FIBRO-FATTY TISSUE AND ITS RELATION TO CERTAIN "RHEUMATIC" SYNDROMES*

BY

W. S. C. COPEMAN, M.A., M.D., F.R.C.P.

*Physician in Charge, Department of Rheumatic Diseases, West London Hospital ;
Hunterian Professor, Royal College of Surgeons*

If the observations I here put forward are correct, we are now in a position to turn over a fresh page so far as our conception of certain of the so-called rheumatic syndromes is concerned. I am not able to do much more than write the chapter heading for this new page; it seems to me, however, that this new chapter will be worth writing when adequate material is forthcoming.

It is generally agreed that much of the pathology described for the chronic rheumatic diseases is speculative rather than factual. Biopsy does not seem to confirm the current impression that muscle or fibrous tissues are generally the seat of cellular change in non-articular rheumatism, nor indeed that inflammation is the underlying pathology.

So far as aetiology is concerned, I suggest that bacteriology has had its day, and that the day of endocrinology and perhaps genetics is dawning. The therapeutic witch-hunt for focal sepsis is slackening—we need an alternative line of thought.

Pathologically, the contribution I wish to make is simple but, I believe, fairly far-reaching in this field. There is a third tissue, also of mesodermal origin—namely, fat—which has seldom been considered in this connexion, but which seems to be quite commonly subject to pathological variations which may cause symptoms that are labelled "rheumatic." Fatty tissue is widely distributed and constitutes nearly 20% of the body weight. It appears to be functional as well as protective, and, this being so, it would be strange if its functions were not sometimes disordered. One of these functions seems to be concerned with water storage (the most striking example of this is perhaps seen in the behaviour of the camel's hump). It has been established of recent years by Bishop and others that human fat may retain water to a pathological degree in certain disorders. It would seem to be some derangement of this normal function of water storage which underlies the syndromes discussed here.

Fibrositis

Fibrositis as a clinical entity has for many years past been accepted in this country, although its pathological foundations are, as has been mentioned, slender, resting almost entirely upon the theories of Gowers (1904), the equally unconfirmed histological studies of Stockman (1920), and the suggestion of Elliott (1944) regarding muscle spasm as a cause. Stockman defined fibrositis as "a condition of chronic inflammation of the white fibrous tissue of the fascial aponeurosis, sheaths of muscles and nerves, ligaments, tendons, periosteum, and subcutaneous tissues, occurring in all parts of the body and giving rise to pain, aching, stiffness, and other symptoms, the result of preceding general infections or local inflammations or injuries."

It is now generally defined less comprehensively as an idiopathic disorder of the soft tissues chiefly characterized by pain and tenderness, which may be local, widespread, or referred, and is often associated with muscular spasm.

Nature of the Pain in Fibrositis

It was only comparatively recently that Lewis and Kellgren and others pointed out that the pain in fibrositis generally has its origin in certain focal points from which the more general subjective pain complained of by the sufferer is referred according to a segmental plan. This referred pain may seem to be situated at a considerable distance from its real origin. A good example is to be seen in those cases of sciatica not due to a disk mechanism, in which the focal point of pain—the "trigger-point"—may be found in the region of the iliac crest or even in the lumbar region. These trigger-points, which when palpable are generally termed "fibrositic nodules," are definite objective clinical entities in so far that when they are found by the examining finger the patient winces involuntarily. They are not merely tender spots, which are also commonly found, but they are specific points at which real pain is produced, and from which the more general pain can be referred by quite light pressure. The existence of these trigger-points is now well recognized in view of the therapeutic success which often attends their injection with local analgesics in saline. Palpable nodules which are not tender are not infrequently found, but do not appear to be significant from a clinical point of view.

Classification of Fibrositis

Himsworth, in his 1949 Oliver-Sharpes Lectures, has emphasized the liberation of medical thought which has resulted from the substitution of syndromes for "disease entities" as units of illness. The syndrome has its philosophical basis in a chain of physiological processes, interference with which at any point produces the same impairment of bodily function. He points out that the same syndrome may thus arise from different causes. This conception inspires a much more catholic concept of aetiology, which is no doubt fully applicable to the field of "rheumatism" in all its forms. It must not therefore be assumed that the conclusions put forward here are thought to explain more than a certain proportion of cases. It will also be apparent that an aetiological classification will be unlikely of attainment in this field, where causes are probably multiple.

It would seem that the only objective sign of the disorder lies in these localized trigger-points, which are, moreover, sometimes palpable in the form of nodules; it therefore seems reasonable to attempt to classify idiopathic fibrositis according to the anatomical nature of the nodule where this is known or strongly suspected. Very little biopsy or

*Hunterian Oration delivered at the Royal College of Surgeons of England on March 25.

other work of this nature has been done as yet, and the accompanying table based upon this objective must be regarded as being very provisional. It seems possible, however, that some form of classification such as that which follows might ultimately prove useful.

