ORTHOPAEDIC FEATURES IN THE PRESENTATION OF SYRINGOMYELIA

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The orthopaedic surgeon is often the first consultant to whom a patient with syringomyelia is referred. The disease is not as rare as he may suppose, but its early presenting features are very variable; if he relies solely on such familiar features as pes cavus and scoliosis, he may well miss the diagnosis.

The commonest presenting symptom is pain in the head, neck, trunk or limbs; headache or neckache made worse by straining is particularly significant. A history of birth injury also may suggest the possibility of syringomyelia, especially if any spasticity subsequently worsens.

Neurological features which may be diagnostic include nystagmus, dissociated sensory loss, muscle wasting, spasticity of the lower limbs or Charcot’s joints. Radiographic features include erosion of the bodies of cervical vertebrae and widening of the spinal canal; if, at C5, the size of the canal exceeds that of the body by 6 millimetres in the adult, pathological dilatation is present. The presence of basilar invagination or other abnormalities of the foramen magnum, of spina bifida occulta and of scoliosis are further pointers. Thermography is a useful way of showing asymmetrical sympathetic involvement in early cases.

A greater awareness of the prevalence of syringomyelia may lead to earlier diagnosis and to early operation, which appears to hold out the best hope of arresting what is all too commonly a severely disabling and progressive condition.

Syringomyelia is the term used when tubular cavities containing fluid are present within the spinal cord. Williams (1969, 1970) has suggested that syringomyelia should be divided into two groups: those in which the cord cavity is flaccid and contains cerebrospinal fluid may be called “communicating syringomyelia” on the assumption that a communication between the cavity and the posterior fossa is, or was at some time present; those in which the fluid in the cord has another origin such as from a tumour or traumatic paraplegia, may be called “non-communicating syringomyelia”. The latter group usually have tense cysts with a normal posterior fossa and certainly no functioning communication between the syrinx and the fourth ventricle.

The neurological disturbances caused by accumulation of fluid within the cord are summarised in Figures 1 to 5. Diagnosis is relatively easy in advanced disease, because the classical features (dissociated sensory loss, loss of tendon reflexes and so on) are unmistakable (Grinker, Bucy and Sahs 1959; Finlayson 1962). Recent improvement in diagnostic methods, particularly air myelography with air studies of the posterior fossa, has led to earlier recognition of cases in the “communicating” group.

Table 1. Orthopaedic features in the presentation of syringomyelia

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<tr>
<th>Pain</th>
<th>Affecting head, neck, trunk or limbs</th>
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<tr>
<td>Bone deformity</td>
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<tr>
<td>Skull</td>
<td>Large</td>
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<td>Encephalocele</td>
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<tr>
<td>Basilar coarctation</td>
<td>Softening</td>
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<td>Muscle disorder</td>
<td>Wasting or hypertrophy, and fasciculation</td>
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<td>Sympathetic disturbance</td>
<td>Horner’s syndrome, sweating disorders and temperature changes</td>
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<tr>
<td>Spine</td>
<td>Short neck</td>
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<tr>
<td>Klippel–Feil deformity</td>
<td>Enlarged spinal canal</td>
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<tr>
<td>Scoliosis</td>
<td>Spina bifida</td>
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<tr>
<td>Limbs</td>
<td>Unequal</td>
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<td></td>
<td>Hand deformity</td>
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<td></td>
<td>Pes cavus</td>
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<td>Charcot’s joints</td>
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<td>Stiff joints</td>
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Early diagnosis affords the best opportunity for operative arrest of the destructive process and, as many patients are seen by orthopaedic surgeons before signs are florid, it seems timely to review the clinical features (Table 1) with particular reference to those which appear early.

PRESENTING FEATURES

Pain
Pain is the most common symptom (Saez, Onofrio and Yanagihara 1976; Mohr et al. 1977) and is almost universal; but it may change over the years. Severe pain may be replaced by numbness, and initially painful areas may become anaesthetic. Headache may come and go or be precipitated by different factors. Figure 6 indicates the probable causes of pain at different sites.

Headache. Transient high pressure in the head may occur with communicating syringomyelia after straining, coughing or sneezing. This occurs because of thoracoabdominal pressure which is transmitted to the venousplexuses around the spine, forcing the cerebrospinal fluid into the head. As the strain relaxes, the fluid in attempting to return to the spine, jams the cerebellum into the foramen magnum and partially blocks it. The phenomenon is usually asymptomatic but the patients may complain of pain, usually nuchal and midline, for a few seconds after exertion. This is one of the causes of "cough headache" (Symonds 1956) or "benign exertional headache" (Rooke 1968). Pain of this type may be immediately relieved by tonsillar decompression.

