

additional damage to the already injured spinal cord. The management of paralysed bladder, bowel and sexual functions, the problems of spasticity, reflex responses of autonomic mechanisms, pressure sores, the physical and psychological readjustment of the paralysed and his vocational and social re-integration are, today, of paramount importance for the future life of the paralysed and constitute a whole-time study.

A new speciality has been born, and the medical profession and the public at large should become more and more conscious that the spinal specialist who is concerned with the *whole* treatment and rehabilitation of paraplegics and tetraplegics is no less a specialist in his own right than, say, a chest physician, E.N.T. surgeon, medical or surgical neurologist, orthopaedist, or urologist. Until this is officially recognised by Government Health and Medical Authorities, young members of our profession will hesitate to take up this work as a proper training in this subject of medicine. The great danger is that the advances achieved over the years may be lost through lack of continuity.

I feel that this meeting today is the right occasion to put these views on record, as a basis for further thought with a view to finding the best ways of developing a specialised service in paraplegia all over the world.

### **Main Subject I**

#### *The Initial Treatment of Traumatic Paraplegia and Tetraplegia*

##### **1. PATHOLOGICAL PRINCIPLES IN THE INITIAL TREATMENT OF TRAUMATIC SPINAL CORD DAMAGE**

By G. M. BEDBROOK

*Paraplegic Unit, Shenton Park, Perth, Western Australia*

TREATMENT of all medical and surgical conditions is governed by a knowledge of their essential pathology, both morbid and experimental. Such should be the case with the initial treatment of traumatic spinal cord damage. An examination of cases coming to post mortem in both early and late stages has convinced the author of the fundamental necessity for conservatism in almost 100 per cent. of cases of spinal cord injury with cord damage. The pathological principles which govern this decision are as follows:

1. The importance of the consideration of blood supply to the spinal cord and its relationship to trauma.
2. The mechanism by which trauma is caused to the spinal-column flexion, extension, rotation.
3. The mechanism by which the spinal cord is damaged; crushing, stretching, compression, flexion and extension.
4. The types of pathological syndromes which are observed.

#### **In the Acute Stage**

- i. Neural:
  - (a) No macroscopic damage whatsoever.
  - (b) Gross haematomyelia of the cord.

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- (c) Gross crushing of the cord.
  - (d) Subarachnoid and extradural haemorrhage.
- ii. Bony:
- (a) Fracture dislocation (with disc changes).
  - (b) Extension injury.

### **Subacute Stage**

- i. Collequative necrosis; the various factors which cause the collequative necrosis.
- ii. Central cysts of the cord.
- iii. Early scarring of the cord.
- iv. The organisation of the extra-dural clots and the sub-ligamentous haematomata.

### **The Chronic Phase**

In specimens examined many months and years after accident, the predominating factor is the presence of severe scarring in all layers. Such scarring is considered to be the real problem in the useful recovery of incomplete cord lesions and in consideration of the problem of deterioration of paraplegia at a much later date.

With a firm knowledge of these pathological principles and facts, the author believes that a rational method of treatment can be undertaken. These pathological principles explain the almost universal rejection of operative interference in such cases in the early stages; such operative interference can do very little to affect the pathological principles which have been enumerated. Rarely is compression found to be the continuing cause of spinal cord damage in such cases as these.

The clinical experience accumulated in Australia has been analysed in regard to these pathological principles and will be reported. Careful observation shows that:

- (a) Movement at the fracture site is minimal with proper nursing.
- (b) That cervical spine fractures adequately reduced are usually stable and can be maintained by conservative methods.
- (c) Non-union is a rarity in lumbo-dorsal fractures and uncommon in cervico-dorsal fractures after adequate conservative methods.

## **2. EXPERIENCES ON RECENT TRAUMATIC PARAPLEGICS IN 25 YEARS**

By Professor Dr. W. EHALT  
*Graz, Austria*

SINCE 1940 we have treated a total number of 221 inpatients with traumatic paraplegia.

There was a sharp change in 1947—the year I visited Guttman in Stoke Mandeville. Our statistics are given in Tables I and II.

TABLE I  
Acute Spinal Cord Injuries following Fractures of the Spine, 1940-64

	Paralysis	Partial	Complete
Cervical .	86 (47)	42 (13)	44 (34)
Thoracic .	89 (31)	31 (8)	58 (23)
Lumbar I .	36 (6)	28 (3)	8 (3)
Lumbar II-V	10 (3)	6 (1)	4 (2)
Total . .	221 (87 = 34.8%)	107 (25 = 23.3%)	114 (62 = 54.3%)

( ) = dead.

TABLE II  
Spinal Cord Injuries

	1940-47—Old technique			1948-64—New technique		
	Paralysis	Partial	Complete	Paralysis	Partial	Complete
Cervical .	23 (17)	12 (6)	11 (11)	63 (30)	30 (7)	33 (23)
Thoracic .	15 (14)	6 (5)	9 (9)	74 (17)	25 (3)	49 (14)
Lumbar I .	7 (3)	5 (1)	2 (2)	29 (3)	23 (2)	6 (1)
Lumbar II-V	2 (2)	2 (2)	0 (0)	8 (3)	4 (1)	4 (2)
Total . .	47 (36 = 76.6%)	25 (14 = 56%)	22 (22 = 100%)	174 (53 = 30.4%)	82 (13 = 15.8%)	92 (40 = 43.8%)

( ) = dead.

Before 1947, the patients were treated either by skeletal traction through the tuberosity of the tibia or in lateral position.

The fate of the patients with complete paralysis was irreversible, the final death a deliverance for all—the patient, the doctor, the hospital nurses and the relatives.

**Present Treatment.** Fortunately, most of our paraplegic cases come to our hospital immediately after injury. Firstly, we make an examination with the neurologist, to ascertain exactly the level of the lesion, both clinically and by X-ray. We distinguish between partial, subtotal and complete paralysis. The X-ray also shows whether there is a fracture-dislocation or a pure dislocation. If the X-ray is negative, the diagnosis is haematomyelia. If there is even a very small motility or sensation of skin, we call this case subtotal.

All partial and subtotal lesions we quote as urgent cases and do an immediate reduction to decompress the medulla. All patients are put in a bed with foam-gum mattress and planks. For lesions in the cervical region, we apply an extension with Crutchfield tongs. For those in the thoracic region, we start immediately with rotation treatment. For fracture-dislocations in the lumbar region, which are more

unstable, we do—if the general condition is good enough—an open reduction and internal fixation either with a bone-graft from our bone bank or by metal.

In all cases, whatever the level of the lesion, the patients are turned by two nurses every hour during the day and two hours during the night from one side to another (front, back, right, left). The nurses do this by means of a blanket. We prefer this method to the turning bed, because with our system we can turn the patient in four positions and with the turning bed just two. As soon as possible, the patient helps to turn himself, except in the case of a quadriplegic. We never use a plaster cast.

The patient is catheterised twice a day and the bladder is washed out with saline. We never use a permanent catheter and thus can avoid cystitis in most cases.

Twice a day, a gymnast comes and very cautiously carries out passive exercises to the paralysed extremities.

This treatment is continued until the fracture of the spine is united, which takes about three months. After this time, the patient is transferred to the Rehabilitation Centre. In practically all cases, except very old people, we can avoid decubitus.

### 3. ON THE EARLY OPERATION OF THE SPINAL CORD INJURY

By M. KIMURA

*Department of Orthopaedic Surgery, Tohoku Labour Accident Hospital, Japan*

THE study is based on an investigation of 600 cases compiled with the help of Labour Accident Hospitals in Japan and the Hakone National Sanatorium.

The purpose of this study was to evaluate the operative procedures in the early treatment of spinal cord injuries. On the basis of this investigation and later experience at the Tohoku Labour Accident Hospital, the author's views are summarised as follows:

1. The best treatment for spinal cord injuries is to start rehabilitation as early as possible.
2. Although recovery of paralysis to some extent by conservative treatment only is not denied, it seems that these favourable cases would recover much better if an initial operative procedure had been performed.
3. From a surgical point of view, one should consider what could be done in each case before the patient is handed over to the Department of Rehabilitation without any attempt at operation.
4. The operation procedure for fracture dislocations is open reduction and firm fixation by metal plates to both sides of the spinous processes. This operation is combined with postero-median incision of the spinal cord (Allen's technique) as a decompressing measure. The usual laminectomy is deprecated.
5. The adequate time for the operation must be considered within hours and not days after spinal cord injuries.