Classification of "Fibrositis"

Nature of Pain	Site	Clinical Finding	Morbid Anatomy	Cause
1. Focal ..	Tendon or aponeurosis	Nodule, small and hard	Fibrous	Trauma, rheumatic fever
2. Focal ..	Lumbar or gluteal	Larger nodule	Fibro-fatty	Oedematous changes
3. Focal ..	On muscle belly	Smallish elongated "nodule"	Local spasm of muscle fibres	Irritative focus in neural segment
4. Diffuse ..	Whole muscle group	Muscle tenderness	Unknown	Toxaemia
5. Diffuse ..	Many muscle groups	Spasm	Chronic muscular fatigue	Psychoneurosis
6. Diffuse .. (sometimes local)	Subcutaneous tissues	Panniculitis, tender fat deposits	Abnormal oedematous deep fat	Endocrine

Aetiology of Trigger-points and Nodules

It was observed (Copeman, 1943) that the pain in the back which accompanies most pyrexial illnesses is of the same nature and pattern as in fibrositis. It was shown, moreover, that, although the pain disappears with the cessation of pyrexia, the tender trigger-point will persist in a proportion of cases often for very long periods, unknown to the patient. These trigger-points can be reactivated by a recurrence of pyrexia, even if this is due to a different cause. It is therefore suggested that the tissues in which trigger-points and nodules subsequently occur in the course of fibrositis may sometimes have been "sensitized" earlier in life in the course of an attack of influenza or one of the exanthemata. The nature of the lesion may be a recurrent oedema painfully distending certain fat lobules in the deep subcutaneous tissues. It has also seemed certain that trauma, and probably also the direct action of cold, can be causative of similar lesions or at least precipitate their development in this way. No evidence of the direct causative effect of focal infection has been established.

Fibrositis Due to Oedematous Changes in the Fibro-fatty Tissues in Certain Sites

Method of Investigation

The frequency of the occurrence of "fibrositic" pain of the lower back in otherwise healthy young soldiers first stimulated our interest in this matter. As a first step exact measurements were taken of the site of these trigger-points or nodules in a large number of sufferers and a pain chart (Fig. 1) was plotted. The back of every patient who died in hospital was systematically dissected and special reference was made to these areas. As the result of this, and of many subsequent clinical observations and biopsies, certain conclusions regarding "fibrositis" and similar conditions in this and other regions of the body have been arrived at, many of which are embodied in this paper. The pain chart which evolved as the result of plotting the site of the trigger-points or painful nodules in our series of cases of lumbar fibrositis, as already mentioned, was found to outline the erector spinae muscles, the crest of the iliac bones, and the sacro-iliac joints. It was later found that this chart also corresponded with areas in which residual fat occurred, even in patients dead with the grossest forms of cachexia.

FIG. 1.—Usual sites of fibro-fatty lesions. A, herniation. B, tension pain.

As no evidence of pathological change could be found in fibrous tissue or muscle in biopsy material, we decided to examine the deeper layers of fat which constituted the remaining tissue in the neighbourhood of the trigger-points—notwithstanding the usual assumption that no pathology of interest normally affects this type of tissue. We were lucky in our first case in that we noticed a curious herniation of a large lobule of distended fat through a defect in the deep fascia. In a later biopsy of an easily felt and tender nodule from which widespread pain was being referred we discovered by cautious dissection that the nodule in this case was an oedematous-looking node of fatty tissue lying among superficial fat of the upper buttock, but with a pedicle which could be traced down to the layer of fat lying beneath the deep fascia.

Fatty Structures as a Site for Painful Lesions

In our original paper (Copeman and Ackerman, 1944) we described the areas of fat in which painful "fibrositic" lesions occurred as being in the main "residual," in the sense that lobulated fat remains in these areas even when it disappears from other areas as the result of extreme cachexia. The colour of this residual fat in such cases was often darker or pinker than ordinary fat. In two cases we were able after death to trace the pedicle of a superficial fat hernia down to the paranephric fat mass. These observations suggested to us that the areas of fat liable to be affected, at any rate in the lumbar region, might bear some relation developmentally to the primitive renal fat gland round which, from a comparatively early period of embryonic development, fat congregates in closely lobulated clumps, which in rats (according to Hammar) are also of a darker colour than normal. The well-marked area of residual fat which lines the rim of the ilium may not be covered by this hypothesis, although another primitive fat-organ is described in the outer groin in some textbooks. The largest of these fat-organs is said to be situated between the scapulae—a position which seems to correspond with that of our "dorsal fat-pad."