Neckache. The causes of occipital headache blend into those of neckache. Persistent pain has been seen in association with adhesions and deformity of the upper cervical roots. Gardner and McMurray (1976) believed that oedema and distortion of nerve roots associated with "extradural venous engorgement" may contribute to the pain of syringomyelia.

Pain of central cord origin. Fluid tracking along the tissues of the spinal cord may produce pain almost anywhere in the body. It seems likely that the fluid directly irritates cells in the sensory pathway. Characteristically pain occurs many years before the diagnosis is made; it may be replaced by numbness and the pain may move into adjacent areas. Prickling and tingling may coexist with partial numbness in the painful areas. It is common for patients to have had pain in the neck, shoulder or upper arm for many years before seeing a neurologist. A diagnosis of "brachial neuritis" or "diaphragmatic pleurisy" may have been made. Carpal tunnel decompression, biopsy of synovial membranes at
the wrist, ulnar nerve transplantation, cervical rib and “scalenus anticus” operations have all been performed on patients diagnosed later as having syringomyelia. The improvement which may follow operation (Potter 1948) perpetuates the error. Radiographs of the chest, shoulder and cervical spine, cholecystograms and barium meals may all bear witness to the persistence of the pain and the difficulty of diagnosis.

**Bone deformity**

**Skull.** Marked hydrocephalus is seen on ventriculography in about 15 per cent of patients, although in 33 per cent lateral ventricular enlargement is detectable (West and Williams 1979). Plain radiographs may show stigmata of hydrocephalus (Figs. 7 and 8) including platybasia (the basal angle is normally less than 140 degrees). Enlargement of the skull is comparatively uncommon, around 5 per cent (Barnett, Foster and Hudson 1973), although sometimes the back of the skull seems particularly massive and overhangs the neck.

Basilar invagination (in which the top of the odontoid extends above a line joining the lowest part of the occiput to the hard palate) is common. West and Williams (1979) found it in 55 per cent of their patients. The foramen magnum may be upturned, or have a thickened rim or be abnormally wide. Sometimes the lip of the foramen magnum is turned down giving a funnel-shaped exit, or the foramen may be narrow or the odontoid peg displaced backwards. Basilar invagination may be related to birth injury (Williams 1977b) or to causes of softening of the skull, such as rickets, Paget’s disease, osteomalacia, hyperparathyroidism or acro-osteolysis (O’Connell and Turner 1950; du Boulay 1969; Williams 1971, 1977a).

**Neck.** Shortness of the neck and a low hairline are relatively common. On radiography the neck may show excessive lordosis, spina bifida or Klippel–Feil deformity. The atlas or axis may be the site of abnormal fusions or may be abnormally close to the base of the skull with limited mobility. Inequality of the two sides or rotation of the upper cervical vertebrae are common but

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**Fig. 6**

Probable inter-relationships between pain at different sites and pathological causes. The most probable and frequent associations are shaded the most heavily.
orthopaedic features in the presentation of syringomyelia

Figure 7—This seventeen-year-old girl has seven radiographic features of disordered circulation of cerebrospinal fluid. Figure 8—Key to Figure 7. A. Thinning of the calvarium with "silver-beating" of the inner table due to hydrocephalus. B. Low position of the inion; this correlates with hydrocephalus of early onset, usually intra-uterine. C. J-shaped sella, flattened and elongated. D. Basal angle of 144 degrees. E. Concave deformity of the occiput. F. Atlas close to the occiput. G. Basilar invagination shown by the odontoid peg being above Chamberlain's line (joining the lowest part of the occiput to the hard palate).

difficult to observe externally. Severe degenerative changes may produce difficulty in diagnosis between cervical spondylotic myelopathy and syringomyelia.

The canal may be enlarged and the vertebral body reduced in size (Figs. 9 and 10). Enlargement of the canal takes place at the expense of the body and the ratio of canal to body size is more discriminating than uncorrected canal measurements; radiographic enlargement may be ignored. It is convenient to use the fifth cervical vertebra since the diminution of body size and canal enlargement usually reach up to that level (Figs. 9 and 10) and even in severely deformed patients this vertebra is rarely obscured on radiographs. Out of 100 men and 100 women seen as controls at the Midland Centre for Neurosurgery and Neurology with neither syringomyelia nor cervical spondylosis, the mean ratios of canal to body size at C5 were males 1.01 (S.D. 0.15) and females 1.07 (S.D. 0.16).

