results of the treatment of crush fractures of the vertebral bodies by the method of hyperextension are most gratifying. Seventy-five per cent. of the patients so treated should be able to return to their original occupations.

With hyperextension fractures the method of reduction described is definitely contraindicated, for the obvious reason that further hyperextension of the spine may produce cord damage. In these cases the jacket should be applied with the spine in the ordinary neutral position.

FIG. 3.—Plaster jacket maintaining hyperextension.

Old Fractures: Kummell's Disease

In the case of crush fractures undiagnosed in the early stage or treated ineffectively, the patient may later present himself complaining of backache, persistent rigidity, or increasing deformity. This clinical picture, when appearing after a long interval, was formerly known as Kummell's disease (spondylitis traumatica). The treatment to be considered in such cases is: (a) a period of rest followed by the fitting of a support—a course suitable for elderly patients who cannot hope to return to heavy duties; or (b) in the younger individuals the operation of spinal fusion, which is generally effective in curing the backache.

Correction of Fracture-dislocations

CERVICAL REGION

The common fracture-dislocation of the cervical spine with forward displacement at the level of the fifth or sixth vertebra calls for prompt correction. If the signs of cord or root compression are present no time should be lost. Two methods of reduction are available.

Reduction by Manipulation.—The technique devised by A. S. Taylor of New York has been successfully used for some years by many different surgeons. The patient

is placed on a fracture table and a halter applied to the head. A stout cord or rope is attached to the side rings of the halter and passed round the waist of the surgeon. With the neck securely controlled between the surgeon's hands, steady traction is now exerted by a backward movement of the body. Counter-traction is provided by the fixation of the lower limbs to the traction bars of the table. The traction force is first applied in very slight flexion in order to disengage the articular processes. When the neck is felt to elongate, the head and upper part of the spine are allowed to drop back into the position of extension. The accuracy of the reduction is checked in a lateral radiograph, and the head and neck are then fixed in a plaster-of-Paris cast.

Gradual Reduction by Continuous Traction.—This is a recent innovation which has already proved to be particularly effective in the reduction of fracture-dislocations of the upper part of the cervical spine (Mackenzie, Turner, Cone, Crutchfield, and others). The traction is applied direct to the skull either by special tongs which perforate the outer table or by wires passed through drill-holes and connected to a cross-bar (Fig. 4). The

FIG. 4.—Skeletal traction on the head in fracture-dislocations of the cervical spine. (The diagram inset shows the application of the tongs to the skull.)

points of attachment to the skull should be chosen so that the pull is in the long axis of the cervical spine. Counter-traction is provided by raising the head of the bed. A weight of 10 to 15 lb. may be required for a short time to correct gross displacement.

In recent fractures the reduction takes place almost immediately. In fractures of some weeks' standing correction is a gradual process. In cases without cord injury, if the patient is in good condition, the tongs can be removed after the reduction has been confirmed in the lateral radiograph and a "Minerva" plaster jacket applied. In severe cord lesions it is wise to keep up light traction (that is, 4 or 5 lb.) for ten to fourteen days, and if the patient survives this critical period to apply the plaster at a later stage. This method of skeletal traction enables a paraplegic patient to be nursed with safety and comfort. In this respect alone it undoubtedly represents an important advance in the technique of treating fractures.

Skeletal traction is of course inapplicable if there is infection of the scalp.

It will be realized that the reduction of a fracture-dislocation of the cervical spine by either of the methods described requires special training and a high degree of manipulative skill, as well as the necessary armamentarium.

DORSAL AND DORSO-LUMBAR REGION

In hyperflexion fracture-dislocations without cord injury reduction by hyperextension should be carried out as soon as the patient is fit.

In paraplegic cases, although the fate of the cord has been determined from the moment of the injury, the correction of gross displacement is no less essential. The precarious condition of many patients during the first few days, however, makes the ordinary reduction and application of a plaster jacket a distressing and hazardous undertaking. Where for good reasons it is necessary to veto or postpone any attempt at complete correction the patient should be placed in the hyperextended position in a well-padded bivalved plaster bed in which he can be turned repeatedly without flexing the spine. If an air mattress is used hyperextension can be obtained by inserting a rolled blanket under the mattress at the level of the lumbar spine (Byron Stookey).

In a small proportion of fracture-dislocations of the dorso-lumbar region, accompanied by severe injury to the lower end of the cord and roots of the cauda equina, reduction by manipulation or by gravity is impossible owing to interlocking of the dislocated articular processes. In such cases hyperextension not only is ineffective but is also a dangerous manœuvre, which may inflict grave additional damage on the cord or nerve roots. When this type of dislocation is recognized the correct procedure is to operate and remove the superior articular process of the vertebra immediately below the displaced body. This allows the articular processes to be realigned and the displacement of the body corrected.

Treatment of Paraplegia

The modern methods of reduction of fracture-dislocations have entirely supplanted the operation of laminectomy. Despite increasing experience in the handling of spinal fractures the mortality in cases with neural involvement continues to be high. A number of patients die in the first few days from shock or from the effects of other injuries. Of the survivors, some die during the first few weeks from such complications as urinary tract infection, bedsores, or pneumonia. Patients who reach the stage of reflex cord function may live for many years, and in the less severe cord lesions a useful measure of control over the paralysed limbs may be regained.

The prevention of bedsores and contractures and the care of bladder and bowel function demand skilled nursing. The areas of skin in contact with the air mattress or plaster bed at points of greatest pressure should be constantly shifted by gentle stroking. The prevention of urinary infection is the greatest responsibility of all. In a few patients the bladder may be emptied by pressure, but in the majority some form of regular catheterization is necessary. This must be done with the strictest aseptic precautions. A safe and effective method is to use an in-dwelling catheter, changed every five or six days. The bowels should be regulated by mild aperients or enemata, and over-distension should be avoided. The paralysed limbs should be supported in the standard positions, and after the stage of spinal shock is

over all joints should be gently moved through a full range each day. Energetic stretching is to be condemned, as it tends to increase the muscle spasm. When there is recovery of useful cord function the patient may be allowed to get up and re-education in walking may be begun.

Dislocations of the Cervical Spine

There is usually no difficulty in reducing by manipulation the slighter degrees of subluxation of the cervical spine. After a short period of protection in a light plaster collar full recovery of function rapidly takes place. In the rare bilateral dislocations with signs of cord pressure reduction by manipulative traction or skeletal traction should be attempted without delay.

Fractures of the Atlas and Axis

Fractures of the posterior arch of the atlas are often overlooked owing to the mild disability to which they give rise. Stiffness of the neck and occipital neuralgia following a fall on the head are symptoms which should arouse suspicion. When the fracture is recognized a plaster "doll's collar" should be worn for four to six weeks, but the patient can be allowed to lead a free ambulatory existence.

Fracture of the odontoid process of the axis may occur alone or may be associated with fracture of the atlas. In the early stages there is obviously a serious risk of displacement and of a fatal result. With prompt and efficient immobilization sound fibrous or bony union takes place in eight to twelve weeks. In an odontoid fracture the head and neck must be securely fixed in a well-fitting plaster cuirass, which prohibits all movements at the injured site. In this, with due precautions, the patient can be ambulatory. Complete immobilization should be maintained for not less than eight weeks. After this the chin and occiput should be supported by a light collar for another two months. In cases treated early the results are excellent.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE

The annual report of the London School of Hygiene and Tropical Medicine for 1937-8 suggests that the School has had an active and successful year. The usual courses of instruction were given in public health, tropical medicine and hygiene, and bacteriology, and the classes were well attended. The policy of providing short courses of instruction for non-medical men and women has been extended by the institution of a conference on the applications of physiology and psychology to problems of industry. The object was to provide for persons holding supervisory posts in industry an opportunity of learning something of recent advances in research bearing on the health of the industrial worker. It is announced that a similar course will be held in February, 1939. A conference on the control of malaria organized by the Ross Institute principally for planters and mining engineers attracted a record attendance of 186. The organization of courses of instruction for laymen is perhaps an unusual activity for a medical school, but there can be no doubt of the value of such work in the case of a school concerned primarily with the preventive aspects of medicine.

Research during 1937-8

The principal lines of research reported by the School last year have continued to be prosecuted. The Departments of Bacteriology and Biochemistry have made satisfactory progress with their joint work on the isolation of

purified antigenic compounds from pathogenic organisms, including those of typhoid and whooping-cough. Professor Robinson of Oxford is now associated with this work, and it is being in part supported by the British Dyestuffs Corporation, a subsidiary of Imperial Chemical Industries Ltd. The long-range study of experimental epidemics, which is supported by a grant from the Medical Research Council, has been continued jointly by the Departments of Bacteriology and Epidemiology. The work in 1937-8 has confirmed the preliminary findings of the previous year—namely, that a diet containing a proportion of animal protein, when compared with a diet that includes vegetable protein only, not only makes individual mice more resistant to infection with *Bact. typhi-murium* but significantly reduces the mortality in herds in which the disease is spreading by natural contact. The Department of Entomology has paid special attention to the habits of insects of medical importance in relation to climatic factors. On behalf of the Medical Research Council an investigation into the biology of the bed-bug has been continued, and climatic conditions have been studied in relation to its mortality and its ability to hatch. Studies of various species of anopheline mosquitos have included research in Assam on the effects on *Anopheles minimus* of microclimates, particularly in relation to humidity; and a laboratory study of the effect of both high and exceptionally low concentrations of chlorides and other salts in water on the larvae of mosquitos. This latter work has involved the development of a technique of chemical estimations on a minute scale. Dr. Hamilton Fairley made a further visit to Macedonia, and he suggests that the anaemia which is found to occur extensively there results from the prevalence of malaria in a population suffering from dietary deficiency. The Laboratory of Industrial Physiology undertook, at the request of the General Post Office and of the Union of Post Office Workers, an investigation of the energy expended by postmen when delivering letters from house to house, and when ascending and descending long flights of stairs in blocks of flats. It is announced that an arrangement has been entered into with the International Wool Secretariat under which the laboratory will undertake a programme of research into the hygienic properties of clothing. The Institute of Agricultural Parasitology, which is associated with the Department of Medical Parasitology in the School, has acquired an out-station at Gamlingay on the borders of Cambridgeshire and Bedfordshire with a view to extended field work on eelworm disease in potatoes.

Work Over-seas

The School has developed its overseas contacts. Through the Ross Institute it has maintained a branch in India which is principally concerned with measures for the control of malaria on tea estates in Assam and in South India. A branch has been set up in Ceylon to co-operate with the Ceylon Estates Proprietary Association; and it is announced that arrangements have been completed for the establishment of a branch in West Africa which will be associated with a group of industrial firms, principally mining companies, operating on the Gold Coast. The Ross Institute has continued to advise industrial concerns in the selection of medical officers for appointments over-seas.

The Order of St. John and the British Red Cross Society have arranged, through the Ministry of Pensions, as in previous years, to provide additional comforts for the men actually in Ministry hospitals on Christmas Day. There are, however, ex-Service pensioners who will be patients in other hospitals as a result of their war disabilities, and the Joint Council of the two bodies is endeavouring to get in touch with these hospitals, so that no eligible cases in hospital on Christmas Day may fail to receive the same gifts as those in Pensions hospitals.