USE OF ULTRAVIOLET BLOOD IRRADIATION IN THE TREATMENT OF BURSITIS AND TENDINITIS CALCAREA

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TREATMENT of bursitis and tendinitis calcarea has been discussed widely in the literature. Trauma from unusual muscle action seems to be accepted as the main cause; however, other conditions are contributing factors in the production of this disorder. We must accept the fact that bursitis and tendinitis calcarea do occur, regardless of cause or conditions, producing a very painful condition for the patient. Treatments are many and from this fact one may conclude that no one procedure is satisfactory as new efforts are constantly being made to solve the problem of pain, restoring normal function to the involved joint and removal of the calcium deposit. Ultraviolet blood irradiation is a new treatment of this disorder and we believe we can show the use of it to be on a sound basis.

Duplay, one of the early American workers on this subject, in 1872 discussed the painful shoulder but did not recognize bursitis and tendinitis calcarea as an entity. Since then, names such as Kuester, Harrington, Painter, Baer, Bergman, Sticla, Moschowitz, Ackerson and Codman appear in the literature as important contributors to our knowledge of bursitis and tendinitis calcarea. In 1934 Codman published his book, "The Shoulder," which is an outstanding contribution to bursitis and other related painful conditions of this area.

Since the subdeltoid or subcoracoid bursa and its related structures is the most frequently involved of all the bursa throughout the body and since our cases are confined primarily to this condition, we wish to limit the following discussion to subdeltoid bursitis and tendinitis calcarea.

The subdeltoid bursa is a sac-like cavity containing viscid fluid and located at the friction point between the deltoid muscle and the head of the humerus. Anatomically this bursa is located deep to the deltoid muscle and acromion process. The structures beneath the bursa consist of the muscles and tendons of the short rotator group which joins to form the musculotendinous cuff attached to the head of the humerus. The base of the bursa is firmly attached to the latter structures.

Codman has demonstrated that calcium seen associated with bursitis and tendinitis calcarea does not occur primarily in the bursa itself. The actual pathologic condition begins in the tendinous structure, usually involving the musculotendinous cuff, as result of tendon injury, disease or age changes. Following this, necrosis and degeneration occurs in the tendon fibers, resulting in calcium being deposited which may form rice-like bodies within the tendon. As a result of muscular activity this process may become more the consistency of a wen denoting chronicity. In the progress of this disease the process tends to work to the surface of the tendon where it may rupture by force or spontaneously into the tendon sheath or bursa. Symptoms may occur suddenly due to tissue reaction. This material in the bursa or sheath produces acute inflammatory changes causing secretion of fluid and swelling in the involved area. The acute swelling and tension produces severe pain and muscle spasm. The symptoms thus will depend on the amount of the inflammatory involvement, tension of the bursa or sheath and pressure on surrounding structures, especially the sensory nerves. These same reactions may occur more slowly over days or weeks and the symptoms will be less severe and tend to become chronic. After rupture into the bursa or tendon sheath nature responds by secreting fluid and fibrin into the bursa in which the calcium deposits become enmeshed. These deposits may absorb spontaneously or may remain for months or years. Codman believes that the rupture into the bursa or sheath is the normal way that nature has of trying to rid itself of the abnormal calcium that has been deposited in the defective tendon. These ruptures nearly always occur in the floor of the bursa and can be seen before rupture as a boil-like appearance surrounded with a redened zone. Cultures from the calcium material con-
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tained in the bursa are repeatedly sterile which would tend to disprove that the original pathologic condition was based on an infectious process. Grossly the calcium deposits which show so vividly in the x-ray are composed of putty-like material which is white in color and pasty to cheesy in consistency. X-ray appearance of the calcium deposit is more dense in the chronic stage than in the acute. Analysis of this material shows that it consists of calcium phosphate 55.8 per cent, calcium oxalate 44.2 per cent and organic material 14 per cent, which is mostly fibrin.

We would like at this point to review briefly the physiology of calcium. The parathyroids, under pituitary hormone control, appear to be the main factor in calcium metabolism. The absence of these glands produce hypocalcemia resulting in tetany. Calcium accounts for about 2 per cent of adult body weight and about 99 per cent of it is in the bones. One per cent, therefore, is in the fluids and tissues of the body. The serum contains about 10 mg. per cent, half of which is non-diffusible and the other half diffusible or ionizable. It is the latter that is readily dialyzed through tissue membrane, thus making calcium available when and where needed. Traumatized tissue becomes alkaline in reaction due to the lack of carbon dioxide formation, allowing calcium salt to be deposited readily. This phenomena may occur in any necrotic or degenerative process in any organ or tissue of the body.

SYMPTOMS

The symptoms of bursitis and tendonitis of the shoulder may vary considerably depending upon the acuteness of the tissue reaction, tension of the bursa and pressure on surrounding structures. Before rupture occurs and even after rupture into the bursa there may be no pain, or only slight symptoms, but usually the pain is definite and severe in the involved shoulder. Cases are reported in the literature in which calcium deposits may be found in the non-painful shoulder and are asymptomatic. This would indicate the presence of calcium does not necessarily mean a painful process. Pain was present in all of our cases. Arm motion was limited. