Papers and Originals

Pain in the Neck and Arm: a Multicentre Trial of the Effects of Physiotherapy

Arranged by the British Association of Physical Medicine

Brit. med. J., 1966, 1, 253–258

The British Association of Physical Medicine is planning to carry out a series of multicentre trials of physical treatments. The present paper is a report of the first trial, which was devoted to the conservative management of pain in the upper limb believed to arise within the neck. This syndrome was chosen because it is very common and often treated by physical methods, though with little evidence of their value. Furthermore, it has been the subject of a preliminary study (Steinberg and Mason, 1959).

An advisory committee[1] was set up to plan the trial, and nine London hospitals[2] agreed to take part.

Selection of Cases

Though the syndrome investigated is commonly thought to be due to root-compression secondary to degenerative changes within the cervical spine, the Committee acknowledged from the outset that not all authorities agree that this is the cause, and believed it would be impossible to select patients on the basis of a precise diagnosis of this kind. The Committee therefore defined a symptom-complex and agreed to include some patients with clinically normal necks provided they had full root-symptoms and others with partial root-symptoms provided they had definite clinical abnormality in the neck. The absence of abnormal neurological signs did not exclude patients from the trial.

Patients were selected from those attending departments of physical medicine, and when admitted to the trial had to comply with one of the following sets of criteria:

1. Pain in the neck and arm (with or without paraesthesiae), the symptoms having a root distribution and being associated with limited and painful movements of the neck.

2. Pain in the neck and arm of full root-distribution with paraesthesiae but without clinical evidence of abnormality in the neck.

3. Pain or paraesthesiae in the neck and arm of partial root-distribution but with definite evidence of clinical abnormality in in the neck.

[1] *Members of the Committee:* Dr. D. A. Brewerton, physical medicine (chairman); Dr. P. J. R. Nichols, physical medicine (secretary); Mr. Valentine Logue, neurosurgery; Mr. C. W. F. Manning, orthopaedic surgery; Miss M. Martin-Jones, physiotherapy; Dr. R. M. Mason, physical medicine; Dr. D. J. Newell, biostatistics; the late Dr. P. H. Sandifer, neurology.

[2] *The Hospitals:* Guy's, King's College, Lewisham London, Middlesex, Royal Free, Royal National Orthopaedic, University College, Westminster.

Doctors Taking Part in the Trial: A. Beardwell, P. W. Blower, D. A. Brewerton, M. R. Brown, E. D. R. Campbell, G. M. Cochrane, A. B. Corrigan, A. W. T. Eade, E. A. Featherby, D. N. Golding, C. J. Goodwill, E. B. D. Hamilton, W. D. Hayley, H. M. El Ibiari, J. D. Jessop, P. Hume Kendall, P. N. Knight, B. A. Latham, B. E. W. Mace, H. B. McMichael, P. H. Merry, J. MacKenzie, P. J. R. Nichols, K. H. Nixon, A. T. Richardson, J. Spurr, H. Titterington, C. D. Waltham-Weeks.

Though fulfilling these criteria the following patients were excluded from the trial:

1. Patients in whom the symptoms were apparently due solely to local lesions such as cervical rib, rotator-cuff lesions of the shoulder, tennis-elbow, or a carpal-tunnel syndrome.

2. Patients who had definitive disorders of the cervical spine such as rheumatoid arthritis or Paget's disease, or had had a bony injury to the cervical spine in the preceding 12 months.

3. Patients with abnormal neurological signs indicating cord compression.

4. Patients currently being treated with steroids or phenylbutazone.

Method

Recording.—A detailed questionary was devised which covered the history and clinical examination at the first attendance, a follow-up at two weeks, and a detailed review at four weeks. This was completed by the physician. The details of treatment were included in an additional questionary completed by the physiotherapist. Follow-up was by letter questionaries from the co-ordinating centre at six weeks and six months. Altogether 140 questions and answers were recorded for each patient.