### Discussion

BEDBROOK, G. (*Western Australia*), asked the speaker how quickly he could rehabilitate his cases without operation. He believed that those without operation were rehabilitated more quickly.

LIPSCHITZ, R. (*South Africa*), asked if the speaker could tell them what improvement had occurred in those cases which had not been operated upon, as he believed that the results in those cases were better than the results in the cases which had been operated upon.

KIMURA, M. (*Japan*), replied that even in the favourable cases treated only by conservative measures the ultimate condition of the patient would have been much improved if early operation had been performed. When spinal cord injuries were followed by displacement of fractured fragments he usually performed the operative measure in complete cord lesions.

GUTTMANN, L. (*Great Britain*), said that Dr. Kimura's statement that the ultimate condition of favourable cases treated conservatively would have been much improved after an early operation was an assumption for which he had given no proof whatsoever, and this could not be left unchallenged. There was abundant evidence by workers with extensive experience in this field which showed the futility and indeed danger of hasty surgical procedures as initial treatment of traumatic paraplegia. The illustrations shown by Dr. Kimura of the operated cases with simple compression fracture and only slight dislocation and the statistics Dr. Kimura presented certainly did not justify his enthusiasm for surgical interference as initial treatment of traumatic paraplegia.

## 4. THE TREATMENT OF PARAPLEGIA DUE TO FRACTURE DISLOCATIONS OF THE DORSO-LUMBAR SPINE

By A. G. HARDY

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THIS paper concerns the treatment of paraplegia due to bony injuries at the dorso-lumbar level with particular reference to the selection of cases requiring open reduction and internal fixation as described by Holdsworth and Hardy in 1954. The results are based on the experiences gained in the treatment of 214 cases, all of which were early admissions, either direct to the Spinal Injuries Unit or through the Accident and Orthopaedic Departments of neighbouring hospitals. The 214 cases comprise 13 at the D10-11 level, 61 at the D 11-12 level, 95 at the D12-L1 level, 19 at the L1-2 level and 26 in the lumbar 2 to 5 level.

It has been possible to divide these cases into two big groups so as to include those cases which received operative intervention and those that were treated conservatively. Both groups otherwise had the same routine of nursing management and the same routine of bladder and bowel control as well as a similar programme of physical rehabilitation.

The anatomical relationships of the spinal cord and its nerve roots to the bony levels is detailed and its significance discussed in the light of anatomical dissections, of operative findings and post-mortem observations associated with histological sections.

The mechanism of the different types of fracture and fracture dislocation is

outlined and shown to have a bearing on the type of spinal cord and root injury at the lower dorsal and upper lumbar levels.

The importance of the nursing routine is emphasised and the method used at the Spinal Injuries Unit at Lodge Moor Hospital in Sheffield is described.

The results of the overall regime are listed with a comparison between those cases treated conservatively with those treated surgically. The alterations in the neurological patterns did not appear to be substantially different in either group of cases. Both groups had cases which showed improvement and both groups had cases which showed some deterioration in the neurological signs. The ease of handling and the speed of mobilisation was better in the operative group than in the conservative group and none of the cases in either group had any skin lesions at any time. There was no difference in the occurrence of other complications but some of the operative group needed to have their spinal plates removed some months after injury.

### Discussion

BEDBROOK, G. (*Western Australia*), asked how long after operation the spinal pain disappeared compared with the conservative series. His own series in conservative treatment suggested no pain after 10 days.

FRANKEL, H. L. (*Great Britain*), wondered, as it was Dr. Hardy's previous communication which had largely popularised the use of spinal plating and as he had now greatly reduced and narrowed his indication, whether Dr. Hardy would take this opportunity to comment on the widespread use of plating, particularly as shown in the figures of the previous speaker, Dr. Kimura.

HARDY, A. G. (*Great Britain*), said that relief of pain after operation was very dramatic and was usually obtained in 2 to 3 days. This applied particularly to cases admitted with gross displacements. With regard to Dr. Frankel's question, open reduction and internal fixation must be reserved for specially selected cases. It was not necessary in union displacements. Open reduction and internal fixation could have advantages for patients in hospitals in remote places where there were few staff.

GUTTMANN, L. (*Great Britain*), said that Dr. Hardy's paper was of special importance, as he had clearly modified his and Holdsworth's original idea (1953) about the indications for open reduction and fixation by metal plates. They now operated much less and Dr. Hardy now stated that there was no significant difference in recovery of function between the operated and non-operated case. Therefore, he confined the operation to patients with unstable and profound dislocation of the spine and had adopted the conservative approach in the others. Dr. Guttmann regretted that he had left his slides in the Olympic Village, with which he could have shown how both unstable and profound dislocations of the spine could be most successfully reduced and consolidated by postural reduction without surgical interference.

In their original publication, Holdsworth and Hardy had claimed that open reduction and fixation by plating was a simple operation which would prevent redislocation and later angulation and promote root escape, with earlier functional recovery. Holdsworth, in a personal communication (1954), withdrew his statement that open reduction and fixation by plating was a simple procedure, but unfortunately other orthopaedic surgeons with less surgical skill in this subject had taken up this operation, and the results obtained were detrimental to a great number of patients. As Dr. Hardy had now shown by his statistics, open reduction and fixation by plating had in no way proved superior to the conservative approach, especially with regard to root escape and functional recovery.

Dr. Hardy was to be congratulated on his frank statement, and one could only hope that surgeons would take notice and abstain from hasty operative procedure as initial treatment of the fractured spine with spinal cord involvement.

## 5. CONSIDERATIONS OF EARLY SPINE FUSION FROM THE STANDPOINT OF REHABILITATION

By NOBUHISA YAKATA, HAJIME SAITO and KUNITOSHI IDE  
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SINCE 1956, 53 cases with spinal cord injuries have been cared for in our clinic. Ten of these with cervical injuries were not included in this study.

Forty-three cases had injuries of dorso-lumbar vertebrae. Nine of the 43 received early spine fusion treatment.

In the 43 cases, both in those who were operated on and those who did not receive surgical treatment, systematic and reasonable physical treatment has effected satisfactory rehabilitation.

No influence regarding the quality of neurological changes after operation has been noted. The operated cases have been observed for a period of over three years after surgery, but, as other authors have also found, early operation seems not necessary.

## 6. THE INITIAL TREATMENT OF TRAUMATIC TETRAPLEGIA

By PHILLIP HARRIS  
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ONE hundred and sixty-three patients who had sustained severe injury to the cervical spine are discussed, with particular reference to diagnosis, first aid and early hospital management.

These patients were seen over a period of several years, and the development of the proper investigation of this type of patient is traced, as is the development of the management, both nonsurgical and surgical.

Particular stress is placed on the necessity for proper first aid, ambulance and hospital services, and the latter must include special facilities for radiological investigation including myelography when indicated. A group of doctors, who are fully conversant with the many problems concerned with this very serious injury and who realise that the patient's morale, his skin and bladder must be expertly managed without any delay, must be available. The spinal injury service requires specially trained nurses, physiotherapists and other relevant staff members.

The place for tracheostomy is discussed, and special comments are made regarding postural hypotension and hyperpyrexia. Lumbar puncture does not appear to have a place in the investigation of these patients.

The author finds that patients with severe injury to the cervical spine are best treated initially on a Stryker turning frame with Blackburn skull calipers for traction and proper spinal fixation.

Surgery plays a limited part in the treatment of these patients, and decompressive laminectomy is most likely never indicated (apart for certain open wounds). However, in selected patients, in addition to reduction of subluxation and dislocation, fixation of the spine is indicated either by the use of a plastic

substance posteriorly, or by an anterior interbody bone graft. In certain other patients, decompression of the neural and vascular elements is achieved by an anterior approach to the spine with the removal of bone and disc fragments.

Because of the increasing number of traffic accidents, severe injuries to the cervical spine, both in the lower region and in the atlanto-axial region, are becoming more common and therefore more doctors and associated workers will require to become familiar with treatment of patients with these very serious injuries.

### Discussion

HARDY, A. G. (*Great Britain*), asked whether there had been any infection of the dura and brain in cases where Blackburn traction had been applied, whether the gadget for holding the caliper on the Stryker frame was available from the manufacturer and whether the speaker was using anterior approach and fusion in comminuted injuries of the cervical spine.

BEDBROOK, G. (*Western Australia*), asked how many cases had been healed by anterior decompression and what was the mortality rate. In another unit in Australia, experience had shown death rate to be greater and redisplacement had occurred even after operation of anterior spine fusion. He had one such case in his own unit.

