PAIN AND DISABILITY OF THE SHOULDER AND ARM
TREATMENT BY INTRAMUSCULAR INFILTRATION WITH PROCAINE HYDROCHLORIDE

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When a patient presents himself with the common complaint of pain in the shoulder region and arm, with or without limitation of motion and unrelated to severe trauma, the physician usually thinks of the joints, bursae, tendons or nerves rather than of the shoulder girdle muscles as the primary source of pain. Thus the customary diagnosis in this type of patient is either arthritis, subacromial bursitis, brachial neuritis or radiculitis. The well known chronicity of these symptoms and the variety of therapeutic procedures employed suggest either that the customary methods of treatment are unsatisfactory or that the underlying cause is often overlooked. It is our purpose in this report to discuss the diagnosis of a type of pain in the shoulder and arm which has its origin in the muscles of the back or shoulder girdle and to present the results of an effective method of therapy, namely intramuscular infiltration with procaine hydrochloride.

The rationale for this type of therapy is based on several observations. First, it has long been recognized that many instances of "painful shoulder syndrome" present tender areas in the muscles around the shoulder ("periartthritis"). Second, it has been demonstrated that tender areas in muscles may cause pain not only locally but also referred to other somatic structures. The characteristics of referred somatic pain have been studied experimentally by Kellgren and Lewis.1 In this connection the term "trigger zone" was used by Edeiken and Wolfert,2 since in 2 instances of "painful shoulder syndrome" pressure on a tender area in the suprascapular region increased the radiation of pain in the arm. Steindler and Luck3 demonstrated the role of "trigger points" in the muscles of the lower part of the back as sources of pain referred to the leg; injection of procaine into these tender points abolished not only local tenderness but also referred pain. The third observation that recently encouraged the therapeutic application of procaine by the intramuscular route was an empirical one. Steindler4 found that this technic was valuable not only in allocating the source of pain but also as a therapeutic procedure in "sciatia.

The literature at present indicates greater enthusiasm for this technic in the treatment of pain in the lower than in the upper extremity.5 Following his earlier observations on the injection of procaine into "trigger points" in the lower back muscles, Steindler fails to mention this technic in connection with the treatment of the "painful shoulder syndrome."6 Although reports of isolated cases have appeared which advocate intramuscular infiltration with procaine for pain and disability of the shoulder and arm,7 no systematic investigation of this technic in this condition is available. It seemed to us, therefore, that the possibilities of this method of therapy had not been sufficiently explored in relation to the "painful shoulder syndrome."

DIAGNOSIS

Description of Cases.—A group of cases coming to our attention because of the outstanding complaint of persistent pain in the shoulder region showed on examination the presence of tender points in various muscles of the shoulder girdle. Fifty-eight cases were selected for treatment and form the basis of the present report. The patients were, with a few exceptions, ambulatory. About two fifths had hypertensive and arteriosclerotic cardiovascular disease, one fifth had pulmonary tuberculosis and two fifths had general medical complaints. The medical group was comprised of 5 patients with chronic sinusitis, 2 with hypothyroidism, 1 with Paget's disease, 1 with wet beriberi and 16 in whom the shoulder syndrome was the only apparent ailment. There were 37 males and 21 females. Two patients were colored, 1 was Chinese. The ages ranged from 29 to 78 years; the average was 55 years. About one third of the patients had both shoulders involved; the right shoulder was the one involved in 51 per cent and the left in 40 per cent of the 76 affected shoulders. In approximately one third of the shoulders, pain had been present for less than two months before treatment, in one third for from two to eleven months and in one third for a year or longer. A variety of occupations, both sedentary and extremely active, was represented, and, with perhaps a few exceptions, no relation to the shoulder pain was apparent; one third of the patients were unemployed. The onset was gradual in most instances. The precipitating factors appeared to be manifold and included physical fatigue, chilling, infection, trauma, confinement to bed or a period of relative muscular inactivity, and poor posture, especially a tendency to become "round shouldered."