Clinical Examination.—Neck movements were recorded to the nearest five degrees. To aid the assessment of the range of movement doctors taking part were advised to hold a patella-hammer on the patient's head, either on the crown for flexion, extension, and lateral flexion, or on the forehead for rotation (see Fig. 1). A preliminary observer-error experiment had

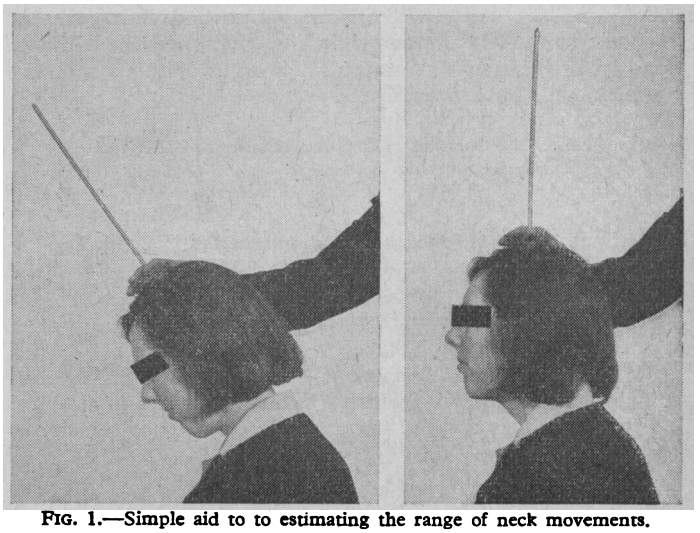


FIG. 1.—Simple aid to to estimating the range of neck movements.

enabled the organizers and the statistician to satisfy themselves that, provided there were 100 patients in each of the treatment groups, a mean difference in improvement of five degrees between the treatments could be detected. This experiment was carried out on 48 young men, and it was decided to establish arbitrary definitions of restricted neck movements in terms of the young normal, as follows: flexion <70°, extension <70°, rotation <80°, lateral flexion <50°. A full clinical examination of the upper limb was carried out with particular attention to neurological signs. The lower limbs were also examined for abnormal neurological signs.

X-ray Films.—These were taken in antero-posterior and lateral planes, and all films were read independently by three observers.[3] Each observer allocated gradings for disk-space degeneration and apophysial joint degeneration, according to the criteria specified in volume 2 of *The Epidemiology of Chronic Rheumatism* (1963). If the three observers did not agree on the grading the average of the three grades was taken. The presence or absence of cervical ribs was noted.

Details of Patients

A total of 493 patients (203 men and 290 women) were accepted for the trial. The age and sex distribution is shown in Fig. 2: 65% were aged 40 to 60 years.

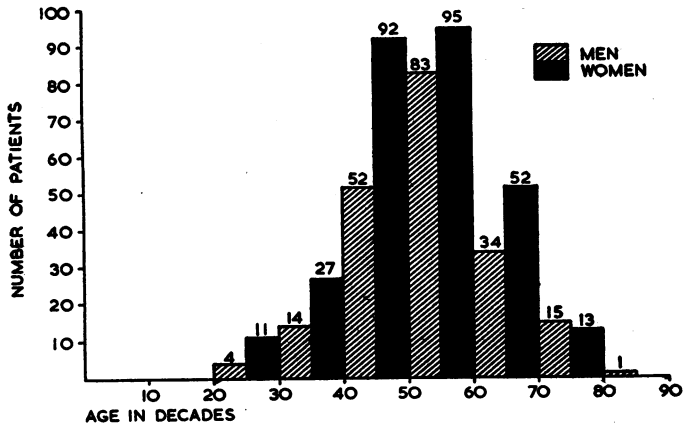


FIG. 2.—Age and sex distribution of patients entering the trial.

Number and Duration of Previous Attacks.—Of the 493 patients 280 (57%) were suffering their first attack, while 92 (19%) had had five or more previous attacks. Those patients who had had several attacks largely corresponded with the 84 (17%) who had a history of more than five years' duration. The duration of previous attacks is shown in Table I. Approximately one-half had settled in one month and three-quarters in three months—an important finding which must be borne in mind when the results of uncontrolled trials of this symptom-complex are being assessed.

TABLE I.—*Duration of Previous Attacks in 213 Cases*

One month or less	104 patients
One to three months	53 „
Over three months	56 „

TABLE II.—*Most Effective Treatment in Previous Attacks*

	No. of Patients		No. of Patients		No. of Patients
Nil	67	Traction	28	Manipulation	6
Analgesics	53	Exercises	15	Massage	4
Heat	49	Collar	8	Other	5

Effect of Previous Treatment.—All patients who had had previous attacks recorded which treatment they had found most effective, but they showed no particular preference for any of the treatments under investigation (Table II).