MEINECKE, F. W. (*Germany*). Did not the prone position cause breathing difficulties in the cervical patient? Because of these difficulties, they no longer used the Stryker frame and had had good experience without the frame.

LIPSCHITZ, R. (*South Africa*), noticed that Mr. Harris was still using the Stryker frame. In the early days he, too, had used a Stryker frame, but they had tended to discard it over the past 10 years. He would like to hear of Mr. Harris's experience in using Blackburn traction on an ordinary bed with pillows *à la* Dr. Guttman. They had found the results if anything better and much more comfortable from the patient's point of view and also from the general nursing point of view, especially if a Bird or Engström respirator had to be used.

GUTTMANN, L. (*Great Britain*), asked Mr. Harris at what date he had performed anterior fusion following fracture dislocation of the cervical spine—*i.e.* whether immediately or delayed. He would like to emphasise the value of conservative treatment in these cases, because the natural forces of repair were able to produce an ideal anterior fusion of the dislocated cervical spine in the great majority of patients. Therefore, there was no indication to rush into anterior fusion. Anterior fusion should be confined, in his opinion, to those few cases where the method of reduction by head traction was unsuccessful and redislocation occurred.

He was pleased to hear that Mr. Harris condemned decompressive laminectomy, and he entirely agreed with this view from his own personal experience, having given up decompressive laminectomy some 30 years ago.

HARRIS, P. (*Great Britain*), answered as follows:

1. No infection had occurred, except in one patient where the calipers had been put in elsewhere. This patient had died from a cerebral abscess.
2. The Blackburn caliper's support was made in the Royal Infirmary, Edinburgh, by a commercial firm. It was not yet available commercially. It would be discussed in a paper to be published in *Paraplegia*.
3. They were using the anterior approach and fusion in comminuted injuries but so far had had a limited experience.
4. To date, no interbody fusion had failed to take.
5. To date, no neurological complications had arisen from the anterior operation—either for cervical spinal injury or other conditions. Over 80 patients had been treated, of whom seven had spinal cord injuries.
6. With regard to the prone position's causing difficulty in breathing for cervical



patients, they had not found this a practical problem, except for some patients who required a respirator.

7. They found the Stryker turning frame—block cum skull traction technique—preferable to nursing the patient on a bed with pillows. It was more comfortable for the patient—as borne out by the nursing staff, patients and the medical staff. There might, however, be some difficulties in using the technique with respirators.
8. They would not condemn a procedure until they had had some personal experience of it and would not accept complications by others with limited experience of the technique.

## **7. THE EFFECT OF ANTERIOR DECOMPRESSION AND INTERBODY FUSION ON THE TRAUMATIC TETRAPLEGIA**

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ATTEMPTS to re-establish nerve conduction in the damaged nerve due to cervical injury had been directed mainly to the posterior decompression during the earliest possible period after trauma. The method has been tested and it still deserves continued use as a method of early surgical treatments. However, it is also true that on many occasions the posterior decompression, although it was properly done at proper time, failed to improve the neurological symptoms.

In a group of tetraplegic patients treated with or without early posterior decompression and skull traction for some time, anterior decompression combined with interbody fusion was done in the later date. The procedure resulted in definite improvement of the neurological symptoms. Mobility and sensations of the upper extremity have been improved post-operatively. This would suggest that disability of the upper extremity is not only caused by the damage in the cervical cord but partly caused by the direct compression of cervical nerve root. The procedure of decompression released the nerve root from pressure. Mobility and sensations of the lower extremity were also improved in some cases by the procedure. This proves that in some cases the pressure upon the cord by the protruded disc and fragmented vertebral body elicited the spinal cord symptoms in tetraplegia. Removal of the causes through an anterior route freed the pressure on the anterior surface of the spinal cord, thus re-establishing conduction of impulses in the motor and sensory tracts.

As the disability of tetraplegia is so great, any procedures which benefit the patient's condition in any extent should be justified. The effects of anterior decompression may be great in some cases and may be only the slightest in the other cases. The effect cannot be predicted in accuracy preoperatively. In spite of this, the procedure, we believe, has a place in the treatment of traumatic tetraplegia.

### **Discussion**

LIPSCHITZ, R. (*South Africa*), said that he had heard a great deal about recovery after operation, and he would like to hear more about the natural recovery without operation. They had found that there was often excellent recovery without operation; one of his cases, who had had a fracture dislocation with total block and gross neurological

sign, had totally recovered without operation. In fact, very often non-operative cases had better recovery than operative ones.

BEDBROOK, G. (*Australia*), asked how the speaker demonstrated compression, as, pathologically, compression had not been demonstrated in the natural history as a continuing cause of neurological damage.

MEINECKE, F. W. (*Germany*), said that they had become much more conservative and in the last two years had not operated at all. He agreed with Dr. Lipschitz; they too had had more recovery than in former years, and this had also been the experience of Dr. Paeslack from Germany. He thought the question was how could the X-ray tell them what had happened to the spinal cord? They all showed cases with severe dislocation without any neurological signs and also cases where the X-rays showed nothing and yet the patient had a complete tetraplegia or paraplegia without any recovery over many years.

GUTTMANN, L. (*Great Britain*), asked the speaker if he could give a little more detail about the improvement after operation. How long, for instance, did it continue? He did not agree with the speaker at all, even with his delayed operation, and could only admire that nature could stand such an operation!

ONJI, Y. (*Japan*), replied that compression was identified by X-ray and neurological symptoms. The effect of anterior decompression could be proved by the case shown in his paper. The patient was operated upon on the sixth month after injury. Spasticity of lower extremities and urinary retention were improved. The general idea of his paper was that decompression should be done either by anterior or posterior route, according to the direction of the compression.

## 8. VASCULAR CHANGES IN SPINAL CORD INJURY BASED UPON EXPERIMENTAL STUDY

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EVERY spinal cord injury is complicated with some vascular changes, such as arachnoideal, subpial or intramedullar haemorrhage, oedema, and/or anaemia (or ischemia). Nature and extent of those vascular changes are not yet well known in the light of clinical findings. The authors maintain the importance of early surgery in the treatment of spinal cord injury, heretofore based upon their clinical experiences; even intramedullary exploration being advocated for the purpose of decompression.

In this report the authors present the result of animal experiment in making use of 60 adult female dogs, in which a definite blow is exerted directly on to the spinal cord at the level of T8-9 (laminectomised). Days and weeks after, the animal is killed; Berlin blue is injected from the abdominal aorta.

At the level of the blow, the grey matter around the central canal and the white matter in the posterior column, which extends to the lateral column in some cases is destroyed. Capillary network close to the involved site gradually diminishes or decreases for a week after the injury, and regains thereafter. Around the newly formed blood vessels fibroblast is more and more observed close to the destroyed area.

Secondary lesions are subdivided into three types. Destruction of nervous elements due to haemorrhage; sometimes haematoma; degenerative changes in nerve tissues, probably due to oligoemia or ischaemia, which extend one or one and

a half medullary segment either above or below the involved site. These changes become most evident in two days, whereas another type of vascular changes becomes most evident in seven days after the injury and subsides in one to two weeks, in which filling of the dye-stuff into capillary and precapillary vessels is obstructed for three to four segments above and below. Accompanied with those kinds of vascular changes, nervous elements are destroyed or seriously impaired so as to give rise to the manifestation of neurological findings, which is of a temporary nature in a certain case, or a permanent one in another.

### Discussion

HARDY, A. G. (*Great Britain*), asked the speaker if he would define what he did on laminectomy. Did he just take off the lamina or did he interfere with the spinal cord or its membranes? He would like to congratulate the speaker on the excellence of his histological sections taken from the experiments on animals.

MIZUNO, S. (*Japan*), replied that in animal experiments they did laminectomy only for decompression. Further research would be continued, sometimes adding incision of dura or even pia mater. He was inclined to do surgery in human cases, too, expecting an improvement. But the choice of the surgery should vary from case to case, depending upon the clinical signs which might develop in accordance with damage of the spinal cord.

## 9. SUBARACHNOID PHENOL BLOCKS IN THE TREATMENT OF PAIN AND SPASTICITY

By HARVEY D. CAIN

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THE first use of subarachnoid injection of phenol to relieve intractable pain resulting from cancer was described less than 10 years ago; more recently, the value of this procedure for reduction of severe spasticity has become recognised. We shall describe our experiences with 43 patients treated by subarachnoid phenol injections for spasticity or pain.