Normal Anatomical Disposition of Fat

Not much information is to be found on this subject in most anatomical textbooks. Subcutaneous fat exists very generally throughout the body, although its distribution is not uniform. In certain situations it collects more abundantly. Here it forms a considerable layer beneath the reticular layer of the corium, where it is laid down in the subcutaneous areolar tissue—panniculus adiposus. This areolar tissue forms a thin, indistensible fibrous capsule round the large lobules, where the fat is lobulated. The lymphatics serving fat accompany the blood vessels in very close relation as they enter the lobule. There are numerous sensory nerves to the blood vessels, and possibly to other structures in the lobules, and sympathetic-nerve fibres which run to the fat cells control the function of storage and yielding. Where the skin is thicker and less movable the reticular layer is fixed to the deep fascia by numerous stout fibrous bands (retinaculum cutis), the space between being filled with firm fat-clusters. This formation normally occurs mostly on the posterior aspects of the trunk and the upper and outer aspects of the limbs.

Pathological Herniation of Fat Lobules

From the brief account which has so far been given it will appear that what pass as fibrositic trigger-points can often be shown to be related topographically in the lumbosacral region with the basic fat pattern. Where these tender points were surgically explored, herniation of distended fat lobules through deficiencies in their investing fibrous covering was often found. Removal or disruption of these

herniae in such cases provided lasting relief from pain. Histological examination of the material removed has shown in practically every case nothing but normal fat tissue distended with oedematous fluid—suggesting that the cause of this oedema is not inflammatory.

FIG. 2.—Fatty hernia: pedunculated type.

FIG. 3.—Fatty hernia: non-pedunculated type.

FIG. 4.—Fatty hernia: foraminal type.

Twenty-two selected case histories from our series have been published (Copeman and Ackerman 1944, 1947) in which removal of a fat hernia of one of these types resulted in a permanent cure of the pain, and many subsequent unpublished cases have been investigated with similar findings and results. Herz (1945), working in Cleveland, has confirmed this work and has published two further, larger series of successful cases.

Lesions Other than Herniation Occurring in Fat of Normal Distribution

Upper Dorsal Region

The skin is normally six to eight times thicker in this situation than in most parts of the body, and islands of fat may be found actually in the reticular layer of the corium of patients suffering from panniculitis. In the upper back the fibrous projections between the corium and the deep fascia normally form a series of honeycomb-like compartments which are filled with vascular fat. The axes of these "cells" are found to be roughly parallel with the tension (cleavage) lines of Langer. This structure is particularly noticeable in the upper back area, and we have called this diamond-shaped area the "dorsal fat-pad." It is one of the common sites of "fibrositic" pain, and its area corresponds fairly accurately with that of the trapezius muscle which lies beneath it.

When painful nodules are palpable, as is commonly the case in "fibrositis" of this region, they are seldom fibrous in nature. Biopsy will generally disclose the nodule to consist of the fatty contents of one or more of these com-

partments, swollen and under tension. Tension is shown by the fact that if the incision is made at right angles to the lines of tension in the skin the wound will gape and the lobule will be seen to present above its surface. It is also shown by the *peau d'orange* appearance if the skin and subcutaneous tissues of an affected area are compressed laterally. Negative evidence of this is afforded by the well-attested observation that palpable nodules of this type can be "rubbed away" by means of deep massage; a fact that could not be rationalized if they were formed of solid material such as fibrous tissue. Herniation of these lobules into adjoining compartments has been observed, but is uncommon owing to the density of their walls.

Periarticular Fat-pads

It does not seem to be generally appreciated amongst clinicians that localized collections of fat are to be found normally in association with certain joints, particularly the knees and ankles, and that these may become painful without the joint itself necessarily being affected. When this occurs an irresponsible diagnosis of arthritis is often made as the result of insufficient examination.

(a) *The Patellar Fat-pads.*—A normal intracapsular fat-pad is situated between the joint and the patella. This is well recognized by anatomists and surgeons. These infrapatellar pads will often become tender and painful without the joint itself being affected; this is particularly so around the time of the menopause. It is this lesion that commonly gives rise to the sensation of grating on movement, which is sometimes considered to imply that arthritis is present. A fold called the infrapatellar synovial fold extends posteriorly from the apex of each fat-pad to be attached to the femur inside the joint cavity. No doubt in certain cases, if this is also affected, intra-articular function will to some extent be deranged.

(b) *The "Popliteal Fat-pad."*—This has not, so far as I am aware, been described as a separate entity. None the less, it is present in more than 80% of normal people over

FIG. 5.—The popliteal fat-pads: normal structures which generally enlarge when painful. Often mistaken for bursae.

40 years of age. When it attracts notice by enlarging and becoming tender it is often wrongly described as a bursal enlargement (Figs. 5 and 6). It is sharply limited at its lower margin by the upper crease of the popliteal skin, and its outer border lies roughly parallel with the course of the semimembranosus muscle.

Its upper border, when the pad is large, is delineated by another crease which develops in these circumstances. The inner border lies to the outer aspect of the midline of the popliteal space. This fat-pad lies between the superficial and deep layers of the fascia covering the popliteal space. When large it distends the skin, although the cause of pain and tenderness seems to lie rather in the distension of the fat itself. In these circumstances, however, full flexion of the knee-joint, by compressing the fat-pad, may give rise to pain—and so again to a mistaken diagnosis of arthritis.