Using the canal to body ratio at C5 in syringomyelia the mean value is 1.14 (S.D. 0.3) and pathological abnormality is almost certain if the ratio of canal to body size is greater than 1.5, that is to say if the canal is more than half as big again as the body. Only 0.5 per cent of normals exceed this ratio. The results for 200 controls and 139 patients with syringomyelia are given in Table II. If the canal is 6 millimetres bigger than the body, it is pathological. If the canal is 4 millimetres bigger than the body there is a 3:1 probability of faulty pathology.

Figure 9—Means of the measurements of the anteroposterior diameters of the cervical spinal canal in sixty-nine cases of syringomyelia and 105 controls. Note that the separation between the patients and the controls comes as high as C5 in both sexes. Figure 10—Means of the measurements of the anteroposterior diameters of the cervical vertebral bodies. Note that the diminution of body size is present at all levels for this measurement. (Reproduced from Lee and Williams (1977) Clinical Radiology, 28, 395-400, with permission.)
though not necessarily syringomyelia; neurofibromatosis, "dysraphism" and solid tumours are other causes.

**Scoliosis.** McRae and Standen (1966) reported forty-three patients with syringomyelia of whom twenty-seven had scoliosis. Of those patients with symptoms of syringomyelia before the age of sixteen years, 87 per cent had scoliosis; of those whose symptoms developed over the age of sixteen, 48 per cent had scoliosis. Fifteen of the scoliotic patients had curves of less than 25 degrees, five had curves of between 25 and 50 degrees, and in seven patients the curve was over 50 degrees.

The probability seems to be that lower motor neuron weakness is principally responsible as in poliomyelitis. The evidence about sensory denervation is unclear: Liszka (1961) and MacEwen (1968) showed that experimental dorsal rhizotomy might cause scoliosis but Alexander, Bunch and Ebbesson (1972) suggested that motor denervation might be more important in experiments where this had been reported. Abnormal sensory input was suggested when a series of dogs were given syringomyelia by injection of cerebrospinal fluid into the spinal grey matter (Williams and Weller 1973). It was noted that the spine was forcefully curved after the injection while the animal appeared to suffer some discomfort. This would rapidly pass, but in some cases the scoliosis remained for a while and the dog would walk slightly crabwise with the hind legs to one side of the front legs. Scoliosis seen in puppies given communicating syringomyelia after kaolin injected into the cisterna magna (Williams, in preparation) was less marked than the thoracic lordosis apparently due to inadequate neutralisation of gravity. The dorsal spine seemed to sag and twist slightly.

Riseborough comments that treatment is rarely necessary for the scoliosis with syringomyelia and points out that the spinal cord is particularly vulnerable to damage. Huebert and MacKinnon (1969) reported two patients who developed paraplegia during fusion, even

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<th>Table II. Distribution of patients with syringomyelia and of controls in relation to the differences between anteroposterior diameter of the vertebral body and of the spinal canal at C5 (whole millimetres difference and above)</th>
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<td><strong>Body bigger than canal</strong></td>
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In an analysis of radiographs of patients with syringomyelia from the Midland Centre for Neurosurgery and Neurology, fifty-two out of seventy-three men had a scoliosis of 6 degrees or above and fifty-six out of seventy-five women were thus affected; the sides, levels and degree of scoliosis are indicated in Figure 11. Robin (1975) has found that the side of the cord cavity and the curve are unrelated. Riseborough and Herndon (1975) point out that patients may present with scoliosis before syringomyelia is suspected and suggest that a high double thoracic curve should arouse suspicion. Hall et al. (1976) point to the common association of myelodysplasia with developmental scoliosis and suggest that this association is almost always due to syringomyelia.

The aetiology of the scoliosis is unclear. The term "abiogenesis" as used by Roaf (1977) is no longer justifiable nor is the assumption that the spine and spinal cord are both similarly affected by a primary developmental disorder.