Phenol blocks can circumvent many of the disadvantages of other treatment methods for spasticity and pain while giving comparable or greater relief. Dilute solutions of phenol dissolved in anhydrous glycerin are less caustic than aqueous phenol solutions and have an advantage because they affect mainly the smaller nerve fibres. Phenol in *Pantopaque* mixtures lend themselves to X-ray control, but phenol-glycerin solutions, which we prefer, are more effective, can be equally well controlled clinically, and, in contrast to *Pantopaque*, do not have to be removed.

Subarachnoid phenol blocks should not be performed for pain or spasticity problems which can be treated by simple local peripheral procedures on the neuro-muscular system.

With the patient lying on the side to be treated, the spine is flexed laterally by raising the head and foot of the bed so that the target nerve roots are at the lowest point. A lumbar subarachnoid puncture is performed and one-third millilitre of the phenol solution is injected. Using subjective sensations and responses to pin prick as a guide, the location of the solution is verified and adjustments in body position made if necessary. If the patient has pre-existent

anaesthesia of the area to be treated, alteration of deep tendon, superficial reflexes, and muscle tone determine the location of the injection of the phenol solution. Gradually the remaining 1.0 to 1.5 ml. of the phenolglycerin solution is injected and the patient is left in this position for 30 minutes. All blocks in this series were to the low thoracic, lumbar, or sacral nerves. Concentrations of phenol solutions used ranged from 2 per cent. to 15 per cent.; a 5 per cent. solution was used most frequently.

During a 14-month period, 43 patients were treated—some with combined spasticity and pain problems—with a total of 86 subarachnoid phenol blocks. The breakdown of diagnoses of these 43 patients was: quadriplegia, 16; paraplegia, 7; hemiplegia due to head injury, 5; hemiplegia due to stroke, 2; multiple sclerosis, 8; and cancer, 5.

For treatment of pain, 33 blocks were done in 19 patients. The end-results were mild to moderate diminution of pain in 16 patients and complete and permanent relief from pain in one.

For treatment of spasticity, 67 blocks were done in 33 patients. Mild to moderate reduction in spasticity resulted in 17 patients and excellent reduction occurred in 15.

To reduce bladder spasticity, 17 blocks were done in 13 patients. The results were good or excellent in all patients.

Complications of the procedure were mild motor weakness and decreased sensation in a few patients, though functional capacity was not impaired. No loss of voluntary bladder control occurred.

Duration of effect of the phenol blocks varied considerably even in those cases in which complete relief of spasticity was produced.

We feel that the subarachnoid phenol block provides a simple and effective therapeutic technique, with minimum side effects for the management of moderate or severe pain and spasticity.

## **Main Subject II**

### *The Care of the Urinary Tract in the Acute and Late Stage of Paraplegia*

#### **10. THE CLINICAL OBSERVATION IN TRAUMATIC PARAPLEGICS WITH REFERENCE TO RENAL FUNCTION AND CYSTOGRAMS**

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and

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THE management of the urinary tract in the paraplegic patients is one of the most important problems in the course of their treatment. The urological examinations

concerning the functional disorders of the kidney, the ureter and the urinary bladder including the urinary tract infection should be regularly carried out. About 40 from 70 paraplegic inpatients in Kyushu-Rosai Hospital are examined on renal function and cystography. The excretory pyelography, the phenol-sulphonphthalein test and blood urea nitrogen are examined for the former and the immediate, voiding and postvoiding cystographies for the latter.

Based on these results, some considerations on the relation between renal function and the findings of cystograms are tried. The vesicoureteral reflux (VUR), one of the most prominent aspects in cystograms, may be responsible for the deterioration of the renal function.

## 11. RENAL AND BLADDER FUNCTIONS OF PARAPLEGICS IN THE LATE STAGE

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THE urological study was carried out among about 90 such patients from the standpoint of intravenous pyelography, contrast cystography, cystometry, residual urine and serum electrolytes. The subjects were divided for comparative purposes into two groups; bedfast patients and those with sport activities.

## 12. CLINICAL SIGNIFICANCE OF THE PHARMACODYNAMIC VESICAL FUNCTION TEST FOR CORD BLADDER

By A. KONDO and S. MIYAZAKI

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It is very important to know in detail the situation of insufficient bladder function on each patient for the treatment of urinary tract disorders of the patient with cord injuries. Therefore, it is mandatory to add cystometry to routine urological examinations.

Since two years ago, we have done the cystometric examination for neurogenic vesical dysfunction using the following procedures:

(1) A retrograde continuous cystometrogram (Curve I) is made by means of the Lewis Recording Cystometer, instilling water of room temperature into the bladder through the urethral catheter at the rate of 30 ml. per min.

(2) Another cystometrogram (Curve II) is made in the same manner after administration of anticholinergic drug (20 mg. of Buscopan) when the appearance of hypertonic bladder is shown in Curve I; after administration of cholinergic drug (2.5 mg. of Besacolin) when the appearance of hypo- or atonic bladder is shown in Curve I. And then comparative study of these two cystometrograms (Curve I and

II) is carried out. In each case, dose of the drug which is not large enough to affect the cystometrogram of the normal bladder is used.

(3) Retrograde urethral resistance is measured by means of continuous instillating apparatus (mm.Hg/ml./min.).

(4) From the results obtained as described in (1), (2) and (3), voluntary pressure (VP) or reflex pressure (RP); resting pressure in a definite or maximum capacity (MRP); retrograde urethral resistance (UR) are called as three main indexes. Then, coefficient of urination (VP-UR or RP-UR) and coefficient of incontinence (UR-MRP or UR-RP) are calculated.

(5) Taking into consideration these two coefficients as well as the results of other clinical urological examinations, one of the most important factors of urination, co-ordination (C) between detrusor muscle and sphincter muscle, is evaluated on each patient.

All of these factors are clinically useful both in the choice of therapeutic measure and evaluation of effectiveness of the treatment.

The method as described above, including both cystometrograms before and after administration of parasympathetic drugs and measurement of retrograde urethral resistance, is called as 'Pharmacodynamic Vesical Function Test for the Neurogenic Bladder'.

In this meeting, we would like to report the clinical significances of this method by presenting the datas before and after the treatments in different ways in the several patients with spinal cord injuries.

### 13. MICTURITION AND INCONTINENCE OF THE PARAPLEGICS: PRESSURE STUDY

I. TSUJI and K. KURODA

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and

T. INOKE and T. NISHIDA

*Bibai Rosai Hospital, Japan*

To understand the kinetics of disturbed micturition in the paraplegics, excretory cystometry, recording of the maximum voluntary pressure, retrograde sphincterometry and posterior urethral kimography were performed.

#### 1. Posterior Urethral Kimography

Posterior urethral kimography (PUKG) is a method devised for the kimographic pressure recording in the balloon situated at the posterior urethra. It will be feasible to know by this method about the state of the posterior urethra, which plays an important role in the urethral resistance. It was found that there were two types of curve in PUKG: spikes and waves. The spikes corresponded to the spasms of external urethral sphincter. Frequent occurrence of the spikes and high urethral resistance value will be considered to indicate that the pudendal neurectomy is the operation of choice. Of 27 cases of automatic bladder, 22 were spike positive, only 5 were negative. In the 8 cases of autonomous bladder, 7 cases had spike negative pattern. These observations coincided with the findings con-

cerning the relations between excretory cystometrogram and bulbocavernous reflex. The group of cases with frequent spikes had higher urethral resistance value than the groups of infrequent or negative spikes. Pudendal neurectomies were performed on 10 cases of poor bladder efficiency with frequent spikes. Eight of them reacted with improvement on the residual urine.

## 2. Urinary Incontinence

Of 35 paraplegic patients in the chronic stage, 30 had the various types of urinary incontinence: 17 were of incontinence with reflex micrition type, 8 of stress incontinence, 2 of overflow incontinence, 2 of overflow and stress incontinence, and one of reflex micturition and stress incontinence. It is not strange that the majority of reflex micturition cases showed the positive conal activity, but it was noted that by the cases of stress incontinence the positive incidence was relatively high. Mechanism of incontinence at the time of spasms onset of skeletal muscle was studied by means of cystometry and PUKG. It was able to get some presumptions as follows:

(i) Changes of urethral resistance and spasms of external sphincter had not almost the direct relationship with the incontinence of this type.

(ii) This incontinence was caused by the automatic contraction of the bladder initiated by the spasms of the skeletal muscles. The spasms, however, could not be the trigger of the bladder reflex contraction when the intravesical urine had small volume.