[3] *X-ray Assessors:* Dr. P. W. Blower, physical medicine; Dr. J. A. Gleeson, radiology; Dr. P. J. R. Nichols, physical medicine.

Sites of Pain and Paraesthesiae.—Of the patients 72.5% had unilateral symptoms, 26.3% had symptoms predominantly in one arm, and 1.2% had both arms equally affected. The right and left arms were the site of the worst pain with equal frequency. The commonest sites of pain were the shoulder, neck, upper arm, scapula, forearm, and hand; and the commonest sites of worst pain were the neck, shoulder, upper arm, and scapula (Table III). Paraesthesiae were recorded in 321 patients (65%) (see Table IV).

TABLE III.—*Sites of Pain*

Sites Recorded	No. of Patients	
	Pain Present	Worst Pain
Neck	403	142
Scapula	308	67
Shoulder	431	139
Upper arm	391	114
Forearm	303	49
Hand	213	27

Some patients recorded more than one " worst site " of pain.

TABLE IV.—*Sites of Most Pronounced Tingling*

Shoulder	5
Upper arm	34
Forearm	50
All fingers equally	131
Thumb	52
Index finger	63
Middle finger	49
Ring and little fingers	54

Some patients recorded more than one " worst site " of tingling.

Neck Movement.—Ninety-three per cent. of the patients had some restriction of neck movement when compared with normal values for young men; 52% had found that certain postures or movements of the head and neck made the pain or tingling in their arm either better or worse.

Abnormal Neurological Signs.—Forty per cent. of the patients had abnormal neurological signs in the upper limbs. The commonest abnormal findings were a diminished triceps reflex, weak elbow-extension, and minor sensory loss in the fingers.

X-ray Gradings.—Fig. 3 compares the prevalence of degenerative changes of the disk spaces in our series with the prevalence in the general population of Leigh and Wensleydale, as recorded by Lawrence (1963). However, it is probably unwise to place too much emphasis on these figures as they include grade 1 changes, which are minor and may vary owing to *x*-ray technique or interpretation. More reliance should be placed on Fig. 4, which compares the prevalence when restricted to patients with disk changes of grade 2 or more. A similar comparison of apophysial joint changes (grade 2 or more) is shown in Fig. 5. The incidence of cervical ribs was 6.6%.

X-ray Grading and Clinical Severity.—The clinicians' initial assessments of the severity of the current attacks was compared with the *x*-ray grades for disk and apophysial degeneration (see Table V). The correlation between the clinical severity and the *x*-ray changes was not clinically significant.

X-ray Grading and Presence of Abnormal Neurological Signs.—Patients with and without abnormal neurological signs in the upper limb had an almost identical distribution of *x*-ray grades both for disk and for apophysial degeneration, and the mean *x*-ray grades were the same whether or not they showed such abnormal signs.

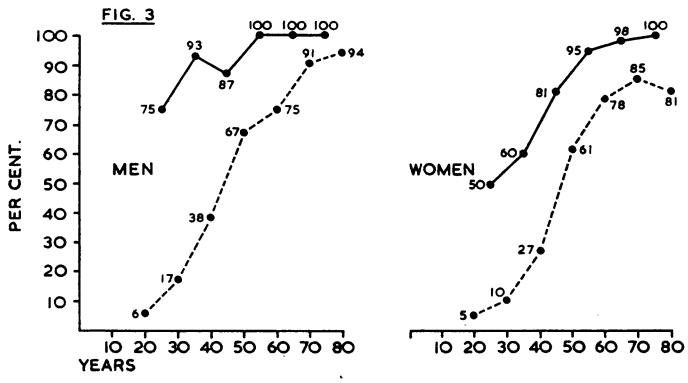
X-ray Grading and Neck Movements.—The ranges of all neck movements measured clinically were compared with the

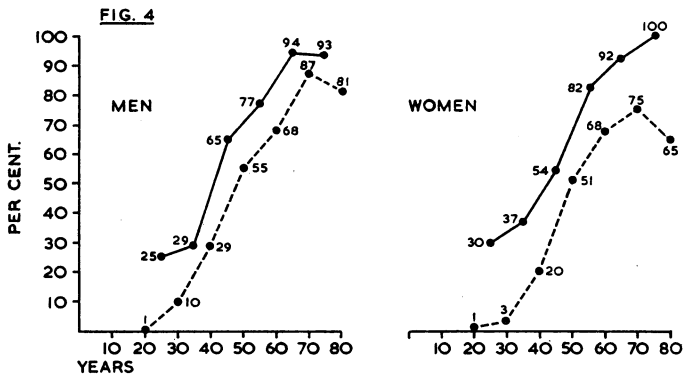
TABLE V.—*Comparison of X-ray Grading and Clinical Severity*

