THE DIAGNOSIS AND TREATMENT OF PAIN AND PARAESTHESIAE IN THE ARM

D. TAVERNER, M.B.E., M.D., F.R.C.P.

Reader in Medicine

D. W. MILES, M.B., B.Sc.

Registrar

J. L. JAMES, M.B., B.Sc., M.R.C.P.

Tutor in Medicine

D. E. CLARK, M.B., CH.B.

May & Baker Research Fellow

E. P. LANGWORTH, M.B., CH.B.

Late Registrar

From the University Department of Medicine, The General Infirmary at Leeds

PAIN and paraesthesiae in the arm are common symptoms. Four-fifths of the sufferers are women usually of middle age and the majority experience their discomfort at night. Because of sleep disturbance the morbidity of the condition is considerable.

The syndrome of 'acroparaesthesia' has been recognized for many years, and the term was coined by Schultze (1893). After a number of identifiable causes had been eliminated, there remained a substantial group of patients with stereotyped symptoms but no diagnosis. Such vague terms as 'sleep tetany' and 'sleep rheumatism' were applied to them. Wartenberg (1944) suggested that compression of the brachial plexus by a normal first rib during sleep was the cause. Walshe (1945), who saw chiefly women with such symptoms in wartime conditions in Britain, attributed the compression to drooping of the shoulder girdle because of muscular fatigue. He called it the 'axillary outlet' or 'costo-clavicular compression' syndrome.

A significant contribution to the problem of aetiology was made by Brain, Wright and Wilkinson (1947) when they described a patient with bilateral spontaneous compression of the median nerves in the carpal tunnels. Since that time the 'carpal tunnel syndrome' has been diagnosed with increasing frequency, but in certain circles there has been a tendency to group all patients with painful arms under the label 'brachial neuropathy' (Lishman and Russell, 1961).

Effective therapy demands precise diagnosis and the need for precision is enhanced by the effectiveness of surgical division of the anterior carpal ligament in relieving the symptoms of the carpal tunnel syndrome (Garland, Sumner and Clark, 1963; Garland, Langworth, Taverner and Clark, 1964). A valuable aid to such precision was demonstrated by Simpson (1956). He showed

that slowing of nerve impulse conduction occurred in the compressed segment of the median nerve producing an increase in the latency of the action potential recorded from the abductor pollicis brevis muscle when the median nerve was stimulated above the wrist.

This paper records our experience using this technique in the investigation of 401 patients referred to us with pain or paraesthesiae in the arm.

Materials and Methods

401 patients have been examined during 1962 and 1963. Some were referred directly by their family doctors to the Department of Electromyography, the General Infirmary at Leeds, but most came from other consultants in the region, chiefly orthopaedic surgeons.

After a history had been obtained each patient was examined clinically and classified as (a) clinically positive for median nerve compression, (b) clinically doubtful or (c) clinically negative. Nerve conduction measurements were then carried out. A coaxial concentric needle electrode was inserted into the abductor pollicis brevis muscle. The median nerve was stimulated above the wrist by a supramaximal square wave stimulus (amplitude 250 volts; duration up to 40 μ sec.) which simultaneously triggered the sweep of a calibrated cathode-ray oscilloscope. The muscle action potential picked up by the coaxial electrode was displayed, after suitable amplification, on the oscilloscope and its latency in milliseconds was read off directly. The process was repeated following stimulation of the median nerve at the elbow. By measuring the distance between the points of application of the electrodes, the conduction rate in the elbow-wrist segment of median nerve was determined. Both median nerves and one ulnar nerve were examined in each patient, to exclude the possibility that any increase in the latency of the action potential in the thenar muscles was due to some generalized pathological process affecting nerve conduction. Depending on whether local slowing was present or absent the patients were classified as (a) electrically positive or (b) electrically negative.

In the early stages of this work it was not possible, for technical reasons, to record a sensory action potential from the median nerve. Later on, the latency, amplitude and duration of the action potential in the median nerve at the wrist were observed following electrical stimulation of the skin of the thumb using ring electrodes.

Results

Examination of normal subjects

Thomas (1960) examined 50 normal subjects and found latencies of the motor action potentials between 2.9 and 5.0 msec. (mean 3.8 msec. S.D. ± 0.5). In the present study 71 normal subjects were observed and gave a mean of 3.6 msec. (S.D. ± 0.5). The upper limit of normal was therefore taken as 4.6 msec. (Mean ± 2 S.D.).

The Present Series

Of the 401 patients, 323 (80.6%) were women and 78 (19.4%) men. Their ages ranged from 22 to 79 years, but the diagnosis was made most frequently in the fifth and sixth decades in both men and women. The duration of symptoms varied from 2 weeks to 20 years.

162 patients (women 134; men 28) had unequivocal clinical and electrical evidence of median nerve compression. The 'classical' clinical picture obtained by analysis of these emerges thus:

Symptoms:

	Patients	
(1) Pain	116	
Site: Neck	9	
Shoulder	32	
Arm	28	
Forearm and hand	51	
(2) Paræsthesiæ	103	
Confined to median territory	54	
Spreading into ulnar territory	49	
(3) Numbness of digits	44	
(4) Morning stiffness of fingers	28	
(5) Swelling of hands	11	
(6) Tendency to drop things	8	
(7) Joint pains	3	
(8) Depression:		
Under 40 years: women	6	(antecedent 4)
men	0	(" 0)
Over 40 years: women	23	(" 12)
men	3	(" 1)
(9) History of trauma	10	
Site: Neck	1	
Arm	3	
Elbow	1	
Wrist	5 (All Colles' fractures)	

Of these 162, 61 patients had symptoms on the right, 17 on the left and 84 bilaterally. In the whole group of 293 cases of median nerve compression, the distribution was:

right:— 115; left:— 39; bilateral:— 139.

Signs:

(1) Wasting and/or weakness of abductor pollicis brevis:	121 patients
right	44
left	35
both	42
(2) Sensory loss (light touch and pin prick)	
median	88 patients
ulnar	1

The accuracy of sensory examination is notoriously low, and the correlation between the finding of sensory

loss and the confirmed diagnosis of median nerve compression in this series is poor.

Classification of patients in sub-groups

On the basis of combined clinical and electrical findings, the patients were divisible into 6 groups.

I Clinically and electrically positive	162
II Clinically positive and electrically negative	34
III Clinically doubtful and electrically positive	62
IV Clinically doubtful and electrically negative	87
V Clinically negative and electrically positive	7
VI Clinically and electrically negative	38

Refused examination 11

Subsequent observation of groups II to V suggested that the diagnosis of median nerve compression was substantiated in the following proportions: II 20 out of 34; III 59 out of 62; IV 47 out of 87; V 5 out of 7.

Diagnosis in patients without median nerve compression

Other diagnoses were possible in a number of cases; in Group IV for example, the following were made:— periarthritis of shoulder—8; root pressure due to cervical spondylosis—8; 'tennis elbow'—6; rheumatoid arthritis—4; diabetes mellitus—4; depression—13. However, no diagnosis was possible in 18 of this group.

Final diagnosis of median nerve compression

In the whole group of 401 patients, a final diagnosis of median nerve compression was made in 293 and in 64 of these (Groups III and V) it was made in the absence of clinical confirmation, and principally on the basis of electrical tests.

Results of Treatment

240 operations have been carried out in 180 patients; 60 had operations on both wrists. All patients have been reviewed one month and 12 months post-operatively; 13 are dissatisfied with the results of treatment, but the rest profess themselves glad that they were operated on. However, 29 patients complained transiently of pain in the operation scar; this was severe in two cases.

Post-operative electrical studies

Fig. 1 shows the definite tendency for the results of electrical testing to return to normal following effective relief of pressure on the median nerve. This applies to both motor and sensory function.

Discussion

The Clinical Syndrome

It has been suggested that electrodiagnosis is unnecessary in the carpal tunnel syndrome and that a competent neurologist can always make the

a.

FIG. 1.—Conduction times in 123 cases of median nerve compression: (a) before operation; (b) one year after operation. Before operation 78% had latencies of more than 4.6 milliseconds; one year after operation only 28.5%. NIL in both histograms means that no action potential could be recorded from the abductor pollicis brevis muscle.

b.

diagnosis clinically (Garland, Sumner and Clark, 1963). In a patient with typical symptoms and signs of nocturnal pain, paræsthesiæ in the digits supplied by the median nerve—worse after a day's work—and weakness and wasting of the abductor pollicis brevis, this may well be true. However, our experience is that the clinical picture is atypical in an appreciable number of patients—111 (37.6%) in our series. If this proportion of the total had gone unrecognized, much avoidable morbidity would have resulted.

The site of the pain in median nerve compression has caused some diagnostic confusion. Miller (1961) is reluctant to accept the occurrence of pain in other parts of the arm than the hand, but Garland, Sumner and Clark (1963) and ourselves have seen it frequently as high as the shoulder. The latter authors did not essay an explanation of this distribution of the pain, but the experimental studies on animals of Granit, Leksell and Skoglund (1944), suggest the possibility that at the site of compression of the median nerve an artificial synapse is created. This would allow the interchange of impulses between the fibres of the median nerve at that level, causing a diffuse reference of pain to all the dermatomes supplied through the median nerve.

The Value of Electro-diagnosis

Garland and others (1963) damn electro-diagnosis with faint praise, and dismiss such studies as of 'academic interest'. However, they

concede their value in showing 'objective evidence of improvement in the patient who claims to be no better'. Occasionally the surgeon does not divide the flexor retinaculum completely, and the patient's symptoms persist. In such a case, the temptation is to consider the initial diagnosis of carpal tunnel syndrome incorrect, or to dismiss the patient as neurotic. Both of these pitfalls can be avoided by repeating the electrical tests. Where the median nerve is not effectively decompressed the latency of the muscle action potential increases, or, at best, does not fall. On these two counts, therefore, we assign great importance to electro-diagnosis. Its value lies in the objective nature of the evidence it provides. On the question of operative failure the following case history is revealing.

Mrs. H. C. suffers from cyanotic congenital heart disease and is therefore not a good subject for surgery. The first operation to relieve her carpal tunnel syndrome failed, and electrical examination showed that the median nerve was still compressed. A second operation produced only transient improvement, and following it the latency of the motor action potential increased considerably. A third operation was completely successful.

No more stringent test of the value of electro-diagnosis can be envisaged. Add to this the recognition of atypical cases, and the ability to follow and record the improvement following operation, and we believe the value of electro-diagnosis to be substantiated.

The Efficacy of Surgical Treatment

Some authors are reluctant to advise surgical treatment, at least initially. Splinting and hydro-

cortisone injections still have their protagonists, but we would support all Garland, Sumner and Clark (1963) say in favour of operation. Garland, Langworth, Taverner and Clark (1964) using the method of sequential analysis have shown the efficacy of surgery. The high success rate in our 293 patients—95% were relieved of their carpal tunnel syndromes—accords with that experience.

Spontaneous Remission of Symptoms

The carpal tunnel syndrome occurs not infrequently in pregnancy and spontaneous remission after delivery is the rule. Consequently we do not advise operation in this group, but there is a tendency for the condition to recur in later years.

Apart from these patients, spontaneous permanent remission of symptoms is unusual—only 7% in this series.