## 14. EARLY UROLOGICAL MANAGEMENT OF THE NEUROGENIC BLADDER

By DAVID BAND

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THE practical management of patients with spinal cord lesions, traumatic or non-traumatic, requires the same specialist care from every angle, whether it be neurological, orthopaedic, urological, or in the immense field of rehabilitation (Bors, 1957). Accordingly, I agree with Damanski and Gibbon (1956) that patients cannot derive full benefit from treatment in special spinal centres unless delay in admission is reduced to a minimum and a regular follow-up is carefully carried out in the centres themselves.

In recent years it has been possible for us in Edinburgh to study the benefits of treatment in a special spinal injuries unit where the services of a neurologist, neurological surgeon, urologist, orthopaedic surgeon and plastic surgeon are combined with all the various ancillary services. Patients admitted to this unit have stated quite categorically that they have appreciated that all the energies of the staff in its various branches have been directed towards their recovery. In fact, they have realised that a programme towards rehabilitation has been drawn up for them from the moment of their admission.

### Classification of the Neurogenic Bladder

Classification depends essentially on the site of the lesion, that is, whether it is in the spinal cord above, at, or below the conus medullaris. If the lesion is above

the conus medullaris the autonomic innervation of the bladder through the pelvic nerves and the internal pudendal (somatic) nerve remains intact, the stretch reflex of the bladder is maintained, and an automatic or spinal reflex bladder function should be achieved. This is sometimes called the upper motor neurone bladder. If, however, the conus and the cauda equina are damaged, there is no autonomic or somatic innervation of the bladder, and the bladder musculature is deprived of reflex spinal activity. The bladder becomes autonomous and functions as a lower motor neurone bladder. In a third group there may be a mixed motor neurone bladder when reflex activity is present via the pudendal innervation, but absent via the pelvic innervation or vice versa.

Management of the bladder in paraplegia must always be directed towards the achievement of a balanced bladder function, and this is concerned with the residual-capacity relationship. Fortunately, the upper neurone neurogenic bladder is nearly always balanced in that the residual urine, after voiding, is negligible. In the strictly autonomous bladder of the lower motor neurone type the residual urine after straining is apt to be high, and with a high filling intra-vesical pressure, residual urine of over 10 per cent. capacity renders such bladders in imbalance. When the cauda equina is grossly involved, the bladder being atonic and the intra-vesical filling pressure low, a residual urine of over 20 per cent. may be permissible, after voiding by the Credé or straining method. In the initial phase of paraplegia, urological management must be directed towards stabilisation of the neurogenic bladder in one of three categories:

- (a) the spinal reflex automatic bladder,
- (b) the autonomous bladder, or
- (c) the mixed upper and lower motor neurone lesion, provided that the neurogenic bladder remains in balance with an appropriately low residual urine.

For over a century the term 'spinal shock' has been used to describe the loss of segmental reflex cord activity below the level of injury and many workers have reported that during this stage the urinary bladder is in an atonic state (Fernsides, 1917; Walker, 1917; Holmes, 1933; Munro & Hahn, 1935; Riches, 1943). However, the experimental work of Kolb (1940) indicated that section of the spinal cord or of the sacral nerve roots did not produce an immediate stretching of the bladder detrusor muscle, and from the pharmacological and clinical studies of Nesbit and Lapidès (1948) it seems doubtful whether flaccidity or atonicity of the bladder in the stage of spinal shock can be directly attributed to its dissociation from extrinsic nerves or spinal reflexes. It is probable that bladder atony under these circumstances is more frequently the direct result of over-distension of the denervated viscus immediately after cord injury.

### **Urethral Catheterisation in the Initial Phase of Management**

We consider that the catheter designed by Gibbon in 1958 is the nearest approach to the ideal instrument, and we have used this catheter in the initial stages wherever possible. It provides for closed, continuous and aseptic urinary drainage and can be used without interference with forced diuresis, acidification of the urine, a full diet, correction of anaemia, two-hourly turning, and physiotherapy. Until a year ago the Gibbon catheter with closed drainage was changed at weekly intervals. Collecting bottles were autoclaved and were individual to the patient. During the



changing of bottles every effort was made to avoid the ascent of bubbles within the lumen of the catheter to the bladder.

The recent work of Slade and Linton (1960) has drawn our attention to the importance of ascending infection from the urethra, male or female, to the bladder, during the passage of the catheter; to air-bubble infection through the lumen of the catheter; and to infection along the outer wall of the catheter from organisms lying within the urethra and its crypts. We have for long used Phenoxytol antiseptic in the lubricating jelly before the passage of a catheter. Slade and Linton have suggested that Hibitane should be incorporated in the lubricating base and injected to the urethra before the passage of the catheter. Before the withdrawal of any catheter when it is to be changed, they have suggested that Hibitane solution should be instilled to the bladder through the catheter. In obstetrical and gynaecological practice such techniques have produced remarkable results in the control of urinary tract infection.

During the past several months in paraplegic cases in Edinburgh the Gibbon catheter has been changed more frequently. The technique used has been that suggested by McLeod *et al.* (1963). The external genitals are sprayed with polybactrin, and then using a very fine catheter to permit of return flow, the urethra is irrigated with 2 ml. of a solution containing 1 per cent. neomycin, 1 per cent. bacitracin, and 0.4 per cent. polymyxin. The parts are then covered with sterile lint or wool, and after an hour they are sprayed afresh with polybactrin, and a catheter is passed using a non-touch technique consisting in manipulation of the catheter with forceps and handling of the penis, if necessary, through sterile lint. The catheter is changed every few days. In addition, an adequate antiseptic is placed in the bottles into which urine is being drained from catheters, and the catheter and tubing are connected with aseptic and antiseptic precautions.

### Summary

The physiological and clinical basis for the use of continuous urethral catheter drainage in the initial management of traumatic paraplegia is presented, and the application of the method described in detail. Recent developments in the methods adopted for the prevention of infection are mentioned. The value of cystometry as a guide to the correct use of a catheter regime is illustrated, and methods of bladder training to restore reflex bladder activity with spontaneous voiding are discussed.

### Discussion

GUTTMANN, L. (*Great Britain*), noticed from Mr. Band's paper that the Spinal Unit at Edenhall, Edinburgh, had been changing the Gibbon catheter more frequently. He wondered what was the reason for the frequent change and how often the catheter was changed. In their experience at Stoke Mandeville, the Gibbon catheter was an advance to the Foley catheter and was particularly valuable in patients who had to be transported after spinal injury for long distances. However, it did not prevent accumulation of mucus in the bladder or infection. Most cases admitted to Stoke Mandeville with the Gibbon catheter had developed bladder infection.

BAND, D. (*Great Britain*), replied that the Gibbon catheter was changed weekly at Edenhall in order to carry out urethral hygiene; *i.e.* Hibitane was instilled into the bladder, the catheter was removed, the urethra was instilled with a solution of Hibitane and Neomycin, the external parts were sprayed with polybactrin, and the new Gibbon catheter was inserted taking care to avoid the ascent of infection.

## 15. PREVENTION OF URINARY INFECTION BY INTERMITTENT CATHETERISATION

By H. L. FRANKEL, M.B., M.R.C.P., and  
L. GUTTMANN, C.B.E., M.D., F.R.C.P., F.R.C.S.  
*National Spinal Injuries Centre, Stoke Mandeville Hospital*

THE authors report an extension and follow-up of a previously reported series (Guttmann, 1963). The sterility of the urine on arrival and discharge of 346 male and 56 female traumatic paraplegics admitted to the National Spinal Injuries Centre within 14 days of injury is described. On arrival 80 per cent. of the males and 60 per cent. of the females had sterile urine, but in cases initially treated with indwelling Foley catheters only 40 per cent. of the males and 25 per cent. of the females had sterile urine on arrival.

After arrival at the National Spinal Injuries Centre all patients were initially treated by intermittent catheterisation using the non-touch technique. All catheterisations on male patients were performed by medical officers and on females by State Registered nurses. On discharge from hospital 64 per cent. of the males and 48 per cent. of the females had sterile urine.

Two hundred and thirty-seven of the male patients have been followed up for an average of three years; of 150 sterile cases 125 remained sterile and 25 returned infected, and of 87 infected cases 69 remained infected and 18 had become sterile. Of the men, 4 developed renal stones and of these 1 has died, 12 had ureteric reflux, 11 hydronephrosis and 5 hydronephrosis and ureteric reflux. The corresponding figures for females were stones 1, reflux 2, hydronephrosis 2.

Although intermittent catheterisation demands much detailed and exacting work on the part of the medical attendant in charge of paraplegic and tetraplegic patients it has proved to be superior to all other methods of management of the paralysed bladder in preserving the sterility of the urine.