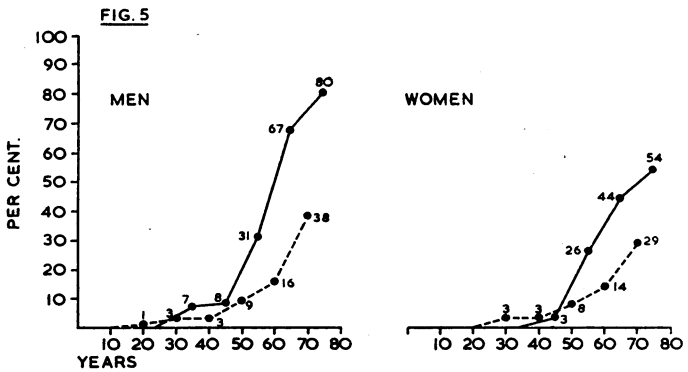
Mean *X*-ray Grade	Clinical Severity		
	Mild	Moderate	Severe
Disk degeneration	2·08	2·19	2·26
Apophysial „	0·88	0·94	1·02
% with cervical ribs	7·3	8·7	7·0

x-ray gradings for disk and apophysial joint degeneration and a significant correlation was demonstrated. The more severe the *x*-ray grading the greater was the restriction of neck movements.

Effect of Age on Relationship Between Neck Movements and X-ray Grading.—As age increases, the neck movements decrease and the *x*-ray gradings increase. We therefore considered whether the association between *x*-ray grading and neck movements was merely the effect of age. The associations were expressed as correlation coefficients, which were adjusted for age, giving partial correlation coefficients measuring the average amount of association between *x*-ray grade and neck movement over each age group. Though the associations were partly dependent on age, in most cases they remained significant when the effect of age was eliminated for both disk degeneration and apophysial joint changes. Thus, although the range of neck movement is related to age, it is also directly related to the amount of degenerative disease in the disk spaces and apophysial joints, as seen on the *x*-ray film.







FIGS. 3 to 5.—Incidence of *x*-ray changes in cervical spine. FIG. 3.—Disk degeneration (grade 1 or more); FIG. 4.—Disk degeneration (grade 2 or more); FIG. 5.—Apophysial joint degeneration (grade 2 or more) —— Trial patients. ---- Leigh and Wensleydale.

Treatment

The main treatments studied were cervical traction, comparable positioning without traction applied, instruction in posture for everyday activities, a temporary collar, placebo tablets, and untuned short-wave diathermy used as a placebo.

It was considered essential that physiotherapy should be given every chance to succeed. A meeting was held with 20 leading physiotherapists working in the London area, and all details of technique were discussed thoroughly until a pattern of management was laid down that was acceptable to all of them. It was agreed that treatments were to be given by physiotherapists specially selected by their superintendents as being particularly experienced in these techniques and competent to judge the necessary variations in method. Though they were provided with written guidance, physiotherapists were expected to use their judgment in details such as the angle of pull during traction and the poundage required for an individual patient. In this way the treatments were not completely standardized but should give the results to be expected from experienced physiotherapists in good hospitals working to principles agreed by leading physiotherapists.

Originally the organizers wished to have patients treated daily, but this was not done, because it was not standard practice at some of the hospitals concerned, and also it was felt that with daily attendances too many patients might default. Therefore all physiotherapy was given three times a week for four weeks.

Traction.—The physiotherapist was allowed to give what she thought to be necessary preliminary treatment, such as heat and gentle mobilizing exercises. The techniques for these were agreed by all concerned. The exercises given were only gentle active movements, no passive movements or manipulations of any kind were allowed. Traction was applied continuously for 20 minutes, the patient lying supine with his neck on an electric heat-pad. The angle of pull of the traction was chosen by the physiotherapist to give the maximum relief of pain to each patient, usually with the neck in a flexed position.

Positioning.—Patients were treated exactly as if they were having traction except that no traction was applied. Each patient had the same preliminaries and then lay supine with his neck on an electric heat-pad and his head in a position to give maximum relief of pain.