Somatic pain elsewhere than in the shoulder and arm was a complaint in 38 per cent of the cases. Acute pain arising in trigger points in muscles in these other regions usually was dramatically relieved by intramuscular infiltration with procaine, and an enthusiasm for the general application of this type of therapy for pain of muscular origin, expressed especially in the British literature, seems to be entirely warranted.8

The distribution of pain in the upper extremity varied. It was usually most intense over the front or back of the deltoid region, was occasionally felt in the scapular region and frequently radiated to the forearm and hand, in which paresthesias were sometimes present. Rest pain was present in 72 per cent of the cases. Pain was always elicited or increased by active motion and was associated in about three fourths of the cases with limitation of active motion at the shoulder joint. The

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most common type of limitation was difficulty in placing the hand behind the back; this was noted in all but 1 instance. The distribution of cases according to the severity of pain and limitation is shown in table 3. There were no neurologic changes.

Trigger Points and Pain Radiation.—All the cases presented one or more “trigger points” or “myalgic spots.” Such an area is more resistant than the surrounding muscle and is excruciatingly tender on strong pressure. It is usually not identical with the site of spontaneous pain. Pressure on the area may increase or elicit pain in the reference zone. Either active contraction or passive stretching of the muscle in which the trigger point is located may induce referred pain. Not only pain but also tenderness and weakness of the muscles in the reference zone may be pronounced. This is in line with the demonstration that stimuli arising in a muscle or ligament can provoke not only pain but also tonic contraction of muscles at a distance having the appropriate segmental distribution; hence the phenomena customarily described as “referred” may actually be the result of reflex changes in the so-called reference zone.

Trigger points were found in various muscles in the shoulder girdle or back, and it seems likely that any muscle innervated by the spinal segments from the fifth cervical to the first thoracic may cause radiation of pain to the upper extremity. The vast majority of cases presented between two and four such trigger points.

The muscle that most often caused pain in the shoulder region and arm was the serratus posterior superior. A tender point in this muscle was present in 57 of the 58 cases, or in all but 1 of the 76 shoulders affected. In 8 cases it was the only primary source of pain. The trigger point was usually located in the upper lateral portion of the muscle and was partially covered by the scapula (fig. 1). In order to expose it for palpation and injection, the scapula was retracted and its upper part rotated laterally by placing the hand in the opposite axilla, depressing the shoulder and flexing the spine. The radiation of pain from this muscle is shown in figure 2A. The referred pain is most intense on the long head of the triceps brachii at the posterior border of the deltoid; it often extends to the entire triceps region, occasionally to the ulnar border of the forearm, the palm and fourth and fifth fingers of the hand, and the pectoral region, and less frequently to the spinous processes of the upper two or three thoracic vertebrae. It is possible that the variations in pain radiation from this muscle depend on variations in its anatomic structure; one or more of the slips are frequently absent. Muscles in the reference zone which have the same segmental innervation as the trigger point in the upper part of the serratus posterior superior, namely the eighth cervical and first thoracic, include the pectoralis minor and major, triceps brachii, extensor and flexor carpi ulnaris, flexors of the digits, muscles of the little finger and deep muscles of the hand.

Next in frequency as a source of referred pain was the infraspinatus (fig. 1). A tender point was found in this muscle in half of the affected shoulders. The radiation of pain from this muscle (fig. 2B) is quite constant; it is most intense over the front of the shoulder and the long head of the biceps and may extend down over the entire biceps to the brachioradialis muscle. These muscles, like the infraspinatus, are innervated by the fifth and sixth cervical segments. The reference of pain from the infraspinatus to the “shoulder tip” has also been noted by Kellgren.

A number of less frequent but clear-cut reference patterns were observed from trigger points in other muscles of the shoulder girdle. In general, the radiation of pain was in agreement with the somatic reference zones which Kellgren and Lewis have mapped out for single spinal segments.

Differential Diagnosis.—The minimal criteria for the diagnosis of shoulder and arm pain due to “idiopathic myalgia,” on the basis of which infiltration with procaine may be undertaken, are (1) increased pain on active motion, elicited either by a quick or sustained effort, and (2) tender points in the muscles of the back or shoulder girdle. Reproduction of the spontaneous pain pattern by pressure on the tender point and limitation of motion are valuable signs when present but are not essential to the diagnosis. Confirmation of the presumptive diagnosis is usually secured by the therapeutic test of infiltration of the myalgic points with procaine. The conditions from which this syndrome should be differentiated include:

1. Abnormalities of the bones and joints, such as fractures, dislocations, cervical rib, and arthritis. These are readily demonstrated by roentgen examination.