### Discussion

BEDBROOK, G. (*Western Australia*) asked whether any of the spinal cases had developed complication by reflux.

PAESLACK, V. (*Germany*) asked whether the speaker had found any difference in sterility of the bladder depending on the level of spinal cord lesion.

GUTTMANN, L. (*Great Britain*) said he would like to answer Dr. Bedbrook. At their Annual Meeting in 1963 on the subject of vesico-ureteric reflux, he had reported about 122 patients who had had a cystogram within the first 12 months after injury. Those patients who were sterile had no reflux and in the patients with infected urine, who represented the majority of the acute cases, only two had reflux. This indicated that reflux in paraplegics might, as a rule, be a development in later stages, but this problem would be discussed on an even greater material at a later date.

FRANKEL, H. L. (*Great Britain*), replying to Dr. Paeslack, said that there was a difference and that the figures in those groups of lesions of which they had a significant number were as follows:

Complete cervical . . . . .	55 per cent. Sterile
Incomplete cervical. . . . .	66 per cent. Sterile
T1-T5 complete . . . . .	66 per cent. Sterile
T6-T12 complete spastic . . . . .	59 per cent. Sterile

T6-T12 complete flaccid .	46 per cent. Sterile
Below T12 complete flaccid .	63 per cent. Sterile
Below T12 incomplete flaccid .	91 per cent. Sterile

In general, the results were better for incomplete than complete lesions and for spastic better than flaccid.

## 16. THE CLINICAL CASES OF NEUROGENIC BLADDER, EXAMINED IN THE PAST FIVE YEARS

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THE results of investigations on the cause and the cystometrogram of the 191 cases of clinical neurogenic bladder, which have been examined in the past five years, are presented with some references to the therapy for them.

There can be found 32 cases of neurogenic bladder due to traumatic spinal injury. Twenty cases were treated on admission, being classified into 7 cases with hypotonic curve in the cystometrogram, 11 cases with autonomic curve, and 2 cases with reflex contraction curve, respectively. One case received Cotte's operation, 2 cases received sacral rhizotomy, 10 cases received pudendal neurectomy, one case received ileocystoplasty, and one case received partial cystectomy against paralysed portion of the vesical wall and followed by ureterocystostomy. The latter case showed improvement as decreasing the amount of residual urine and of the voiding state. The other cases have been treated by medication and bladder training, and showed reasonable improvement in the vesical status. Twelve cases have been treated by only medication in the out-patient department, and had shown improvement of their complaints.

We found 39 cases of neurogenic bladder due to the systematic disturbance of the spinal cord. Ten cases were treated after their admission, being classified into five cases due to tabes dorsalis of syphilis, four cases due to myelitis, and one case due to tumour of the spinal cord. The cystogram obtained from these cases were classified into three of hypotonic curve, and seven of autonomic curve. T.U.R., pudendal neurectomy or medication were performed, and furthermore, effective syphilotherapy was done for the case with syphilis. Twenty-nine cases in the out-patient department were treated by almost the same way.

There were 34 cases of neurogenic bladder due to spina bifida, and the cystometrograms revealed the autonomous hypertonic state of the vesical wall. Ileocystoplasty, pudendal neurectomy, and medication were performed on them, and there could be found reasonable effects on the improvement of the vesical dysfunction.

A diabetic neurogenic bladder was found in 17 cases, while the neurogenic bladder due to brain disturbance, such as cerebral accident, was observed in 15 cases. Furthermore, neurogenic bladder due to the injury of the pelvic nerves at the radical operation for cancer of the uterus or the rectum was found in 35 cases. On the other hand, disturbance of innervation for the urinary bladder was assumed with the results in the cystometrogram obtained from 19 cases in which organic

change in the urinary tract and any abnormality of general nervous system could not be found. These were treated by medication followed by the pudendal neurectomy, and there could be found some improvement on their complaints.

### **Main Subject III**

#### *Problems of the Physical Rehabilitation of Paraplegics and Tetraplegics*

#### **17. EXPERIENCE OF PARAPLEGIC REHABILITATION IN OUR CENTRE AND IN KANAGAWA PREFECTURE**

By K. TSUCHIYA, Y. SATO and T. OKAWA  
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KANAGAWA KOSEISHIDOSHO was founded as the rehabilitation centre of Kanagawa Prefecture on February 1963.

We have chiefly carried out the medical rehabilitation from the beginning of the centre.

Since the start of this centre, paraplegia, hemiplegia due to cerebrovascular accident and amputation were three major causes of disability.

Accordingly we want to explain the problem of paraplegic rehabilitation in our centre.

(a) We visited patients who hoped to be admitted to the centre. We discovered many careless patients in their homes, so we felt the importance of home-care system.

(b) The patients, admitted to our centre (the majority of cases) were being sent from their homes. They were discharged from hospital one or more years ago. Such a long term home-care interferes with the rehabilitation programme.

(c) In our centre, the number of non-traumatic paraplegics exceeds the number of traumatic paraplegics. The cause of non-traumatic paraplegia was chiefly myelitis.

(d) We emphasised the difficulty of relationship between medical rehabilitation and social rehabilitation.

#### **Discussion**

HARDY, A. G. (*Great Britain*), asked whether the bed-ridden patients in the speaker's series were confined to bed because of old age, paraplegia or severity of the paralysis.

TSUCHIYA, K. (*Japan*), replied that, as he had said in his paper, the main causes which had prevented patients from returning to society were urinary complications and decubitus ulcers. But the most important thing was the patient's lack of desire to be rehabilitated. That was why he wanted to emphasise the importance of psychological and mental treatment.

## 18. PHYSICAL TREATMENT IN PARAPLEGIA

By EMMA APOLINARIO, HORACIO J. ROZENWURCEL and JOSÉ B. CIBEIRA  
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THIS report intends to consider the many problems we must face when treating spinal injuries in our country.

We feel the physical methods of treatment are already very well outlined, and the troubles coming from this kind of patient depend upon the special feature and local possibilities of each medical environment.

In our case, for instance, the principles of early care of the disabled are not widespread over the enormous extension of the country. Therefore, patients are received at the main centres in a late stage with many complications, and they are these complications and not the lesion itself, which produce our most difficult problems of treatment.

Accordingly, we must develop a threefold kind of function:

(a) Medical assistance and care, which is very extensive because of the complications, physical training, vocational guidance and re-employment.

(b) Education and teaching activities in order to prepare medical people for appropriate management of such cases.

(c) Diffusion for training community, patient's environment, family, school, factories, etc.

Accomplishment to point (a) is obtained by healing all kind of bed-sores by surgical procedures when conservative methods have failed or would take a long time.

In the urological field, the main problems are those arising from an incorrect early treatment, which very often occurs. Distended bladders, urine infection, fistulae and stones are frequently seen.

In the long-term patients some few cases of ureteral reflux and hydronephrosis have been found, but these disturbances are more frequent in myelomeningoceles which come too late to us.

In this aspect, we are very much devoted to a programme of prevention, because once produced, urological complications are very hard to treat and involve the general conditions of patients in various degrees.

Orthopaedic procedures and surgery are needed to correct deformities in lower limbs, to increase mobility, or to stop spasticity.

When patients and physicians have overcome all those extra problems, time comes to undertake the physical training. We always have in mind the social conditions and labour possibilities when planning the programme for a particular patient. Generally speaking, we train the cauda equina and lumbar spine lesions for an ambulatory living. We consider them completely independent in all activities of daily living, and able to undertake a job in open industry, or full-time work in factories, provided they remain free of complications, and under periodical check up.

Thoracic lesions are inclined to be wheelchair bound, depending on the age and level with regard to work. Anyway, these patients are trained to walk and climb within their possibilities, for using these activities indoors as an exercise. They generally work at home because of difficulty in travelling when not having their own invalid car.

Thoraco-cervical levels produce wheelchair patients without any ambulation, and not independent in activities of daily living. The aim of treatment is to prevent complications depending upon respiratory involvement, and then to obtain the most possible use of hands. We perform operations using remaining functions in the lower lesions, and train in the use of splints and gadgets in the higher. We consider them unable to undertake remunerative work, but we always encourage them to learn some kind of recreative activity, as well as feeding themselves and writing at least.

At time of discharge, a close follow up is started, but even so, in many cases we fail to prevent urological complications and bed-sores, and patients have to be readmitted.

At present we are devoted to developing a programme of teaching for physicians of other countries by the system of residence. We feel it is only by the daily approach to the whole problem of spinal lesions that the problems can be overcome in the future.

## 19. STABILITY OF THE INJURED SPINE IN THE PARAPLEGICS

By T. AKATSU, T. HARA and K. CHIHARA

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IN case of fracture-dislocation of the spine, the initial treatment must be considered for the spinal stability.

Our hospital has treated 341 cases of the traumatic spinal cord injury patients the past fifteen years.

Out of these patients 302 cases underwent systematic extensive rehabilitation programmes.

10 cases (3·8 per cent.) of the ambulatory training group showed marked instability of the injured spine which interrupted rehabilitation programmes so that a spinal fusion was indicated later.

All instability of the injured spine was noted below dorso-lumbar areas and had no relation to the time of starting ambulation.

The medical history of these 10 cases has reviewed the unsuccessful reduction and immobilisation of the injured spine, and irreparable old cases.

### Discussion

TAMESIS, V. (*Philippines*), asked how much of what was referred to as 'instability', especially in the old cases, was due to architectural weakness of the spinal column and how much was really due to muscle paralysis and loss of muscular control.

MASSE, P. (*France*), asked how the patient was immobilised during the post-operative period.

ONJI, Y. (*Japan*), wondered why, if there were no additional damage to the spinal cord and nerve, the spine was fused, as this seemed to be unnecessary in such cases.

AKATSU, T. (*Japan*) said that the instability of the injured spine did not result in any neurological change. They used a Stryker frame and occasionally plaster of paris for the post-operative phase, and the patient was usually put on bed rest for three months.

The reasons for the fusion of the unstable spine were (a) to relieve the patient's anxiety about discomfort of the instability and (b) to give a speedy support of the body in the ambulation programme. The operative procedure gave local stability of the spine and good support to compensation by remaining muscle groups.

## 20. ENERGY METABOLISM AND TRAINING OF THE PARAPLEGIA

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and

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1. Estimations conducted on the basic metabolism in the paraplegia by Knipping's method revealed that the metabolic rate was decreased from the normal level by average of about 20 per cent. in the five cases with cervical cord injury, about 14 per cent. in the patients with thoracic cord injury, and about 13 per cent. in those with lumbar cord injury.

It is to be noted that the greater the area of anaesthesia, the lower the metabolic rate.

2. In determining the energy metabolism according to the type of activity of movement in patients with paraplegia, the rate of energy metabolism has been found to be increased 2-2.5 times of the basic metabolism in activity in sitting position and 4-5 times in activity in standing position.

3. We have conducted a diurnal analysis of the hours spent by the patients with paraplegia who are hospitalised in Okayama Labour Emergency (Rosai) Hospital and found that those with cervical cord injury spend an average of about 19 hours and those with thoracic cord injury an average of about 16 hours in supine position.

4. Relative metabolic rate = 
$$\frac{\text{metabolism at movement} - \text{metabolism at rest.}}{\text{basic metabolism}}$$

Quantity of activity = relative metabolic rate  $\times$  time.

The quantity of activity for one day in the paraplegia has been found to be an average of 288.2 in the patients with cervical cord injury and an average of 450.8 in those with thoracic or lumbar cord injury, and most of these patients are dependent on crutch walking.

5. From the standpoint of preventing complication in paraplegia it is desirable to have at least the quantity of activity in the range of 500 per day. To obtain this quantity it is necessary for the patient to go on crutch walking. In this instance, however, it must be borne in mind that the energy metabolism at crutch walking will be increased to four to five times that at supine position. Therefore, it is obvious that a systematic rehabilitation programme must be commenced at initial stage in paraplegia.

## 21. ELECTROMYOGRAPHIC STUDY ON THE EFFECTS OF ARCHERY

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As a part of physical rehabilitation programmes, various sport activities have been given to the paraplegics at the above centre since 1961.

Forty of such patients have been encouraged to do archery since 1962. The effects of archery on muscle training were measured with the use of a 4-channel pen-writing oscillograph (0.03 sec. T.C.). A series of motion measured included 10 elements such as stance, grip, bow arm, knocking, drawing, anchoring, relaxation, aiming, concentration, releasing, and follow-through. During these activities, the action currents of the involved muscles were simultaneously recorded through the surface or needle electrodes placed at the upper extremities, chest and back. The electromyographic findings indicated that a marked tonicity is present in the back muscles and spine erectors, as well as in the shoulder girdle and arm muscles.

## 22. THE EFFECTS OF SWIMMING FOR THE SEVERE SPINAL CORD INJURIES

By C. TOMITA and T. MATSUBAYASHI

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SINCE 1961, 34 of 120 such patients at the above Centre have been training through swimming for physical rehabilitation.

These patients have remarkably improved psychologically and physically; in particular, we have found many developments in physical strength, respiratory and circulatory system, and muscular power.

The results of these examinations are reported here.

## 23. 'VOCATIONAL GUIDANCE IN PARAPLEGIC AND TETRAPLEGIC PATIENTS'

By HORACIO J. ROZENWURCEL, JOSÉ B. CIBEIRA and EMMA APOLINARIO

*Centro de Rehabilitacion, Buenos Aires, Argentina*

UNTIL very recently, there were no well-organised or well-planned rehabilitation services in the Argentine Republic.

Only isolated projects were carried out originated either by doctors or by some public welfare institutions with special interest in the treatment of the poliomyelitis patient.

Long-term patients were and are still being sent to the Federal District, though we consider that as a discipline. It is more functional for them to be treated within the community to which they belong.

The National Committee for Rehabilitation of Disabled to which staff the authors belong is under this Committee.



The concept of team work was slowly developed with the added difficulties of a Latin-American country where traditional medical behaviour is against new ideas in the medical field.

The Centre for Rehabilitation of Disabled became in 1960 a pilot centre for the treatment of the disabled in subacute and chronic states, several weeks or months after the onset of the disease or accident of the paraplegic and tetraplegic patients. The most important aim was to create the spirit of team work, which is an essential condition to the integral physical, mental, social, and vocational management of the paraplegic and tetraplegic patients who are not so ill originally but can become gravely ill if complications occur.

When the patient comes into the centre, he is evaluated by all technical departments; as a result of this study we obtain a first impression of the patient's personality, I.Q., social medium, family conflicts, personal situation, previous to disease or accident, diagnosis of disabling sequelae and physical prognosis.

Vocational Guidance is performed at the Rehabilitation Centre through a prevocational study carried out mainly by the staff of the Social Service, Psychology, and Occupational Therapy departments.

Throughout the evaluation, his adaptation problem is analysed (wheelchair, braces, etc.) and they are fitted to his work possibilities.

From a practical point of view we classify these patients according to the psycho-physical aptitudes, social and economic status and decide at which level they will be able to perform:

1. Non-competitive environment—  
Work at home: *controlled* by the home-care team.
2. Partially competitive environment—  
Sheltered work: carried out in sheltered workshops created and controlled by welfare organisations.
3. Competitive environment
  - (a) Previous job  
without adaptation.  
with few adaptations.
  - (b) New jobs  
with few or several adaptations.

Patients in the third group complete their training at the Professional Rehabilitation Centre through testing in several jobs carried out by a specialised team which is able to analyse the work prognosis in a two-month period.

The Professional Rehabilitation Centre works as an institution for specialised training and is under the National Commission, and supervised by the National Council for Education which provides teachers and study plans and grants official diplomas.

The Professional Rehabilitation Centre teaches at present, the following jobs:

Carpentry  
Shoe-making  
Tailoring  
General mechanics  
Radio-electricity  
Book-binding

These jobs have been previously analysed by an expert in work resettlement who takes into account the original characteristics of the zone to which the patient belongs.

## 24. A PRELIMINARY REPORT ON THE EFFECT OF CHLORPROETHAZINE ON SPASTICITY

By M. ESPIR and J. D. GOODE  
*Leicester, England*

1. Chlorproethazine, a phenothiazine derivative, has been given to ten patients with severe spasticity. The temporary reduction of hypertonicity and clonus following intravenous injection of this drug, which has previously been reported by Sigwald and his co-workers in Paris, has been most impressive.

2. This has been used as an aid to physiotherapy, allowing the patient and therapist to have repeated periods of reduced spasticity, so that active and passive exercises can be undertaken, at a stage when these could not be done otherwise. There is usually some reduction of power as well, but in two cases with the appropriate dose walking was improved during the period when spasticity was relieved. A short strip of film shows these effects.

3. Large doses of the drug cause generalised weakness. There have been no obvious side effects; sensation, consciousness and cardiovascular state have remained unaltered, and there has been no disturbance of sphincters.