Instruction in Posture.—Patients were advised about correct neck posture at work, at play, and for sleeping. Special attention was given to heavy lifting, strenuous rotation movements of the neck, and the odd postures that may be adopted in driving, in reading with bifocal glasses, and in watching television.

Collar.—Simple collars were made of felt or foam plastic covered with stockinet, and were shaped to maintain the position giving greatest comfort. Patients were instructed to wear the collar invariably during the night and at home in the evenings, and as much as possible during the day. If it was possible for patients to wear their collars all the time they were encouraged to do so.

Placebo Tablets.—Inert tablets looking like phenylbutazone were prescribed three times a day.

Untuned Short-wave Diathermy.—The application of short-wave diathermy which has not been tuned is a useless manœuvre, but it involves a certain amount of obvious attention and preparation and requires patients to attend the physiotherapy department as often as those patients having other physiotherapy.

Analgesics.—As it was believed that many patients would take analgesics whether they were prescribed or not, patients in all treatment groups were given soluble aspirin as an analgesic unless they were sensitive to this drug, in which case an equivalent analgesic was supplied.

Treatment Groups

In a predetermined random fashion patients were allocated to five treatment groups: traction, positioning, collar, placebo (heat), and placebo (tablets). The treatments given under these headings were:

Traction: Aspirin, instruction in posture, a collar, and traction with the preliminaries and details of technique as already described.

Positioning: In every detail the same treatment as for traction except that the patient was put in a position that gave maximum relief of pain, but no traction was applied.

Collar: Aspirin, instruction in posture, and a collar, all provided at the first attendance.

Placebo (heat): Aspirin and untuned short-wave diathermy.

Placebo (tablets): Aspirin and inert tablets taken three times a day.

The Medical Research Council (1964) Report for 1962–3 on "Responsibility in Investigation on Human Subjects" was considered, and it was decided that placebo groups were justified, as there was genuine doubt whether the treatments under investigation were more effective than a placebo.

Originally it was intended to have untuned short-wave diathermy as the only placebo, giving four treatment groups with approximately 120 patients in each group. However, it was thought that the use of a form of physiotherapy as a placebo might be unreliable, as the physiotherapist giving the treatment could conceivably influence the patient's response. It was therefore decided to divide the placebo group into two, untuned short-wave diathermy being given at five hospitals and placebo tablets at the other four.

All patients attending for regular physiotherapy were treated three times a week for four weeks. After four weeks' treatment the trial was deemed to be ended so far as the treatment was concerned, and the physician was then free to treat the patient as he wished.

Assessment of Effects of Treatment

All patients were assessed by their physician initially, at two weeks, and at four weeks. He did not know in which treatment group the patient had been placed, and after each assessment the completed section of the questionary was forwarded to the organizing centre. Follow-up from the organizers was carried out by letter questionary at six weeks and six months.

Attendance and Follow-up.—Of the 493 patients accepted for the trial 27 were not included in the main trial, usually because they did not attend for the treatment allocated to them. This left 466 records which could be analysed to determine the responses to treatment. The defaulting rate of these patients was 6% at two weeks, 12% at four weeks, and 32% at six months' follow-up (Table VI).

Factors Assessed.—The following factors, which were recorded initially at two weeks and at four weeks, were used for assessing and comparing treatments: (1) the physician's assessment of the severity of the condition, (2) the patient's assessment of his pain, (3) the effect of the symptoms on the patient's ability to work, (4) the effect of the symptoms on the patient's sleep, and (5) the range of neck movements.

TABLE VI.—*Patients Defaulting*

	Treatment	Patients Entering Trial	Missing at Two Weeks	Missing at Four Weeks	Missing at Six Months	
Not attending department	Placebo tablets	52	4 (8%)	8 (15%)	14 (27%)	64 (37%)
	Collar only	120	7 (6%)	21 (17%)	50 (42%)	
Attending department	Placebo physiotherapy	66	3 (5%)	4 (6%)	14 (21%)	82 (28%)
	Positioning	114	4 (4%)	5 (4%)	33 (29%)	
	Traction	114	9 (8%)	17 (15%)	35 (31%)	
	Total ..	466	27 (6%)	55 (12%)	146 (32%)	

Comparison of Treatment Groups

The patients allocated to the various treatment groups were analysed and compared for the following main criteria recorded: sex, age, length of history, duration of present attack, presence of paraesthesiae, continuity of pain, effect of pain on the patient's ability to work, effect of pain on sleep, the initial assessment of severity made by the physician, and the *x*-ray grading for disk spaces and for apophysial joints and the presence of cervical ribs.

The five treatment groups did not differ significantly in any of these respects.

Results of Treatment

Immediate Response to Physiotherapy.—During traction relief of their symptoms was obtained in 105 of the 114 patients (92%). This compares directly with the 90% recorded by Wareham and Farrow (1960). During positioning relief of symptoms was recorded in 98 of the 114 patients (86%). The difference between this figure and that for traction is not statistically significant. Those who did not obtain relief during treatment were analysed, and did not form a particularly severe group of patients on any of the criteria recorded. Many cases classified as severe did receive relief, and some which were only moderate or mild did not obtain relief during treatment.

Effect of Four Weeks' Treatment.—Judged by the assessments at two weeks and four weeks the patients' improvement in the five treatment groups did not differ significantly (Tables VII–X).

Six Months' Follow-up.—The letter follow-up brought 320 replies.

Patients were asked whether they had had pain since the follow-up letter at six weeks: 100 had been without pain, 128

TABLE VII.—*Physicians' Assessment at Four Weeks*

Assessment at 4 Weeks	Treatment Group				
	Traction	Positioning	Collar	Placebo (Heat)	Placebo (Tablets)
"Cured"	21%	23%	24%	21%	16%
Mild	52%	54%	56%	53%	41%
Moderate	24%	20%	15%	23%	41%
Severe	4%	3%	5%	3%	2%

TABLE VIII.—*Patients' Assessment at Four Weeks*

Pain at 4 Weeks	Treatment Group				
	Traction	Positioning	Collar	Placebo (Heat)	Placebo (Tablets)
Gone	21%	18%	20%	21%	12%
Getting better ..	55%	63%	54%	49%	44%
Unchanged	15%	13%	19%	21%	38%
Getting worse ..	10%	5%	7%	9%	6%

TABLE IX.—*Increase in Joint Range at Four Weeks in Patients who Initially Had Restricted Movement*

	Traction	Positioning	Collar	Placebo (Heat)	Placebo (Tablets)
Flexion	10·6°	10·3°	11·0°	10·7°	13·3°
Extension	6·0°	9·4°	11·0°	6·2°	12·0°
Rotation (R) ..	3·9°	8·6°	9·2°	6·9°	5·7°
„ (L) ..	8·1°	6·2°	7·3°	7·5°	3·3°
Lat. flexion (R) ..	5·8°	5·2°	8·0°	7·0°	7·9°
„ „ (L) ..	6·7°	5·3°	8·2°	6·1°	4·3°

TABLE X.—*Effect of Pain on Ability to Work and Sleep*

	Interfering with Work or Stopping Work		Sleep Disturbed or Seriously Disturbed	
	Initially	At 4 Weeks	Initially	At 4 Weeks
Traction	57%	27%	72%	37%
Positioning	54%	31%	69%	35%
Collar	53%	35%	60%	33%
Placebo (heat)	55%	31%	68%	34%
„ (tablets) ..	58%	38%	62%	47%

had had some pain but had sought no further advice, and 92 had sought further advice (at same hospital 55, from G.P. 22, from a different hospital 5, from osteopath 9, and one had been referred for spa treatment). Comparison of the treatment groups showed no significant difference either in the incidence of those with pain or in the further advice they had sought.

Comparison of Placebo Treatments.—It was reasonable to expect that regular attendance at a hospital department for individual treatment by a physiotherapist would evoke a stronger placebo response than inert tablets. For this reason it was important to compare the two placebo groups—both for the general value of assessing the placebo effect of physiotherapy and in an attempt to assess whether in future trials inert tablets would constitute an adequate placebo treatment. No statistical difference was found between the two placebo groups. Though there was a trend towards one or other group in some of the assessments, these advantages were equally distributed between them. Altogether 37 criteria were assessed and compared, the main criteria of improvement being based on the physician's assessment, the patient's assessment of his pain, changes in neck movements, and the effect of pain on his ability to work and sleep. These were assessed at two weeks and four weeks after treatment was started, and by follow-up letter at six months.

Patients with a "Cast-iron Diagnosis."—A group of 66 patients were assessed separately because their diagnosis was more definite in that they had had symptoms for at least three months in their present attack, with pain in the neck, pain of a full root-distribution, and paresthesiae. These patients were evenly distributed through the five treatment groups, thus not causing any bias. There was a tendency for their symptoms to persist slightly longer than average, as was true of other patients who had had symptoms for more than three months ; but the rate of improvement was the same for all treatment groups.