Gardner and Collis (1960) have suggested that the deformity of the spinal cord itself might directly influence the growth of the spine, perhaps through expansion of the dura. That enlargement of the spinal canal may be produced in that way seems undoubted but it seems that Gardner's attempt to correlate all the abnormalities with embryonic hydrocephalus may be unjustified. Experimental work from Holtzer (1952) suggests that the size of the cord may influence local bone growth in early development and if such mechanisms are at work in humans they may be asymmetrical. There is a correlation between patients with an enlarged spinal canal and those with scoliosis (West and Williams 1979) but this is not a close correlation and it is probably because both are more common with early onset. Gardner (1978) believes that the factors causing the scoliosis may be determined early in foetal life, even before the subarachnoid pathways of cerebrospinal fluid are patent but this is unproven.
though Harrington rods were not used. Paraplegia during correction of scoliosis may be the first declaration of neurological abnormality in syringomyelia. Halo traction (Pieron and Welplpy 1970) is probably most suitable because of the avoidance of local damage to the spine and the risks arising from corrective casts used in the presence of numbness.

The lower limbs are usually more spastic than flaccid. Pes cavus is common as is inequality between the clawing deformity; polydactyly may be seen.

Inequality in length of upper or lower limbs may be found, the shorter limb usually being the one with the major neurological signs. The hands or feet may be unequal in size.

**Fig. 11**

Incidence of scoliosis in radiographs of 148 patients with syringomyelia seen at the Midland Centre for Neurosurgery and Neurology. Males (squares) show no significant differences from females (circles). Cases with 5 degrees of curvature or less are not shown; "double primary curves"—those with two convexities approximately equal—are recorded as double entries.

**Limb deformities.** In the upper limb there is little or no deformity in early cases. With more advanced disease deformities may include extension at the metacarpophalangeal joints, fixed flexion of the digits, wasting of the intrinsic muscles and sometimes trophic changes, swelling of the fingers, scars of burns, ulcers or excessive callus formation giving the classical picture of "la main succulente" (Marinesco 1897). "Morvan's syndrome" refers to absorption of the terminal phalanges (Morvan 1883). Cheiromegaly also may occur (Charcot and Brissaud 1891).

In the lower limb Charcot's joints are uncommon. Barnett, Foster and Hudson (1973) reported 100 patients with no neuropathic joints in the lower limbs.

**Muscle deformity**

Wasting is common from lower motor neuron involvement; the scapular muscles, forearms and hands suffer most. Fasciculation is sometimes intense and may respond to surgical treatment.

Hypertrophy is uncommon (Heldenberg 1901; Lapresle, Métreau and Risvegliato 1976). The mechanism of this enlargement is obscure.

**Sympathetic nervous system disturbance**

Horner's syndrome may be difficult to assess when it is incomplete, or when the face is asymmetrical from other causes such as plagiocephaly. Irregular and eccentric pupils are sometimes seen and third nerve disturbance
may be responsible for pupillary abnormalities. Sweating may be excessive initially.

The skin temperature may be increased and any asymmetry of temperature is neatly demonstrated by thermography (Figs. 12 to 15). Even in normally nourished and otherwise symmetrical limbs, temperature differences may be marked and the face may be similarly asymmetrical. The increased warmth on one side probably results from sympathetic paralysis. Charcot’s joints may be hot and disused or atrophic limbs may be cold; these differences are independent of sympathetic disturbance.

PAST HISTORY AND NEUROLOGICAL FEATURES

Once the suspicion of syringomyelia has been raised, confirmatory evidence should be sought from the family history, the birth history and from neurological examination.

Family history. With syringomyelia the family history is usually negative, although cases have been reported (Bentley, Campbell and Kaufmann 1975; Giménez-Roldán, Benito and Mateo 1978; Stanworth 1978). Familial scoliosis has been reported (Garland 1934), but does not seem to be connected with syringomyelia. A family history of spina bifida or anencephaly may be significant, since spina bifida is one of the causes of syringomyelia.

Birth history. A history of heavy birthweight, protracted labour, or damage to the head from a forceps delivery, makes syringomyelia more likely. A history of difficulty during the delivery of any siblings should also be sought. Difficult birth is the most common identifiable cause of this problem and some abnormal factor in the birth was found in over half the patients reported by Williams (1977b).

Neurological features. Neurological complaints not normally sought by orthopaedic surgeons may include diplopia, giddiness, difficulties with swallowing, hypersalivation, hypo-salivation, change in phonation, and sexual difficulties in men (failure of erection or more commonly failure of ejaculation). The patients may also have symptoms related to coughing or sneezing, particularly exacerbation of pain in a limb or in the trunk, occipital headache or electric-shock-like paraesthesiae.

On examination, particular attention to the pupils and scrutiny for nystagmus may yield quick confirmation of the diagnosis. Involvement of the lower cranial nerve may be asymptomatic but examination of the tongue and palate may confirm syringobulbia. A hoarse voice and bovine cough may indicate involvement of the tenth nerve; the onset may have been so gradual that the patient denies any abnormality. Neurological examination of the limbs is commonplace to orthopaedic surgeons, but perhaps it is notable that in no other orthopaedic condition is careful examination of the arm reflexes likely to be so informative.

ILLUSTRATIVE CASES

Case 1. A sixteen-year-old girl presented with pain on the left side of the lower back radiating across the top of the buttocks. She also complained of numbness on the dorsum of the left foot. On examination she had mild weakness of both legs and could not stand on tip-toe; neither could she walk on her heels with the toes pulled up, although she was not aware that she had muscular weakness in the legs.

The birth history was normal. On examination it was noticed that she had a mild thoracic scoliosis and on direct questioning she said that she had had some pain in this area about six months earlier. She had been advised that the curvature was mild and that the pain would pass off, which it did. In the arms there was a striking absence of reflexes on both sides, but no other abnormality. She had no symptoms relating to the arms. Both abdominal reflexes, as well as the gluteal and anal reflexes were absent. There was no muscle wasting. Sensory testing showed an area of non-specific “funny feeling” on the anterior aspect of the left lower leg and foot. Position sense was slightly impaired in both feet.

Plain radiographs showed only enlargement of the cervical spinal canal; the skull was normal. The Queckenstedt test was positive and the protein content of the cerebrospinal fluid 3 grams per litre. On Myodil (Pantopaque) myelography an expansion was found in the terminal part of the conus. Air myelography showed the cord to be grossly swollen and tense up to the foramen magnum. The fourth ventricle and tonsils were normal and the cisterna magna was normal. The diagnosis was therefore that of non-communicating syringomyelia due to a tumour, but the tumour could not be localised from the clinical signs. Double laminectomy was carried out at the conus and in the cervical region and the syrinx was shown to be continuous between these two sites; it contained a yellow fluid with a protein content in excess of 30 grams per litre. A syringogram was possible after the laminectomy and Myodil was injected. This showed a ragged filling defect opposite T3. Microscopic removal of the tumour which proved to be a benign type of astrocytoma was carried out through a small myelotomy. Next day the patient was able to walk. Seven months after discharge the patient was almost normal. There was slight weakness of dorsiflexion of the left big toe and occasionally pain in the thoracic spine if she exerted herself too much, but no other functional deficit.

Case 2. This lady presented to an orthopaedic surgeon at the age of forty-seven. Immediately before presentation she had had an operation for varicose veins in the right leg. It is not clear whether the discomfort of which she complained was due to the veins or to cord disease. Shortly after the operation she complained of pain in the right foot spreading upwards on the medial side of the leg. The pain was continuous and was made worse by lying flat. A hammer deformity of the right hallux was present with a tight contracture of the extensor hallucis. She had a slightly ataxic gait with a positive Romberg test, brisk leg reflexes and rather indeterminate plantar responses. The arm reflexes were normal at that time. Co-ordination of movement in the arms was also normal but in the legs it was abnormal. Vibration sense was absent in the right leg but present in the other limbs. There was no cutaneous sensory loss. She was referred to a general physician who considered that there was no significant neurological abnormality.

The extensor hallucis of the hallux was transplanted and the interphalangeal joint fused. This seemed to relieve her symptoms but the improvement was only transitory. She had to stop work because of progressive deterioration of gait. She also had difficulty in starting micturition. Five years later, burns on her arms were noticed to be painless. She also had pain in the middle of the back and in the right side of the chest and axilla radiating across the top of the sternum; these had been present for twelve months before she was sent for a neurological opinion. Her past history revealed that she was born weighing 10 pounds and was the first child of a pre-diabetic mother.