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2. Subacromial bursitis. A true acute bursitis may be recognized by the usual signs of inflammation, especially local swelling. The mere presence of a calcific deposit in the region of the subacromial bursa is not a sufficient basis for the conclusion that the symptoms are caused by a chronic bursitis. Such deposits may exist for years without pain. In our series calcification in the shoulder region was noted in 3 of 27 patients having roentgen studies and did not influence the results of therapy (fig. 3). The frequent reference of pain to the deltoid region from the muscles of the shoulder girdle and the occasional presence of a primary source of pain in the deltoid muscle itself explain the frequency with which a diagnosis of chronic bursitis is pinned on the patient with shoulder pain and disability due to foci in the muscles.

3. Scalenus anticus syndrome. This is characterized by pain in the upper extremity and neck, signs of venous obstruction, vasomotor changes and, if severe, evidences of arterial insufficiency and damage to the motor and sensory nerves. It is apparent from certain cases in our series that pain due to involvement of the scaleni can result not only from neurocirculatory compression but also from trigger points located in the scaleni muscles themselves; the referred pain extends to the biceps, radial border of the forearm and proximal interphalangeal joints and is associated with an inability to close the fingers. Evidence that in these cases the pain is referred is afforded, first, by the lack of objective signs of compression and, second, by the correspondence of the segmental radiation of pain with the innervation of the scalenus anticus muscle (the fifth to the seventh cervical segments). When frank signs of brachial plexus compression are manifest, pain is present chiefly in the ulnar distribution (eighth cervical and first thoracic), because of the greater impingement of the scalenus anticus muscle on the lower rather than on the upper fibers of the brachial plexus.

4. Neurogenic disorders, including compression of the brachial plexus from any cause, brachial neuritis, radiculitis and spinal involvement of the spinal cord. These causes of pain and disability of the upper extremity may usually be discovered by a complete neurologic examination. In our series the diagnosis of shoulder pain of muscular origin was overlooked in 1 case in which there were residual signs of an old hemiplegia on the affected side; prompt remission of pain and restoration of motion followed infiltration of trigger points in the shoulder muscles with procaine.

5. Coronary artery pain. The frequent association of acute coronary thrombosis and angina pectoris with intractable pain in the arm and limitation of motion at the shoulder has been noted. Thirteen of our patients had effort angina and/or myocardial infarction. Although the similarity in the radiation of pain from trigger points in the serratus posterior superior (fig. 2A) to that of effort angina is obvious, patients had no difficulty in distinguishing between pain of somatic and of cardiac origin. The differentiation depends not on the distribution of pain but on the presence either of constant rest pain, which is aggravated by some motion of the arm or, if rest pain is absent, of pain on motion or limitation of motion at the shoulder joint, and on the finding of trigger points in the scapular region.

6. Vascular disorders of the upper extremity, such as embolism and thrombosis. The picture is generally so striking that it rarely presents a diagnostic problem.

**TECHNIC**

**Material.**—A 1 per cent aqueous solution of procaine hydrochloride without epinephrine was used in most instances. In 2 cases treatment with a 0.7 per cent solution was successful. In a few isolated observations a 0.5 per cent solution seemed not to be as effective as higher concentrations. Control infiltration with isotonic solution of sodium chloride was ineffective.

**Procedure.**—The maximum point of tenderness was located with precision. This was facilitated by putting the muscle "on the stretch" and by the use of strong pressure. The cooperation of the patient is essential in locating points of tenderness exactly. It has been recognized that "blind" injection in the hope of infiltrating a trigger point by chance is usually ineffective. After a small intradermal wheal had been made a sufficient amount of procaine solution was injected to abolish local tenderness. Usually 2 to 5 cc. sufficed for a given site. If the first injection failed to secure the desired result, the area was reinjected at a different level.

Referred pain was often induced momentarily and was helpful in demonstrating the accuracy of injection. If the muscle was infiltrated slowly, little pain was produced. That the primary focus of pain had been reached was indicated by disappearance or diminution in rest pain or improvement in active motion within a few minutes after injection. Frequently an immediate sensation was felt in the arm, described as heaviness, deep
seated numbness or coldness, which was especially noticeable after infiltration of the serratius posterior superior.