FIG. 6.—General obesity. A, Enlargement of popliteal fat-pads. B, Additional fat-pads at inner aspects of knees. (By courtesy of Amer. J. med. Sci.)

The Sacral Fat-pad

This can be observed in about 10% of normal persons (Fig. 7). In structure it is very similar to the dorsal fat-pad. It is rather smaller than the sacrum, but is of the same shape and lies over it. It sometimes enlarges painfully as an isolated phenomenon, but is more often in association with a general condition of panniculitis, either with or without obesity.

FIG. 7.—The sacral fat-pads, present in about 10% of normal subjects.

Two other small fat-pads exist in many normal persons and in all who are obese. I can find no published description of these, however. The first is situated over the dorsal surface of the basal phalanx of

the great toe. The so-called "male hairs" described by Wood Jones spring from its surface. It seems to be designed to buffer the strong action between the tendon of extensor hallucis longus and the skin. It is seldom of clinical significance, although its enlargement greatly contributes to the shiny swelling of the skin in this region in cases of acute and subacute gout. The other fat-pads which seem to be of some significance, in so far as they often become swollen and locally painful in obese persons, are situated at the ankle-joint. Medially there is one between the malleolus and the heel, roughly over the flexor retinaculum; whilst on the fibular side one lies over the stem of the inferior extensor retinaculum. A further fat-pad sometimes develops over the adductor tendons of the thigh at their pubic origin. It is rather doubtful, however, whether this can be considered to be of normal occurrence. It always develops in cases of obesity, and may be very painful.

Clinical Effect of Altering Volume and Distribution of Body Fluids

If the views which have been propounded are correct regarding the role of increased fluid tension in certain tissues causing pain, it should prove possible to relieve the pain by reversing this process. An experiment was accordingly planned (Copeman and Pugh, 1945) whereby 22 cases of fibrositis in which we believed that the pain might be of this type were selected. In these patients we induced the state of clinical dehydration; at which point we added electrolyte to the extracellular fluid to increase its osmotic pressure. Since the cell membranes are impermeable to sodium and chloride, intracellular dehydration would result.

The method of achieving this was to restrict the fluid intake of these patients for 36 hours to about 8 oz. (225 ml.). After this they were allowed neither food nor drink for 24 hours, and their fluid output was increased by the administration of $\frac{1}{2}$ oz. (14 ml.) of sodium sulphate at hourly intervals for six doses. The process of dehydration could be followed by noting the daily loss of weight, which varied between 1 and 3.5 kg. This preliminary stage of dehydration was followed by an intravenous injection of 50 ml. of 30% sodium chloride (15 g.) into a vein. Immediately after this injection the patient was allowed to drink 4 oz. (114 ml.) of tea to mitigate thirst. Apart from this no fluid was permitted for four hours, after which no further limitation was imposed and the patient was encouraged to get up and about.

The clinical result of intracellular dehydration in this group was that of the 22 patients submitted 13 were

rendered completely free of pain for variable periods. It was thought that this experiment confirmed other evidence about the nature of the mechanism of the pain suffered in the successful cases.

Relationship of Panniculitis with Fibrositis

According to Stockman pain of unknown origin occurring in mesodermal tissue, which he believed (as is indicated by his nomenclature) was always due to inflammation of the white fibrous tissues, is covered by the generic term fibrositis. Pain which has been described above as occurring from the distension in normally situated subcutaneous fat lobules can also therefore conveniently be classified under this heading. Where pain of this type occurs in abnormally deposited fat, however, it will be referred to as panniculitis. The condition was described by Stockman (1911) and also by Telling. It was defined by the former as being fibrosis of the deep subcutaneous tissues, or more specifically as "a chronic inflammation of the areolar tissue of the panniculus adiposus, including the small nerves and blood vessels." Although he recognized the presence of excessive fat locally he considered this to be the result of the inflammation and did not recognize that it had any association with the pain.

Panniculitis is a common condition which is insufficiently recognized as a cause of pain which is not infrequently labelled "psychogenic." Our investigations have shown no single instance histologically of an inflammatory reaction having occurred, and we believe that the pain in this condition originates as the result of oedema, and consequently distension, of lobules of the abnormal fat deposits. Panniculitis can best be considered in relation to those regions of the body in which it is most commonly encountered—namely, the upper dorsal region, the upper and outer aspects of the limbs, around certain joints, especially the knees, elbows, and ankles, and some other sites. Panniculitis is often associated with general obesity. Even in cases showing this association the sites of pain generally remain confined to the regions in which pain is situated in cases not so complicated. This continuing localization of the pain in cases of general obesity may be due to the less lobulated nature of the fat which is laid down elsewhere and also to the fact that in other sites, such as the abdominal wall, no fibrous fascia or capsule is present to limit the distension of the fat if it becomes oedematous. Herniation of fat lobules is common in association with obesity.

Although adiposis dolorosa would seem to differ from the preceding syndrome merely in degree, it does show more generalized areas of pain. The nodular feel of the fat deposits, the fluctuation in the sites of pain, and the histological findings, however, suggest that the underlying cause of the pain may be the same as in the preceding syndromes—namely, a shifting non-inflammatory oedema affecting the pathological fat deposits. In this connexion it is interesting to note in Dercum's (1892) original description that "occasionally very severe paroxysms of pain occurred, and these were coincident with temporary swelling and hardening of the fat masses."

Panniculitis of the Upper Dorsal Region

The "dorsal fat-pad," which has been described as the seat of local lesions in fibrositis, is more generally involved in cases of panniculitis. The tissues are sometimes excessively thickened and the subcutaneous tissues cannot be lifted between the finger and thumb. It is sometimes the only region involved in this process, in which case the condition tends to be concentrated round the base of the cervical spine—the "buffalo hump."

Panniculitis of the Upper and Outer Aspects of the Limbs

Tender nodules not infrequently form along the upper and outer aspects of the thighs, often in association with enlargement of the periarticular fat-pads of the knee, which are discussed below. Pain due to this cause is generally diagnosed as "fibrositis." A few biopsies and dissections have been made in order to study the method of formation of nodules in this site.

The usual situation of these localized collections of fat is in the panniculus adiposus, where certain portions of the areolar tissue seem to become more heavily charged with fat than do others. These portions appear to be more closely lobulated and independent of the average layer of fat at this level, although lying in it, and give the appearance of being small independent "mesenteries" each with its own blood and lymphatic supply. There is also a large potential space between the superficial and deep layers of the fascia which overlies the fascia lata of the thighs, and fat nodules sometimes form also in this space.

In cases in which these collections become painful in this situation it is found that they have become circumscribed by adhesions which seem to prevent lateral extension of the fat mass. The pain is presumably due in such cases to attempted distension of the unyielding fascial walls. The cause of these limiting adhesions is unknown; it may be traumatic, but since their occurrence appears to be related in many cases to the menopause they may result from a drying up of the normal lubricating fluid of the fascia. No detailed investigations have yet been carried out to investigate similar conditions in the region of the upper arm or round the elbow-joints, where panniculitis is also commonly found.

The Knee-joint

An abnormal fat-pad develops over the inner aspect of the knee-joints as a menopausal manifestation and perhaps precursor of ultimate osteoarthritis. It also occurs as a prominent feature of general obesity at any age, and of course in those rare cases known since 1892 as Dercum's disease (adiposis dolorosa). The appearance of these abnormal fat-pads, which may become very large and pendulous, is well known (Fig. 6). They are generally bilateral, although pain or tenderness is often confined to one side only. Posteriorly they cover the lower insertion of the inner group of hamstring muscles, being separated by a definite sulcus near the midline of the popliteal fossa from the normally present (but probably enlarged) popliteal fat-pads described above. Anteriorly they are limited by the internal aspect of the patella, but often appear to blend lower down with the infrapatellar fat-pad. There is no accompanying sensory abnormality of the overlying skin, although it is often the seat of multiple stellate or spider-like collections of thin superficial veins.

Varicose veins and local thromboses are also a common association, as is spontaneous bruising. On palpation distinct lobulation of the contained fat is easily felt, and it can be appreciated that only certain lobules—which feel more tense—are tender. If these be marked it will be found that this localized tense tenderness will affect different lobules on different days. This tenderness appears, therefore, to depend upon a condition of shifting oedema which moves from lobule to lobule. Excision of the painful fat-pad successfully relieves the pain. Microscopical examination shows only oedematous fat of normal structure and with no cellular reaction.

These pads are not to be considered as lipomata; the fat is laid down in the reticular areolar tissue between the corium of the skin and the synovial capsule, into the folds

of which lobules will often penetrate and adhere. The arrangement of this areolar tissue does not seem to be as a continuous layer but in discrete sheets which when infiltrated with fat lobules in this way have the appearance each of a separate miniature mesentery. The various collections of lobules are thus in fact discrete clumps, each with its own blood supply and lymphatic system.

These medial fat-pads when they attain a large size can interfere considerably with the free function of the joint, and pain from these is quite often referred to the joint itself subjectively, although carefully objective search will reveal a tense periarticular fat lobule in the pad as its real origin. The differential diagnosis of "arthritis" and its despondent-sounding implications is all too often made in such cases, more particularly if the normally occurring "age-changes" are interpreted as radiological confirmation of this view.

Aetiology

Endocrine

The cause of the non-inflammatory oedema which is found locally to be distending the fat lobules which cause pain in the type of "fibrositis" which has been described, and in panniculitis, is unknown, although it may well be part of a more general process. It may be part of a general condition of dysfunction of fat-water metabolism, as it appears to be in those cases associated with obesity. It is this factor which accounts for those rapid and otherwise inexplicable variations in weight which occur during the dietetic treatment of the obese.