Effect of Abnormal Neurological Signs.—There was no significant difference in the rate of improvement in patients with abnormal neurological signs when compared with those having no such signs ; and patients with abnormal neurological signs responded equally well in the five treatment groups.

Effect of Restriction of Neck Movements on Prognosis.—There was no significant difference in the response to treatment of 36 patients who had no restriction of neck movement in any direction when compared with patients who did have restriction of neck movement, and their rate of improvement was the same.

Factors Affecting Prognosis

As there was no significant difference in the rate of recovery in the five treatment groups, it was possible to consider all the patients together and to determine which factors that were present initially influenced the prognosis as judged by the assessments at four weeks and six months.

The following factors had a statistically significant effect on improvement at four weeks: age, the severity of the attack, the number of previous attacks, the average duration of symptoms in previous attacks, and whether symptoms were getting better or worse when the patient was first seen.

All other factors recorded at the initial assessment had no significant effect on improvement at four weeks. These included the range of neck movement, the presence or absence of abnormal neurological signs, and the presence of *x*-ray changes in the disks and apophysial joints and their grading, so that the clinical examination of the patient and the *x*-ray picture gave no indication of the expected rate of recovery.

Only tentative conclusions can be drawn from the follow-up questionary at six months, as 173 patients did not reply, but the following factors in the initial assessment had a statistically significant adverse effect on the recorded improvement at six months: a history of attacks for more than five years, more than three previous attacks, bilateral paraesthesiae, women over the age of 50, and symptoms that were getting worse when the patient was first seen.

Discussion

This study is a reminder of how little is known of the natural history of this common syndrome. Only limited conclusions can be drawn from a study of this kind, in which a highly selected group of patients attending hospitals are followed for a maximum of six months. Nevertheless it is worth commenting that some of the findings do not fit well with the concept of a steadily progressive degenerative disorder. Most patients fell in the 40 to 60 age group, and relatively few gave a long history or a history of many previous attacks. Those who had had previous attacks had usually recovered within three months.

Of the patients followed in this study 74% were assessed as cured or mild at the end of four weeks' treatment, and 75% reported that their pain was gone or getting better. This can be compared with the series of "brachial neuropathies" reported by Lishman and Ritchie Russell (1961), in which 84% of 130 patients were classified as improved or cured at three to six weeks.

Many patients are referred to physical medicine departments for out-patient treatment of this syndrome, and it is now necessary to reconsider what treatment should be given. There can be no doubt that patients have less pain if their posture is correct, and many of them benefit from discussing questions of posture with a physiotherapist. Similarly, many patients seem to be more comfortable in a collar. There is therefore a case for the physiotherapist to instruct patients in posture and to provide a collar for those with more severe symptoms, even though this trial has shown that these two measures do not influence the natural history of the condition. There is also no doubt that traction can relieve pain at the time it is applied and perhaps for some hours afterwards, even though it does not influence the rate of recovery. The question to be considered is whether patients should be encouraged to undergo the inconvenience and expense of attending regularly as out-patients for temporary relief of pain, particularly as most of them would get relief by lying supine in a position of maximum comfort at home. It seems that the indications for traction as a hospital out-patient are few—probably confined to patients with severe symptoms that are not relieved in any simpler way.

There were obvious limitations to this trial: it was confined to a group of patients with pain in the arm, only certain forms of conservative treatment were investigated, and out-patient treatment was given three times a week for four weeks. Nevertheless it does show the need for further trials of physical treatments. Physiotherapists would welcome these trials, and their enthusiastic co-operation in this investigation was essential for success.

Summary

The first multicentre trial of physical treatments sponsored by the British Association of Physical Medicine is described. It was devoted to a study of certain conservative treatments of the common syndrome of pain in the arm seeming to arise in the neck.

Of the 493 patients studied 466 were treated in five groups: (*a*) instruction in posture, a temporary collar, and traction in the position and direction of greatest comfort ; (*b*) the same treatment as (*a*) except that the patients were placed in a position of maximum comfort with no traction applied ; (*c*) instruction in posture and provision of a temporary collar only ; (*d*) placebo physiotherapy (untuned short-wave diathermy) ; and (*e*) placebo tablets.