If the patient's tolerance permitted, as many points as possible were injected at each visit in an attempt to render the patient entirely free from pain and limitation.

**Dosage.**—The amount injected at any one visit was usually between 10 and 20 cc. of the 1 per cent solution. An initial test dose of 1 to 2 cc. was given to patients not known to have received procaine previously. The maximum amount at any visit was 100 cc., given over a period of two hours. It is stated that 50 cc. of a 1 per cent solution represents a conservative amount to secure local anesthesia in operative procedures; it should be noted that in this case much of the material is given subcutaneously. Owing to rapid absorption from the intramuscular route, the susceptibility of the patient to minor toxic effects usually limited the dose to not more than about 5 cc. every five minutes.

**Reactions.**—No serious procaine reactions were encountered in a total of two hundred and fifty-four visits, in spite of the fact that many of the patients had

<table>
<thead>
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<th>Table 1.—Results of Treatment in Various Clinical Groups</th>
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<tr>
<td><strong>Group</strong></td>
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<tr>
<td>Cardiovascular...</td>
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<tr>
<td>Pulmonary......</td>
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<tr>
<td>Medical........</td>
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<tr>
<td>All types......</td>
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</table>

Late reactions consisted only of pain or tenderness in the area infiltrated and increased pain in the reference zone. The severity and duration of these aftereffects varied greatly and were not predictable.

Signs of sensory or motor nerve paralysis were not observed following injection of the shoulder girdle muscles. There was also no evidence of penetration into the pleural cavity.

**Frenquency of Injection.**—Owing to the facilities of the clinic, it was usually possible to treat patients only at weekly intervals. To a few hospitalized patients, treatments were given more often, even daily. The optimum interval for repeated infiltration of a given site may differ in different cases; it probably ranges from about four to ten days.

**Interim Treatment.**—As adjuncts to procaine infiltration, the medication included only the occasional use of analgesics, ascorbic acid 75 to 200 mg. daily in 5 cases in which soreness after infiltration presented a problem and wheat germ 30 Gm. daily in 8 cases in which generalized myalgia was present. It is our impression that ascorbic acid was of value in reducing local reactions, owing perhaps to the effects of this vitamin on the speed of tissue repair.22 Wheat germ given in this dose over long periods was, in our opinion, of no benefit.

Other therapeutic procedures were the application of local heat as desired (electric pad, hot water bottle) and the encouragement of active motion of the arm within the limits of pain. Passive motion was not used routinely because it seemed to increase pain.

**RESULTS OF TREATMENT**

Complete relief of both pain and limitation of motion was secured by this technic in 62 per cent of the cases, moderate to considerable improvement in 31 per cent and little or no relief in 7 per cent (table 1). The results are essentially the same for patients with cardiac or pulmonary disease and those without intrathoracic disease. The average period of observation of those patients who obtained complete relief ranged from one to sixteen months; the average was 5.4 months.

Complete relief of limitation of motion occurred somewhat earlier and in a slightly higher percentage of the affected shoulders than did complete remission of pain, namely in 70 and 62 per cent respectively. The average number of treatments which abolished limitation was 2.6, and that which abolished pain was 3.5. Complete relief of limitation was secured by one treatment in 36 per cent of the 50 shoulders presenting restricted motion, whereas complete relief of pain was obtained by one treatment in only 12 per cent of the 76 affected shoulders. Improvement in active motion was always attended by diminution of pain.

The average number of treatments per affected shoulder was 4.2 (table 2). As a rule, improvement was immediate and dramatic. Of the 72 painful shoulders in which complete or partial relief was obtained, definite diminution in pain occurred after the first treatment in 64 instances, after two treatments in 5 and after three treatments in 1 instance. This suggests that if definite improvement is not apparent after about three treatments, it is probably not worth while to continue this method of therapy.

The duration of the shoulder pain before treatment definitely influenced the results of treatment (table 2).

Of 23 shoulders affected for less than two months, regardless of the severity, nearly all secured a perfect result, and in 9 instances only one treatment achieved this. In the groups affected for from two months to a year or for more than a year, a perfect result was achieved in only about half of the affected shoulders, and in not a single instance did one treatment suffice to attain this. However, the degree and speed of recovery was about the same whether the duration before treatment was several months or a few years.

