more resistant to aureomycin than *Br. abortus*), found that relapses occurred even after a course of 21 g., and in one case a blood culture was positive after a course of 25 g.; two other cases had positive cultures after 20 and 21 g. These authors at first combined a course of sulphadiazine with the aureomycin, but they discarded the former as it did not appear to influence results. Their final recommendation is that the dosage should be approximately from 4 to 6 g. daily for two weeks. They also describe a "Herxheimer" type of reaction in 12 out of the 24 patients with an abrupt rise of temperature sometimes accompanied by a fall of blood pressure and tachycardia some eight to twelve hours after the initial dose of aureomycin if this was as high as 0.5 g. Therefore they recommend that 0.1 g. should be given in divided doses on the first day, 0.6 g. on the second day, 1.6 g. on the third day, and the full dose on the fourth day. It will be observed from Fig. 3 that there was an abrupt rise of temperature to 103° F. (39.4° C.), in spite of the cautious dosage, on the second day of treatment; there do not seem to have been any serious clinical symptoms. The maximum follow-up in Spink's series of cases is a period of three months; they were well satisfied with the clinical response of patients to treatment.

Knight *et al.* (1949) report five cases of brucellosis treated with aureomycin, four being acute cases and one a bacteraemia; their standard course consisted of 6 g. on the first day in divided doses, and thereafter 4 g. daily for five days—a total of 26 g. The report suggests that the immediate beneficial result of aureomycin is very striking, but two of the five cases relapsed after 15 and 42 days respectively; the former patient had received 9.5 g. for seven days instead of the standard course; evidently the length of time the drug is administered, as well as the total dosage, has to be taken into consideration. Knight *et al.* (1949) also record a "Herxheimer" type of reaction in one of their patients. Side-effects consisting of gastric disturbances were unimportant. Their maximum follow-up period was five months.

Heilman (1949) reports that in mice aureomycin alone is not particularly effective in reducing the number of brucella in the spleen of infected mice; aureomycin combined with streptomycin or dehydrostreptomycin was the most effective, but even this combination did not eliminate all the organisms. Herrell and Barker (1949), at the same clinic, employed subsequently a combination of aureomycin (3 g. in divided doses daily) and dehydrostreptomycin (1 g. twice a day intramuscularly for 12 to 14 days) in four cases with initial success; the infecting organisms were *Br. suis* two cases and *Br. abortus* two cases. Their blood cultures after treatment in each case were negative, which suggests a permanent cure. Spink *et al.* (1948) had previously used streptomycin, but discarded it because of its unfortunate effect on the labyrinth. No such effect is recorded with dehydrostreptomycin.

In the present state of our knowledge it would therefore appear reasonable, in an average case of brucellosis in this country, to employ aureomycin in doses of 4 to 6 g. daily for a fortnight, with smaller amounts on the first three days (0.1 g., 0.6 g., and 1.6 g. in divided doses). The ease of administration by the oral route and the lack of important side-effects are important considerations. Should the case prove resistant or relapse frequently, dehydrostreptomycin and aureomycin in the dosage suggested by Herrell and Barker might well be employed.

It is to be hoped that further cases treated with aureomycin and controlled by subsequent blood cultures will soon be published by others.

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BRACHIAL NEURALGIA

BY

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The syndrome of sciatica due to a prolapsed intervertebral disk is well recognized, and in essence consists of symptoms and signs resulting from irritation of a single nerve root. The muscles supplied by the root are tender, painful, and weak, while pain radiates down the dermatome, and frequently paraesthesia, numbness, sensory loss, and interference with the appropriate reflex arc are present. In addition, there is often a history of lumbago, and examination reveals protective spasm of the erectores spinae.

Brachial neuralgia is at present a less exact diagnosis than sciatica, and includes many diseases in which the presenting symptom is pain radiating down the arm; but there is a group of cases in which the symptoms are those of root irritation comparable to that found in sciatica, and in these a diagnosis of prolapsed intervertebral disk is commonly made. There are, however, reasons for believing that such a lesion is not the commonest cause of brachial neuralgia, and that, instead of a prolapse of the nucleus pulposus, arthritic changes in the neurocentral joint are the most usual source of root irritation in the neck (Lund, 1945; Bull, 1948).

A total of 66 cases has been selected from those seen personally in the out-patient department. Each has borne a superficial resemblance to brachial neuralgia, but of these cases 24 have been discarded as belonging to a miscellaneous group which defies classification. In all the others (42) it has seemed probable that the symptoms were the result of irritation of one or more cervical roots; the diagnosis was made primarily on clinical grounds, and the criteria on which individual cases were assessed were: (1) Radiation of pain into the arm. Usually this was referred accurately enough to one or more dermatomes to permit clinical location of the lesion. In only five cases was this not so. (2) Pain with or without tenderness in the muscles supplied by the appropriate root. (3) X-ray changes corresponding with the root involved.

A single root appeared to be involved in 24 cases, and it is in these in which the disease is localized that one may expect to find the characteristic x-ray appearances. The roots affected were: root 5, 1 case; root 6, 7 cases; root 7, 15 cases; root 8, 1 case.

With the multiplication of levels and the development of hypertrophic spondylitis, every variety of change may be found. The important point is that narrowing of the disk and the lesions that result from it are so constantly seen: in only two cases out of the 24 were the radiographs entirely normal. In the remaining cases the lesions were both clinically and radiologically multiple; in 10 the symptoms were bilateral, but one rather striking feature is the way in

which gross osteophytic protrusions into the intervertebral foramina can occur without the production of symptoms.

Osteophytes were demonstrable in the region of the neurocentral joint in 21 cases; the apophysial joint alone seemed to be involved only once. In two cases no oblique views were taken, but from other evidence it is probable that osteoarthritis with pressure on the root was the cause of symptoms; thus in 24 cases arthritis appeared to be the essential factor.

Of the other 18 cases a clinical diagnosis of prolapsed disk was made in 6, but in the remaining 12 cases it was not possible to make a more exact diagnosis than "root irritation." Three of these developed a periarthritis of the shoulder, which may have been responsible for most of the symptoms. Five of these indefinite cases may have been examples of the "costoclavicular syndrome," though in four of them there were also x-ray changes in the cervical spine.

In three cases an attack of sciatica occurred at one time or another, and one may wonder whether there is not some factor, at present unknown, which predisposes to disk lesions. This association has been noted before (Brain, 1948b).

It has been suggested by Keegan (1947) that the patient with a single root lesion can, when tested with a pin, usually map out an area corresponding to the anatomical dermatome. His cases were regarded mainly as prolapsed disks, and perhaps the degree of root compression in these is greater than is usually seen in osteoarthritis. In the present series of 42, definite sensory loss was found in only four cases, and two of these were probably prolapsed disks, while in the other two the arthritic changes were gross. Nevertheless, the patient's description of the symptoms referred to the dermatome gives the best clinical guide to the root involved: objective signs of any sort are usually absent.

The age and sex distribution is shown in Fig. 1, and the incidence of symptoms and signs in the Table.

FIG. 1.—Age and sex distribution.

Incidence of Symptoms and Signs in 42 Cases

	No. of Cases
Onset { Gradual	30
Sudden	12
History of trauma	3
Bilateral symptoms	10
Pain { Muscular { Shoulder girdle	34
Pectoral	4
Dermatome	37
Paraesthesia	24
Sensory loss	4
Diminution of tendon reflexes	4
Wasting	4

Illustrative Cases

Case 1: Diagnosis—Prolapsed Intervertebral Disk.—A bank clerk aged 43 woke up on the morning of March 15, 1949, with pain in his right shoulder. It started in the back of the shoulder and gradually worked its way down the arm into the middle and index fingers of the right hand. At the time of his examination, five weeks later, he had developed "pins and needles" in these fingers and had noticed that the pain was worse when he coughed or if he flexed the neck to the affected side. The right triceps jerk was diminished and there was considerable muscular tenderness in the triceps and supraspinatus.

The root of the neck was tender and there was sensory loss to pinprick over the index and middle fingers of the right hand and along a band running as high as the elbow. A radiograph showed loss of the normal curve of the cervical spine at the disk between C6 and C7 (Fig. 2). There were no osteophytes in the foramen (Fig. 3).

FIG. 2.

After resting in bed at home for a month the pain remained so severe that he was admitted to hospital; the neck was stretched, using tension of 10 lb. (4.5 kg.). Almost immediately he found that

FIG. 3.

while his neck was on the stretch the pain was absent from his arm. His symptoms gradually abated and the sensation returned to the area from which it had been lost.

Case 2: Diagnosis—Arthritis of the Neurocentral Joint.—A polisher aged 63 began to notice pain in his right shoulder five weeks before he attended the out-patient department. This gradually developed and extended down the outer part of his right forearm into the back of his hand; he also had some pain in his chest wall, but there was no paraesthesia. The pain was neither relieved nor aggravated by anything in particular, but he noticed that it was worse at night and disturbed his sleep. Examination revealed no physical signs except for creaking in his neck and some local pain when the cervical spine was moved. A radiograph showed narrowing of the disk space between C6 and C7, but only slight loss of the normal curve. The oblique view revealed considerable narrowing of the intervertebral foramen as the result of osteophytes (Fig. 4). With adequate rest to the arm he largely lost the pain, but eventually had to give up his work as a polisher because he found that excessive use of the arm brought on further attacks.

Case 3: Diagnosis—Arthritis of the Spine, probably with Prolapse of the Intervertebral Disk.—A car inspector aged 57 began to notice numbness and tingling in the left little finger 15 months before attending as an out-patient, and soon afterwards pain appeared and his symptoms began to get steadily worse. Eventually all the fingers, but not the thumb, of the left hand were affected and pain developed in the other hand. Three months before he first attended he noticed that his right leg was becoming weak and tended to drag, and about the same time he was troubled by a stiff neck. The significant findings were as follows: the skin of the hands was smooth and shiny, and there was weakness of the grip on both sides. Both arms were hypertonic and there was clonus of the right wrist. At times fibrillation was seen in the arms and the pectoral muscles. There was a partial loss to pinprick on the trunk below the level of D3 and there was also a band of hypoalgesia down the back of each arm which faded into a loss of sensation of glove distribution on the hands. Vibration sense was impaired on the right side of the trunk and the right leg. The right abdominal reflexes were absent and the right plantar response was probably extensor. A radiograph

FIG. 4.

showed gross osteoarthritis of the cervical spine with posterior osteophytes encroaching on the vertebral canal. Similar changes were apparent around the margins of the vertebral bodies, from the lower border of C4 to the upper border of C7. The main posterior projection was between C5 and 6

FIG. 5.

(Fig. 5). Foraminal lesions were pronounced at each level. Lumbar puncture showed a partial block on jugular compression, but there was no change in composition of the C.S.F. Laminectomy was performed over C4, 5, 6, and part of 7, and an attempt was made to decompress the roots most affected, but haemorrhage prevented this. The patient made an uninterrupted recovery from the operation and nine months later had regained the sensation in arms

and trunk, but the pain and trophic changes were still severe in the hand, and his walking, although improved, was still affected.

Anatomy

In the cervical region the bodies of the vertebrae are not completely separated from each other, as they are in the lumbar region, by the intervertebral disks. Radiographs

FIG. 6.

FIG. 7.

illustrate the position of this joint (Fig. 6). The outline of an isolated vertebra in approximately the same position is included for comparison (Fig. 7).

The postero-lateral wall of the intervertebral foramen is formed by the pedicle and the overhanging lip of the apophyseal joint, and between this wall and the neuro-central joint lie the dorsal root and the anterior root of the spinal nerve (Fig. 8).

FIG. 8.

Pathogenesis

One of two things may happen in the first instance, but the end-result of both is roughly the same. Either the nucleus pulposus may herniate and penetrate the neuro-central joint or a slow degeneration of the disk takes place.

In the first case the prolapsed nucleus presses on the nerve, but at the same time there is an appreciable loss of disk substance with probably a demonstrable narrowing of the disk space. The damage to the joint makes it highly probable that arthritis will follow later. In the second case the process is insidious and loss of disk substance ensues gradually. In both cases the normal cushioning effect of the disk is lost and the weight of the head is borne by the neurocentral joints. These act as a fulcrum about which an angular collapse of the upper vertebral body takes place on the lower, with consequent loss of the normal curve of the cervical spine at the point of the lesion.

As a result of this unaccustomed strain osteophytes appear around the neurocentral joint, and these protrude into the intervertebral foramen. With progressive damage the neurocentral lips collapse and eventually the curve of the spine is restored. Now there is narrowing of the intervertebral foramen in the vertical plane as well as that due to arthritis of the neurocentral joints.

X-ray Findings

As in the lumbar region radiographs may be entirely negative in cases of prolapsed disk. The earliest radiological sign, seen in the lateral view, is loss of the normal curve and narrowing of the disk space at the site of the lesion. Later the oblique views show osteophytes arising in the neurocentral joints and protruding into the intervertebral foramen. The apophyseal joints seem to be less commonly affected: their normal range of movement would obviously allow them to compensate for a slight forward tilt.

Opinion is divided on the value of myelography, but it would seem that in the case of arthritis of the neurocentral joint no change could be expected in the myelogram.

Differential Diagnosis

In the presence of brachial neuralgia the differential diagnosis resolves itself into a consideration of some relatively uncommon possibilities (for example, tumours of the vertebrae or nerves) and three common causes. The distinction is not always as easy in practice as it is in theory.

1. *Osteoarthritis of the Spine* (usually the neurocentral joint).—Characteristically, there is an insidious onset in an elderly person of pain in the muscles and down one or both arms, often into one or two fingers of the thumb. Tenderness of the muscles is often the only physical sign. Sometimes the symptoms are precipitated by minor trauma, such as excessive use of the arm. From the nature of its pathogenesis the condition is often bilateral and often more than one level is affected. Radiographs show the presence of osteophytes encroaching on the intervertebral foramen.

2. *Prolapsed Intervertebral Disk*.—The onset here is typically sudden and affects a slightly younger age group. There may be a preceding or associated pain in the neck similar to the lumbago so common with sciatica, and similarly the condition is unilateral. Physical signs such as loss of tendon reflexes and demonstrable sensory loss are likely to occur. A test which is considered pathognomonic is the neck-compression test. In this the head is flexed to the side of the lesion and pressure applied on top. The compression causes pain to radiate down the affected dermatome. Knight (1948) states that this is not invariably positive. Spurling and Scoville (1944) point out that a positive test theoretically rules out spasm of the scalenus anticus as a cause for the symptoms, because by this manoeuvre this muscle is relaxed; the sign is negative when the root irritation is the result of the comparatively rigid and incompressible osteoarthritic neurocentral joint.

Regardless of the cause of root irritation the scalenus anticus is apt to be tender along with other muscles supplied by the root, and therefore pressure over the brachial plexus in the root of the neck gives rise to pain. Brain (1948a) states that pain in the neck is common in cases of herniated disk, and points out that loss of disk space without osteoarthritis is suggestive of this lesion.

3. *The "Drooping Shoulder Girdle Syndrome."*—This has had its province extended far beyond the bounds of reason. There is no question that minor abnormalities of the thoracic outlet can give rise to symptoms, but some authors claim that compression of the fifth, sixth, and seventh roots can occur at the thoracic outlet or between the slips of origin or insertion of the scalene muscles (Swank and Simeone, 1944; Kirgis and Reed, 1948). Walshe *et al.* (1944) speculate whether acroparaesthesia and acrocyanosis may not be a minor expression of this syndrome, but do not suggest that brachial neuralgia with symptoms referred to one of the higher roots can result from similar causes. Spurling and Scoville (1944) agree that it is only T1 and C8 which can reasonably be involved in this syndrome, and certainly if one of the higher roots should be involved it is difficult to see how the lower roots could at the same time escape. Nachlas (1942) believes that the scalene angle is widened by the contraction of this muscle, and points out that involvement of the posterior muscles, whose nerve supply arises high up, excludes the possibility that the cause of symptoms is in the costoclavicular region. The concept of a primary spasm of the scalenus anticus seems to be somewhat nebulous, and if spasm of this muscle occurs the most likely explanation is that it is in fact due to a lesion of the nerve root or roots.

The typical syndrome of the drooping shoulder girdle or costoclavicular syndrome is not as common as brachial neuralgia. It is precipitated by unaccustomed strain such as the carrying of heavy weights or by some general illness which lowers the tone of the muscles supporting the shoulder girdle.

Treatment

Spontaneous recovery usually occurs after some weeks or months, but is often only partial. Because there is so little to show for their symptoms patients are reluctant to take adequate rest, and indeed may be prejudiced against doing so because they often find that the pain is worse at night and when they are in bed. Nevertheless, rest is the most important factor in treatment, and if the patient can remain in bed this should be advised. In less severe cases a sling may be adequate, and sometimes immobilization of the neck in plaster or in a brace will help, but not all patients will tolerate this, particularly if there is a lot of muscular tenderness in the shoulder girdle.

Physiotherapy is useful, and the injection of procaine into persistently tender areas in the muscles may give lasting relief, but the patient should be warned that when the immediate effect of the injection wears off there will be a temporary increase in the pain. Elliott and Kremer (1945) have shown that electromyographic changes are found in these tender spots, and that the changes disappear after a procaine injection. Elliott (1944) states that such relief does not exclude a root lesion.

In a few cases admission to hospital becomes necessary. Extension of the neck is worth trying, and in cases of prolapsed disk may be strikingly beneficial. As a last resort, if all else fails, the patient can be offered an operation. This is neither so easy nor so successful as the operation for sciatica, and involves risk of damage to the cord. Localization can nearly always be obtained on clinical grounds and confirmed by oblique radiographs. Evidence of long-tract

compression, except in the very old, strengthens the case for laminectomy. If it is suspected that costoclavicular compression plays an important part, scalenotomy is a comparatively simple operation and is worth a trial where the doubt persists.

Besides the case reported in detail (Case 3), a laminectomy was performed in two cases in which symptoms remained in spite of all conservative measures. Both derived considerable benefit, though the improvement was slow in one of them. In neither case was it possible to remove the underlying cause—osteophytes in one and probably a disk protrusion in the other.

Summary

Forty-two cases of brachial neuralgia are reviewed. The importance of the neurocentral joint is underlined and the significance of the radiological changes in the cervical spine, especially narrowing of the disk space, is indicated. The differential diagnosis is discussed.

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COMPLETE EXCISION OF THE PAROTID GLAND WITH PRESERVATION OF THE FACIAL NERVE

BY

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This operation was first performed by Carwardine in 1907, but has not been widely adopted. Hamilton Bailey (1939) has described his technique and experience with the operation, and has also given a very interesting account of the anatomy of the parotid gland (Hamilton Bailey, 1948). D. State (1949), in America, is also an advocate of total parotidectomy as the method of choice for mixed parotid tumours.

The specialized technique, which the advent of intra-tracheal anaesthesia and electro-coagulation has simplified, is not described in modern textbooks, nor is it familiar to many surgeons. This operation should preserve all the branches of the seventh nerve and be followed by a complete recovery of the function of that nerve: it can therefore be performed, without fear of disfigurement, for the cure of a variety of pathological lesions. In frank malignant disease sacrifice of the facial nerve may be an unfortunate necessity, but in other lesions facial palsy is an avoidable tragedy.

Mixed tumours form the majority of parotid tumours and usually occur after the fourth decade. The diagnosis is not always easy, but the history is of considerable assistance. They grow very slowly and have been present