On examination she was a thin woman of normal intelligence, able to walk only with assistance. She could barely stand unaided. There
Thermograms from two patients with syringomyelia. The colour codes can be seen from the left side of Figure 12; brick red is the coolest and the warmer isotherms are progressively green, magenta, blue and yellow, up to white which is hottest. Figure 12—Face view of a patient with right-sided syringomyelia. There were no facial symptoms but the supraclavicular fossa and the face were warmer on the right. Figure 13—Back view of the shoulders in the same patient. The right arm was very painful although its musculature was normal; the patient often kept it in a sling. The coolness of the shoulder and upper arm was probably therefore attributable to disuse. Figure 14—Facial view of a patient with left-sided communicating syringomyelia. There were minimal facial symptoms but distinct warmth on the left side. Figure 15—The backs of both hands resting on the front of the thighs of the same patient. Note that the hand was markedly warmer on the left, particularly the fingers.
was nystagmus on looking to the left and slight slurring of speech. There was claw deformity of both hands. The supraspinatus and deltoid muscles were wasted, more on the right than the left. There was weakness of all muscle groups with gross spasticity in the legs and occasional mass flexor responses of all limbs. There were no signs of spasticity in the hands. The greatest weakness was of the hands and the right foot. Position sense was poor in all limbs. Vibration sense was totally absent below the mid-sternum. She had loss of sensitivity to pin-prick and temperature over most of the body, but with some preservation on the left lower facet and the face around the eyes and mouth. The triceps jerks were just present on both sides, as were the biceps jerks. The knee and ankle jerks were increased. The abdominal reflexes were suppressed. Gluteal and anal reflexes were absent.

Plain radiographs showed a large cervical spinal canal. Myodil myelography showed tonsillar ectopia. Air myelography showed air in the fourth ventricle and aqueduct, and the cerebellar ectopia was confirmed. The cervical cord collapsed on air myelography. There was no hydrocephalus.

At operation the cerebellar tonsils were removed and the site of the presumed communication blocked. The patient showed immediate improvement in gait, the spasticity of the legs being partly released. The power of the arms and legs was unchanged. Sensory perception was greatly improved, with return of temperature and pin-prick sensation of the greater part of the trunk and left leg, as well as the back and shoulders on the left side. In some areas trunk sensation appeared to be normal. The zone of normality on the left side of the head and the front of the face was also enlarged and she could feel temperature with most of the head and neck. Two years after operation she had maintained her improvement and was able to walk distances up to two miles.

Case 3. This man of seventy-two was the fourth child of a twenty-six-year-old mother., and was born without any known difficulties. He began to develop kyphoscoliosis at the age of eight, and all through his life so far as he can remember he had difficulty in feeling temperature and pain with the right hand. Apart from this he was an active man able to do a full-time job until he was sixty. At this time he slipped on some ice and fell with great force on his back, striking the hump of his kyphosis and at the same time fracturing the neck of the right humerus. After this fall he suffered giddiness, headache, pain behind the eyes and progressive weakness of the left arm. The worst feature was the giddiness occurring in bouts which were quite disabling. He had recently begun to suffer more or less permanent unsteadiness which made his walking more difficult than previously. He could not walk without support and was limited to about 200 yards even with support.

On examination he had a grotesque scoliosis (130 degrees) convex to the right and maximal at L2. Overlying the rib hump was an indolent ulcer which had been present for some years and which had been treated unsuccessfully by plastic surgery. The circumference of his head was normal. The humeri and legs were symmetrical but the right forearm was 2 centimetres shorter than the left. There was wasting of the forearms, the intrinsic muscles of both hands and both triceps. He had wasting around the scapulae on both sides and he could not lift his right arm above his head. There was fasciculation in the right deltoid, both biceps and the left triceps. The muscle tone was normal except when interfered with by fasciculation. There were no arm jerks and no abdominal jerks. The knee jerks were normal. The right ankle jerk was absent. The left plantar response was extensor.

Sensory testing showed patchy loss of pin-prick sensation over the right arm extending up over the head and down as far as the lower abdomen. There was slight loss over the left shoulder and arm. There was no lumbar sacral sensory loss nor any signs of syringobulbia. Investigations showed a healed subcapital fracture of the right shoulder, but no evidence of a neuropathic joint. There were degenerative changes in both elbows, again not neuropathic.

Radiographs of the skull showed no basilar invagination; the cervical spine showed hypertrophic degenerative changes but the canal diameters were normal. Computed axial tomography (transmission) showed marked hydrocephalus of the lateral and third ventricles, with a rather small fourth ventricle a little more anteriorly situated than normal.

Patients with hydrocephalus may be considerably helped by a valve shunt and this is being considered, though patients aged over seventy are rarely subjected to operation. An earlier referral might have led to arrest of this man's disease at an earlier stage.

I am grateful to Dr Barrie Reece of the Radiation Protection Service, Queen Elizabeth Hospital, Birmingham 15, who carried out the thermographic studies; and to Dr C. P. Moxon, Dr R. J. West and Dr J. Lee for their help with the radiological measurements.

REFERENCES