In view of the frequent association of these syndromes with the female menopause (both natural and artificial) it is tempting to suspect that the underlying cause must be endocrine. It seems to be accepted by endocrinologists that excessive secretion of oestrogens in the human will result in water retention, which largely affects the fatty tissues. This is released at a normal period, but if this does not occur the condition may become cumulative. Some reflection of this process is often seen clinically in the cases which have been described. The fault here may lie in the dysfunction of the ovarian glands or, more probably, further back in the pituitary or hypothalamus. The latter probability is strengthened by the fact that men suffer from these syndromes, more particularly the fibrositic one, quite often.

Overactivity of the pituitary and the adrenal cortex is known to be associated with pregnancy and the climacteric, and commonly results in obesity. In most cases, however, no objective evidence of endocrine disorder is to be found, and it may be surmised that the metabolism-regulating centres of the hypothalamus are disordered. This is known to result in water retention, owing to the interference with secretion of the antidiuretic factor of the posterior pituitary lobe. It is said that in these cases administration of chorionic gonadotropin will reduce the subcutaneous fat and release water, and probably the effect of this should be tried in selected cases. It may be presumed that there is no gross pathology present in the majority of the cases which are being discussed, and it seems possible that the lesion may be primarily of genetic determination. The thyroid gland has also been invoked, largely on account of its value in the treatment of certain of these cases; it is thought, however, that as this substance possesses the property of eliminating excessive tissue fluids its benefits probably do not reflect any share in aetiology.

Kling (1947), writing of what he terms "juxta-articular adiposis dolorosa" (probably a condition of panniculitis localized to the joints), states that no high degree of endocrine disturbance was found in his patients, although

B.M.R. estimates were only markedly abnormal in one-third of them. He also failed to find evidence of interstitial inflammation of sensory nerves, but he found evidence of increased tissue tension in these sites and considered it probable that the mere increase of the fat tissue causes pressure on the nerve endings and so gives rise to tenderness and pain. Where enlarged knee fat-pads were only part of a more generalized condition of adiposis dolorosa, these findings were generally found to be applicable to the other joint areas which were affected.

No generalized abnormality has been detected in the majority of our cases of panniculitis; all routine clinical tests, including the B.P. and E.S.R., were normal. Arthritis did not develop in those cases which were successfully treated for the periarticular condition. The condition is not necessarily associated with general obesity, although it may be; and when it is it tends to be more severe and widespread. Adiposis dolorosa, both in its full form and in the periarticular form described by Kling, may constitute only a variation of this entity.

Sodium Balance

Disturbances of water exchange in general betoken dislocation of sodium balance. It can be demonstrated experimentally that cells, including fat cells, swell or contract in a predictable manner in response to variations in sodium concentration in the interstitial fluid, since all cell membranes permit the free passage of water but not of sodium and chloride. The water and salt levels are now believed to be controlled largely by activity of the hormone of the posterior lobe of the pituitary and the influence of the desoxycorticosterone fraction of the adrenal cortex.

Genetic Factors

There may also prove to be a genetic factor involved, since close questioning of 50 unselected female cases of severe panniculitis revealed a history of a similar condition having occurred in the family (mostly in a mother or a mother's sister) in nearly one-half of them. This is a very high proportion, but it does not necessarily point to the disease being a familial one, since all these patients had been subjected to similar endocrine disturbance as represented by the menopause. It is perhaps more probable that it is the body type which is familial, and panniculitis certainly occurs most often in that type which Sheldon (1940) designated the endodermic somatotype.

Cold

It is striking how sudden the first onset of pain may be in some cases, leading occasionally to a wrong diagnosis for this reason alone. It has seemed that in a large number of these cases cold has been the precipitating factor, no doubt merely activating a state already in being. This is understandable in light of the observation of Bazett and his co-workers that a temperature gradient exists between the surface of the body and the deep tissues extending inwards to a depth of 2–3.5 cm. and having a temperature difference ranging from 5 to 15° F. (3–9° C.). The fatty tissues which we believe to be chiefly implicated in the type of fibrositis that has been described and panniculitis lie well within this gradient, and, since the temperature gradient—and to some extent its depth—vary in response to the cooling power of the atmosphere, these tissues must be directly affected by the external environment. These reactions are no doubt responsible for the well-attested phenomenon of weather-sensitivity in these cases.

Treatment

The pain which occurs in the two main syndromes considered in this lecture—namely, a certain type of fibrositis and panniculitis—has been shown to be due in each case

to a painful distension of fat lobules within a confined space. Treatment in both will therefore be along similar lines and have the same objectives. Where these syndromes are complicated by the addition of obesity, the factor of weight reduction will also have to be faced.

The results of treatment at the present time are variable, and relapse is common. If the syndrome occurs at the menopause, however, as is not uncommon, and remission can be induced for a sufficient period to cover the completion of this process, prognosis is fairly good. The desiderata of treatment may be epitomized under various headings.