4. If there is already marked weakness or ataxia associated with the spasticity, little advantage results from the temporary reduction of spasticity, although the drug may also be used to assess the proportion of deformity due to spasm as opposed to fixed contractures.

5. Oral administration of the drug in six cases resulted in no objective benefit.

6. Although the cases studied here are too few to draw firm conclusions, it is considered that chlorproethazine given intravenously may have a limited place in the management and rehabilitation of some cases with pyramidal spasticity. A preparation, which has a prolonged differential action in relieving spasticity selectively without interfering with muscular power, and which is effective when taken by mouth, is still required.

### Discussion

CAIN, H. D. (*U.S.A.*), asked whether chlorproethazine was similar to the phenothiazine sold under the proprietary name of Valium (which he knew under a different name). They had used that medication with results similar to those which the speaker had described?

FRANKEL, H. L. (*Great Britain*). Did the drug reduce spasticity in all cases to whom it had been given and how many patients had been treated?

MEINECKE, F. W. (*Germany*), asked for what length of time could a patient be treated with this drug and what happened after that time.

ESPIR, M. (*Great Britain*), replied that the drug (which was not the same as the drug

Valium) reduced spasticity in all the cases treated—10 reported in his paper and 2 more since the paper was written. He did not know for how long one could treat a patient with this drug; he had given one patient an injection daily for six days and six further injections over the course of three weeks. What happened after treatment depended on the cause of the condition. The drug was used as an aid to physiotherapy during the stage of recovery. If the condition was static or due to an irreversible process, practical benefit resulted due to the temporary effect of the drug.

## 25. DRUG TREATMENT FOR SPASTICITY IN PARAPLEGICS

By V. PAESLACK

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THIRTY-ONE paraplegics and tetraplegics with marked spasticity were treated with varying doses of Valium—a derivative of benzodiazepin. In all cases, good to very good effects on the spastic limbs were found. As a result, the rehabilitation of these patients was accelerated or made possible at all. Operations in paraplegics showed better results because sutures were not in danger of bursting. The number of surgical procedures necessary to abolish spasticity definitely diminished.

Apart from the effects of the drug on the limbs, we also observed an influence on the automatic function of bladder and bowels, which, however, was sometimes beneficial and sometimes the contrary. Erections could be eliminated with higher doses. The initial fatigue disappeared within a few days. However, on occasions, an increased impairment of concentration and initiative was found, which has to be taken into consideration in active rehabilitation.

In conclusion, the new substances seems to be a means which promises success in the intractable spasticity of paraplegics, which cannot otherwise be controlled by drugs.

## ANNOUNCEMENT

The 1965 Annual Scientific Meeting of the Society will take place at Stoke Mandeville Hospital on the 23rd and 24th July. The main subjects will be as follows:

1. Electro-mechanical devices.
2. The paraplegic woman.
3. The respiratory problem in tetraplegics and paraplegics.

It is hoped that every Member will do his best to attend.

The International Stoke Mandeville Games will take place from the 20th to 24th July at Stoke Mandeville.

## BOOK REVIEWS

ORTHOPAEDIC SURGERY OF THE LIMBS IN PARAPLEGIA, by L. S. MICHAELIS, pp. 54, with 30 illustrations. (Berlin: Springer; Heidelberg: Goettingen, 1964.)

In this monograph the author presents the results of 459 operations on 227 patients treated at the National Spinal Injuries Centre, Stoke Mandeville. That such operations became necessary in 10·1 per cent. of his material emphasises their importance.

Spasticity, contractures, osteomyelitis under pressure sores and ectopic ossification often prevent the achievement of successful rehabilitation. Guttman's large material—by now some 3000 patients, many of whom arrive at the Centre late after inadequate treatment—lends itself particularly well to establishing the principles of treatment.

After introductory chapters on the definition of terms, on general surgical principles applied to the paraplegic patient and on anaesthesia, we find a detailed description of the methods used. Michaelis—an orthopaedic surgeon with considerable experience—uses a clear and concise style which makes the book easy to read. The line drawings are equally instructive. Description of each operative method is completed by data on the preparation and after-treatment. Both for skin and buried sutures, the author prefers stainless-steel wire. At times he carries out bilateral operations under one anaesthetic. Treatment of fractures of the long bones in the 'old' paraplegic is almost always conservative. For some of the associated fractures of the recently injured patient surgical methods are being used (nails, plates, screws or grafts). The thickly padded splints are removed and re-applied daily in order to ensure the integrity of the skin. Ectopic ossification in the absence of infection is removed only when there is complete or almost complete ankylosis at the hip—or elbow joints. Amputations are, in general, strongly condemned. In tetraplegic patients there is only exceptionally the indication for arthrodeses or tendon transplants. Of particular interest are the chapters on arthroplasty of the knee joint and on the operative treatment of the septic arthritis of the hip-joint under pressure sores, where the author describes new methods. A number of other important questions is answered. With this book the author fills a long existing gap in the literature. For this he is to be congratulated, particularly since he describes not only the successes but also the failures and their likely causes. One can only hope that this excellent monograph will be very widely read.

F.-W. MEINECKE, Bochum

INJURIES OF THE SPINE, by M. BECKETT HOWORTH, M.D., Med.Sc.D., J. GORDON PETRIE, M.D., and GEORGE BENNETT, M.D., Sc.D., pp. 343, with illustrations. Baltimore: Williams & Wilkins Co., 1964.)

Injuries of the spine have been the subject of continuous interest and study for the last 5000 years because of the frequent occurrence of an associated injury to the spinal cord, but it is only within the last 50 years that a better appreciation of the anatomical and pathological problems involved has led to improved results in treatment. William Cone was one of the pioneers in this field and it is appropriate that this book is dedicated to his memory.

It is divided into three parts, the first part by the late George Bennett is a brilliant historical survey of injury to the spine; it is a fascinating story, well told, copiously and beautifully illustrated, and may be profitably read by anyone who is concerned with the treatment of spinal injuries.

The second part of the book is devoted to an account of fractures of the vertebral column and their management. It follows the classical pattern of presentation, giving an anatomical and pathological description before describing in detail the various forms of treatment available in the management of individual fractures.

Unfortunately, although nearly 200 pages are devoted to this aspect, there is a lack

of critical comment and statistical evaluation of treatment. When discussing decompression for acute spinal cord injury in the cervical and lumbo-thoracic region, it is pointed out: 'The difficulties in arriving at clear indications have centred about the great variation in the extent of neurologic involvement in different cases, the problem of estimating the effect of the decompression as compared with spontaneous recovery, and the paucity of adequately followed and well studied series of cases in sufficient numbers to be meaningful.' Figures are presented on pages 126 and 317 of Petrie's and Cones' results between 1930 and 1953, but inadequate information is given to evaluate treatment given, since in the table on page 317, 5 patients are reported to have died out of a total of 94 treated by decompression and laminectomy, whereas in the discussion only 3 are stated to have died, and no details are given of the degree and extent of motor and sensory recovery.

The third section of the book describes the management of the neurological injury, it follows orthodox conservative methods of treatment, but the account is rather superficial and a disproportionate amount of space is devoted to the reproduction of X-rays and illustrations—many of them not original.

A fuller account of the significance of the ligamentous injury in producing instability of the spine, and of the neurological injury frequently seen in association with cervical spondylosis, would have been welcome.

J. R. SILVER, M.R.C.P.E.

**INTERNISTISCHE STÖRUNGEN BEIM PARAPLEGIKER** (Medical aspects of Paraplegia), by VOLKMAR PAESLACK, Priv. Doz. Dr. med. (Stuttgart: Georg Thieme Verlag, 1965.)

The director of the paraplegic centre at Heidelberg University describes in this Monograph the Panorama of Paraplegia as seen by an experienced physician.

Short and clear chapters contain neurological and special pathological data and give diagnostic and therapeutic guidance on spinal shock, on the disturbances of respiration, circulation, of the digestive and renal tracts and of metabolism.

Special essays concern oedema and thrombo-embolism, sexual function, the neurophysiology and clinical incidence of pain and of phantom sensations.

Psychological and social problems are discussed and an outline is given of the purpose and structure of a spinal centre.

This is a good book, of real interest not only to other centres but to all neurologists, neurosurgeons, orthopaedic and accident-surgeons, urologists and general practitioners, who are prepared to do their duty towards the paraplegic patient.

On every page it bears the stamp of a doctor who has thoroughly grasped the significance of the novel synthesis of specialties and who is determined to serve its further progress in practice, research and teaching.

L. S. MICHAELIS