Other Causes of Arm Pain and Paræsthesiæ

The carpal tunnel syndrome is not the only cause of pain and paræsthesiæ in the arm, but it was much the commonest in this series of patients. However, it must be emphasized that these patients were not a random sample, and there was a strong bias in favour of median nerve compression. The only other conditions referred to us with any frequency were: periarthritides of shoulder—13; tennis elbow—23; cervical spondylosis—23; diabetic neuropathy—10; rheumatoid arthritis—7; psychiatric conditions—38; miscellaneous organic disorders—25. Two painful conditions co-existed in 65 patients. No diagnosis was made in 34 patients, but 11 of these refused electrical examination. The small number of cases of 'tennis elbow' in this series casts doubt on Good's (1951) contention that 'cubital myalgia is responsible for the malady known by the name of acroparæsthesia'.

The Doubtful Case

87 patients were clinically doubtful and electrically negative, yet 47 of them were eventually judged to be suffering from median nerve compression. Sometimes serial examinations clarify the picture; sometimes splintage gives relief and justifies surgery; sometimes surgery is tried experimentally.

Occasionally—three times in this series—an electrically positive patient is later judged to have another disorder. This can result from a technical failure, but it is, of course, possible for two disorders to co-exist.

Summary

1. 401 patients were investigated clinically and electromyographically to determine the cause of pain in the arm.

2. The commonest single cause was compression of the median nerve in the carpal tunnel. There were 293 examples of this disorder of which 162 (54.9%) were clinically and electromyographically typical, 113 (38.3%) were atypical in both respects and 20 (6.8%) were only clinically typical.

3. In the atypical cases, the pain and/or paræsthesiæ were unusual in site, character, periodicity and duration or accompanied some other pathological process which at first sight appeared causative.

4. The differential diagnosis and assessment of response to treatment were substantially assisted by electrical tests.

5. In the electromyographically confirmed cases of carpal tunnel syndrome surgical treatment—division of the anterior carpal ligament—was successful in 95% of cases.

We wish to express our thanks to physicians and surgeons in the region who referred their patients.

REFERENCES

- BRAIN, W. R., WRIGHT, A. D., and WILKINSON, M. (1947): Spontaneous Compression of Both Median Nerves in the Carpal Tunnel, *Lancet*, **i**, 277.
- GARLAND, H., LANGWORTH, E. P., TAVERNER, D., and CLARK, J. M. P. (1964): *In the press*.
- , SUMNER, D., and CLARK, J. M. P. (1963): Carpal Tunnel Syndrome with Particular Reference to Surgical Treatment, *Brit. med. J.*, **i**, 581.
- GOOD, M. G. (1951): Objective Diagnosis and Curability of Non-articular Rheumatism, *Brit. J. phys. Med.*, **14**, 1.
- GRANIT, R., LEKSELL, L., and SKOGLUND, C. R. (1944): Fibre Interaction in Injured or Compressed Region of Nerve, *Brain*, **67**, 125.
- LISHMAN, W. A., and RUSSELL, W. R. (1961): The Brachial Neuropathies, *Lancet*, **ii**, 941.
- MILLER, H. G. (1961): Progress in Clinical Medicine. London: J. & A. Churchill, p. 247.
- SCHULTZE, F. (1893): Ueber Akroparæsthesie' *Dtsch. Z. Nervenheilk.*, **3**, 300.
- SIMPSON, J. A. (1956): Electrical Signs in the Diagnosis of Carpal Tunnel and Related Syndromes, *J. Neurol. Neurosurg. Psychiat.*, **19**, 275.
- THOMAS, P. K. (1960): Motor Nerve Conduction in the Carpal Tunnel Syndrome, *Neurology*, **10**, 1045.
- WALSHE, F. M. R. (1945): On 'Acroparæsthesia' and So-called 'Neuritis' of Hands and Arms in Women, *Brit. med. J.*, **ii**, 596.
- WARTENBERG, R. (1944): Brachialgia Statica Paræsthetica, *J. Nerv. ment. Dis.*, **99**, 877.