Diet.—Since fat is the site of the painful lesion in these cases weight reduction is always indicated even in patients who do not appear to be overweight. It is seldom that any improvement is noted as the result of other methods unless the body weight is falling. Restriction may be limited to starch-containing foods and to fat. Ordinarily, protein foods need not be limited.

Endocrines.—It has been pointed out that there is clinical evidence that oestrogen tends to cause fluid retention in the tissues, which is released at menstruation, and that in the menopausal patients this condition may become cumulative. Theoretically, androgens might in such cases be the proper remedy, and some recent observations tend to confirm their usefulness. In menopausal cases ordinary endocrine treatment should be tried; in patients who are not menopausal thyroid is none the less sometimes helpful, except in those cases which normally show a rapid pulse rate. In these cases thyroid extract will generally result in palpitations but no reduction in weight. There are no known drugs or hormones which will reduce pituitary activity, although such an objective would seem to be desirable.

Diuresis and Dehydration.—The type of diuresis that is required in these syndromes is that which not only increases the urinary volume but also depletes the body fluids, producing thirst. This is the type called by physiologists "obligatory diuresis." There are several substances which may be employed, and, since there is no contraindication to employing them at the same time, it is reasonable to do so. (a) Chemical substances which act by distorting the internal environment, such as urea. This may be given in large doses (20 g.), suspended in a little water or fruit juice after each meal, for long periods. (b) Chemical substances which alter the acid-base equilibrium and electrolyte balance, such as ammonium chloride. This is often given to supplement the action of mercurial diuretics, which may also be employed with benefit, and whose effect seems to be to decrease the amount of sodium chloride reabsorbed by the renal tubules. (c) A salt-free diet, which is effective in reducing the volume of body fluid where there is an excess. Its effect results from the removal of one of the essential components of this process, whilst restriction of water, the other chief essential, is rendered unnecessary and thirst will thus be relieved.

Physiotherapy.—Firm localized massage is used to disperse the swelling where oedematous fat lobules can be felt and are the cause of pain. It will generally prove very painful at first, and any reaction caused by this process must be allowed to die down before a subsequent treatment of this sort is administered. In time the patient will become less sensitive, and regular treatment will become possible. Previous exposure to radiant heat and infra-red rays will often increase the patient's tolerance to such treatment. Where actual herniation of fat lobules has occurred, but has not become fixed by adhesions, reduction of the herniation by this method may be possible.

Injection.—The object of local injection treatment is to disrupt the swollen fat lobule by hydrostatic pressure and so relieve the painful tension. Mere infiltration with anaesthetic solution will give temporary relief only, except in those infrequent cases in which this procedure has seemed to allow auto-reduction of a hernia, as judged by the subsequent permanent disappearance of both the nodule and the pain. The solution which we have used mostly for this purpose has been procaine 0.5% in saline. Undercutting or "teasing" with the point of the needle afterwards will complete the disruption. In cases of localized panniculitis the affected area may be thoroughly

infiltrated with an oily anaesthetic solution—such as benzyl salicylate—under pressure, with the same object in view. The fibrous compartments separating the fat lobules should afterwards be disrupted with the cutting edge of the wide-bored needle employed, to prevent recurrence.

Surgery.—Surgery has no place in fibrositis in which herniation is not a cause of the pain. Removal of irreducible fat herniae which cannot be disrupted by injection, however, remains the logical procedure, and in well-chosen cases is highly successful. These structures, however, are sometimes surprisingly difficult to locate in a well-covered person and local analgesia is essential, as the patient's subjective impressions are often necessary to ensure that it has been rightly localized. It must not be forgotten that herniations are sometimes multiple. In cases of panniculitis with obesity, persistent pain which cannot be remedied by other means can sometimes be cured surgically by undercutting the painful area. Presumably the sensory nerves responsible are cut in the course of this procedure. In two cases of persistent severe pain situated in an enlarged fat-pad on the medial aspect of the knee-joint the whole pad was excised, with permanent relief of pain, to the satisfaction of the sufferers, who had found no relief from less drastic procedures.

Several papers have been published in America during the last few years confirming the part played by fat herniae in the causation of pain in the lumbar and gluteal regions. The largest series is that of Hertz, of Cleveland. In a personal communication in 1948 he stated that since 1944 his series of such cases had reached a total of 229, 68 of which he had operated upon. At his last follow-up 62 of these had maintained complete relief from pain. Hutcherson, in a paper read before the Association for Surgery of Trauma in July, 1948, reported 42 such cases operated upon, with permanent relief of pain in 40. In England I know of no published series, although I have received accounts of isolated operations of this type which have been successful. Among surgeons who have communicated with me in this way I wish to thank Messrs. L. E. C. Norbury, S. L. Higgs, Rodney Maingot, Harold Edwards, J. C. R. Hindenach, and David Trevor.