Temporary relief of pain at the time of treatment was recorded in 92% of the patients receiving traction and 86% of those who were positioned without traction.

The rate of improvement was approximately the same in the five treatment groups, as judged by clinical assessment two weeks and four weeks after the beginning of treatment and by follow-up questionary at six weeks and six months.

The improvement at four weeks was influenced by age, the initial severity of symptoms, the number of previous attacks, the duration of previous attacks, and whether the patient was getting better or worse when first seen.

We are deeply indebted to all the patients, doctors, physiotherapists, secretaries, and administrative staff who helped with this trial. Dr. D. J. Newell and his staff did invaluable work in analysing the statistics. Dr. P. J. R. Nichols was responsible for organizing and co-ordinating the returns from each centre.

We gratefully acknowledge the gift of £1,200 from the National Fund for Research into Poliomyelitis and other Crippling Diseases, which made this trial possible.

The Arthritis and Rheumatism Council Field Unit helped considerably by providing figures from studies on the *x*-ray changes in the general population of Leigh and Wensleydale.

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Leukaemia and Neoplastic Processes Treated with Langat and Kyasanur Forest Disease Viruses: a Clinical and Laboratory Study of 28 Patients

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Marked leucopenia occurs both in naturally occurring Kyasanur Forest disease (Chatterjea *et al.*, 1963) and in *Macaca radiata* monkeys experimentally infected with Kyasanur Forest disease (Webb and Chatterjea, 1962). The large amounts of nuclear debris seen phagocytosed in the reticulo-endothelial system following the leucopenia suggested that leucocytes are destroyed by the virus (Webb and Chatterjea, 1962 ; Webb and Burston, 1966), that Kyasanur Forest disease virus or the closely related Langat virus might be used to treat leukaemic patients, and that there might be an oncolytic effect on other neoplastic conditions. Both viruses are members of the closely related tick-borne complex of group B arthropod-borne arboviruses.

Langat virus, which was isolated from the tick *Ixodes granulatus* in Malaya (Smith, 1956), was mainly used in this study. Human infections with it are rare and no natural disease due to it is known. It was hoped that Langat virus might produce at least a remission in some of the patients with little or no virus-induced illness. If the infections caused only mild symptoms or were asymptomatic this virus would be a candidate live vaccine against the serious illnesses produced by other tick-borne complex viruses. Experiments in monkeys (O'Reilly *et al.*, 1965) have shown that considerable cross-protection can be conferred by a similar strain and passage level of Langat virus against other tick-borne complex viruses (Kyasanur Forest disease, tick-borne encephalitis). Price *et al.* (1961) showed that one strain of Langat virus (TP-21-9) which had been passaged in chick-embryo-tissue cultures did not produce encephalitis when inoculated intracerebrally into rhesus monkeys and that when three live viruses—yellow fever, West Nile, and Langat (TP-21-9)—were given in series there was subsequent good protection against a wide range of group B arboviruses. Shah *et al.* (1962) studied Langat virus in mice and guinea-pigs and demonstrated a good measure of protection against some tick-borne complex viruses. Smorodintsev (1963) carried out preliminary trials in man with live Langat virus as a vaccine against Russian spring-summer encephalitis.

Virus was therefore given to patients with various malignant diseases. Most patients were in the late stages of the disorder, many had become refractory to conventional therapy, and the remainder were thought unlikely to respond to such treatment. The nature of the treatment was carefully explained to each of them and to their relatives by one of us and their full consent was obtained.

Materials and Methods

Since November 1960 33 patients have been treated. The 28 whose findings are presented fall into two main groups: 10 leukaemic patients and 18 with a variety of other neoplastic processes, of which bronchial carcinoma was the most common (Tables I and II). The remaining five patients given virus are mentioned only briefly: three given virus orally developed neither viraemia nor antibodies ; one died following a myocardial infarction 48 hours after inoculation and no virus was recovered post mortem ; one died three hours after inoculation, from respiratory failure, and virus was recovered from the site of inoculation only.

All but one of the patients with leukaemia were receiving, or had been receiving, singly or in combination, chlorambucil, mercaptopurine, and prednisone. Though these drugs could have influenced the course of the virus infection and the development of antibodies they could not have been directly responsible for any observed therapeutic or haematological

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Much of the work by two of us (C. E. G. S. and D. McM.) was done at the London School of Hygiene and Tropical Medicine.