The relation of the severity of pain and limitation of motion to the results of treatment is shown in table 3. When the limitation was slight (1 +) normal motion was nearly always restored, whereas when there was extensive limitation (2 + and 3 +) this result was achieved in only about 60 per cent of the shoulders; this difference appeared in spite of the fact that the proportion of those having involvement for less than two months before treatment was lower for the mild than for the severe grades of limitation. The severity of the pain also appeared to be a factor in the outcome, since a portion to the severity of the pain, that is, pronounced restriction of motion was associated with pain only on motion and not at rest. Contrary to other observations, the relative degree of localization and of reference of pain did not depend on the depth of the primary source of pain beneath the body surface. These facts suggest that different pathologic processes may be represented in muscles which behave differently with respect to the degree of reference of pain and to the speed of response to this type of therapy.

The high degree of success which we have achieved by this method of treatment of the "painful shoulder syndrome" is probably attributable to (1) identification of new trigger points, (2) recognition of the specific referred pain patterns from different trigger points, (3) avoidance of infiltrating areas of referred pain and tenderness and (4) persistence in injecting all primary sources of pain. The trigger points in the serratus posterior superior and infraspinatus muscles, which we have found to be the most frequent sources of shoulder and arm pain, are not indicated in the charts of "myalgic spots" or "common focal points of pain and tenderness in myalgic states" at which local analgesic injections are given.

Assuming that a correct diagnosis of "idiopathic myalgia" has been made and that the primary sources of pain and their referred pain patterns are recognized, there still remain certain limitations to this method. Difficulties may be encountered because of (1) low tolerance to procaine, (2) poor cooperation of the patient in locating the myalgic points owing to deafness, a language difficulty or temperament, (3) inaccessibility of the primary sources of pain, that is, their location in the subscapularis or serratus anterior muscles in front of the scapula, (4) continuance in operation of the precipitating factors, (5) chronicity, (6) multiplicity of points and (7) a high degree of local rather than of referred pain.

### Table 2.—Relation of Duration of Shoulder Pain Before Treatment to Results of Treatment

<table>
<thead>
<tr>
<th>Duration, Months</th>
<th>Total Shoulders Involved</th>
<th>Complete Relief of Pain</th>
<th>Improvement in Pain</th>
<th>No Relief of Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Secured by One Treatment,*</td>
<td>Average Number of Treatments</td>
<td>Number of Shoulders</td>
</tr>
<tr>
<td>Less than 2</td>
<td>23</td>
<td>31 (91%)</td>
<td>2.8 (1-10)</td>
<td>2 (9%)</td>
</tr>
<tr>
<td>2-11</td>
<td>29</td>
<td>12 (41%)</td>
<td>1.2 (2-10)</td>
<td>16 (61%)</td>
</tr>
<tr>
<td>12 or longer</td>
<td>24</td>
<td>13 (54%)</td>
<td>3.9 (2-7)</td>
<td>8</td>
</tr>
<tr>
<td>All periods</td>
<td>76</td>
<td>47 (62%)</td>
<td>3.5</td>
<td>25 (52%)</td>
</tr>
</tbody>
</table>

* The term treatment is used to indicate a single visit at which one or more myalgic areas were injected.

normal, and in some instances biopsies of the painful, indurated muscle areas have not revealed signs of inflammation. It is possible that the fibroblastic proliferation which has been observed in other cases is secondary to a functional disturbance and occurs only if the latter persists for a period of time. The meager pathologic data relating to this condition have been recently reviewed.

One theory as to the mechanism of the lasting therapeutic action of procaine is that the temporary abolition of pain permits an increased range of motion and a consequent breaking of adhesions and absorption of exudates. This implies that the limitation of motion is due to a structural lesion and that permanent relief of pain is the result of the improvement in motion. This mechanism would not apply to the relief obtained in those cases characterized by rest pain without restriction of motion.