Summary

It is thought that an aetiological classification, although desirable in the case of a "disease entity," must remain impracticable in the case of a syndrome. The classical conception of fibrositis is briefly reviewed, and a classification based upon the structure of the nodules found at the source of the pain is tentatively proposed.

Evidence is produced that the fat tissues of the body are subject to pathological variations which cause pain. This pain is generally labelled as "rheumatic" or "fibrositic." When this occurs in the neighbourhood of joints the condition is often wrongly termed arthritic.

It has been shown that several recognizable "rheumatic" syndromes can be the result of an abnormal retention of fluid by fat lobules in certain situations. When this occurs they endeavour to swell, but, being confined by indistensible fibrous tissue, they are unable to do so, and tension pain results. This oedema shows no sign of being inflammatory in nature.

In some such cases a flaw occurs in the fibrous covering, resulting in herniation of the enclosed fat lobule into an adjoining layer. Such herniations may be of three types, which are described.

The origin of this selective swelling is probably endocrine. The direct effect of cold may unmask it.

The syndromes described as being due to this abnormality of fat are: (a) "fibrositis," which occurs in any of the several normally occurring fat-pads which are described, and (b) panniculitis, which occurs in abnormally deposited fat, mostly in predictable sites. Panniculitis may occur with or without general obesity. In either case the chief sites of pain tend to remain similar. Adiposis dolorosa (Dercum's disease) would appear to be only a quantitative variation of this combination.

Treatment must be directed concurrently along several lines if success is to be achieved. Those discussed include diet, endocrines, diuresis and dehydration, local injections, physiotherapy, and surgery.

The indications for surgery are limited but tend to afford dramatic relief. These are the removal of irreducible fat herniae, and to a smaller extent removal of localized areas of painful tissue in severe cases of panniculitis.

The illustrations are from a film-strip kindly made for me by Mr. E. Wilson in the Photographic Department of the Royal Society of Medicine.

REFERENCES

- Copeman, W. S. C. (1943). *British Medical Journal*, 2, 263.
 — and Ackerman, W. L. (1944). *Quart. J. Med.*, n.s. 13, 37.
 — (1947). *Arch. intern. Med.*, 79, 22.
 — and Pugh, L. G. C. (1945). *Lancet*, 2, 553.
 Dercum, F. X. (1892). *Amer. J. Med. Sci.*, 104, 521.
 Duncan, G. C. (1947). *Diseases of Metabolism*. Philadelphia.
 Elliott, F. A. (1944). *Ann. Rheum. Dis.*, 4, 22.
 Gowers, W. R. (1904). *British Medical Journal*, 1, 117.
 Herz, R. (1945). *J. Amer. med. Ass.*, 128, 921.
 Hutcherson, D. C. (1948). *Amer. J. Surg.*, 76, 605.
 Kling, D. H. (1937). *Arch. Surg.*, 34, 599.
 Sheldon, W. H. (1940). *The Varieties of Human Physique*. New York.
 Stockman, R. (1911). *British Medical Journal*, 1, 352.
 — (1920). *Rheumatism and Arthritis*. Green, Edinburgh.

RHEUMATOID ARTHRITIS IN THE YOUNG*

BY

BERNARD SCHLESINGER, M.D., F.R.C.P.

Physician to the Paediatric Department, University College Hospital, and to the Hospital for Sick Children, Great Ormond Street

[WITH PHOTOGRAPHIC PLATE]

The aetiology of rheumatoid arthritis still remains unsolved, but fresh light has been cast on the problem by a wider view of the clinical picture. The term "rheumatoid disease" has been wisely suggested (Ellman and Ball, 1948), and realization of the extensive nature of the condition, with less emphasis on the locomotor system, is a great step in the right direction. Arthritis has obviously attracted the most attention, but concentration on this single manifestation has certainly hampered search for the cause. That is why a study of the disorder can most profitably be undertaken in the young, for it is then that disease in general appears in its most acute and unadulterated form.

My remarks will be chiefly confined to certain aspects of Still's disease, which all now agree is no more than an acute form of rheumatoid arthritis in children. Further, I will try to correlate several striking features which have appeared fairly constantly in the group I have been studying with some of the rarer syndromes described by the able physicians of the past.

The study of rheumatoid arthritis, even in children, has to my mind centred too largely on the disease after it has become well established. Investigators have often not the opportunity of witnessing the onset and must rely largely on second-hand accounts from the child's relatives. In this way important developments may be missed.

Acute examples of a disease are also more likely to give information than insidious cases. I have therefore chosen for study from my case notes 20 children all of whom suffered from considerable fever and the usual general acute manifestations first described by Still. In nearly all of them careful clinical observations were made early in the disease, if not from the onset; subsequently the progress of the children was followed for many years, sometimes into adult life.

The account deals particularly with the early stages and general aspects of the disease; following the principles already expressed, arthritis will receive only short consideration.

*Read in opening a discussion in the Section of Rheumatology at the Annual Meeting of the British Medical Association, Harrogate, 1949.