Table 3.—Relation of Severity of Pain and of Limitation to Results of Treatment

<table>
<thead>
<tr>
<th>Severity *</th>
<th>Total Number of Shoulders</th>
<th>Number of Shoulders</th>
<th>Duration of Pain</th>
<th>Number of Shoulders</th>
<th>Complete Relief</th>
<th>Limitation of Motion</th>
<th>Complete Relief</th>
</tr>
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<tr>
<td>1+</td>
<td></td>
<td>26</td>
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<td>26</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>(69%)</td>
<td>(32%)</td>
<td>(69%)</td>
<td>(32%)</td>
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<tr>
<td>2+</td>
<td></td>
<td>16</td>
<td></td>
<td>19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(69%)</td>
<td>(27%)</td>
<td>(53%)</td>
<td>(27%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3+</td>
<td></td>
<td>34</td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(53%)</td>
<td>(53%)</td>
<td>(60%)</td>
<td>(50%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All degrees</td>
<td></td>
<td>76</td>
<td></td>
<td>56</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>(42%)</td>
<td>(49%)</td>
<td>(70%)</td>
<td>(37%)</td>
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* Pain: 1+ pain only on motion.
2+ moderate rest pain.
3+ severe rest pain.

Limitation (active motion) in any direction:
1+ restriction less than 25 per cent of normal range.
2+ restriction 25-50 per cent of normal range.
3+ restriction greater than 75 per cent of normal range.

Another theory, advanced by Leriche, is that a disturbance of the sympathetic nervous system causes localized vasosconstriction within the muscles, which results in ischemic pain.

A third and, it seems to us, the most plausible hypothesis is that the pain is the consequence of a sustained spasm of the skeletal rather than of the arterial musculature, which likewise results in ischemic pain. According to this view, limitation of motion is primarily a reaction to pain rather than the result of a structural lesion. If muscle spasm causes pain, and pain reflexly produces muscle spasm, a self-perpetuating, pain-producing cycle might be established under certain conditions which would explain both the chronicity of the symptoms and the mechanism of cure by procaine. In this case procaine injected intramuscularly would break the vicious cycle by relaxing the localized muscle spasm, by virtue of its action in blocking afferent nerve impulses or by its curare-like action at the motor end-plates. That the former action alone is sufficient to interrupt the cycle is suggested by the permanent relief of pain in the upper extremity, secured in some cases following brachial plexus block or suprascapular nerve block.

Failure of brachial plexus block in other cases might be explained by the fact that at this site of injection procaine does not block the intercostal and suprascapular nerves which supply the serratus posterior superior and infraspinatus muscles. In the case of suprascapular nerve block, improvement would be anticipated only if the primary focus of pain were located in the supraspinatus or infraspinatus muscles. Another therapeutic procedure which is sometimes effective in the myalgias is strong sustained pressure applied directly on the tender point in the muscle which serves as the source of referred pain (Libman maneuver). The mechanism of action of this procedure has not been explained but may be analogous to that of procaine in interrupting tetanizing motor discharges, since it has been shown that 25 pounds pressure per square inch will block motor nerve fibers; the small sensory nerve fiber is more susceptible to the action of procaine than is the large motor fiber, whereas the reverse applies to the effect of pressure. The relief of pain and limitation of motion by ethyl chloride applied to the skin over the tender muscles might be explained by a similar mechanism, since local anesthesia of the skin produces relaxation of the skeletal muscles having the same segmental innervation, presumably by altering the tonic impulses. It is noteworthy that all these varied procedures which relieve pain in the upper extremity have in common the effect of relaxing muscle.

SUMMARY AND CONCLUSIONS

1. Treatment by intramuscular infiltration with procaine hydrochloride was carried out in 58 cases exhibiting pain in the shoulder region and arm. These cases were characterized by tender points in the muscles of the back and shoulder girdle, by increased pain on active motion of the arm and in about three fourths of the 76 affected shoulders by limitation of active motion at the shoulder joint.

2. Full restoration of motion and complete remission of pain were secured by this technic in 62 per cent of the patients; 31 per cent showed improvement, and no relief was observed in 7 per cent. Complete relief of pain and disability was obtained in 91 per cent of those whose symptoms had been present for less than two months.

3. The results of procaine infiltration were similar whether the "painful shoulder syndrome" occurred in patients with heart disease, with pulmonary tuberculosis or without intrathoracic disease. This suggests that this type of pain in the upper extremity is not dependent on visceral impulses.

4. The therapeutic effect of procaine infiltration indicates that in these cases the pain in the shoulder and arm is the direct result of impulses arising in one or more foci in the muscles of the back or shoulder girdle. The restriction of motion is primarily a reaction to pain. The term "idiopathic myalgia" best describes the syndrome.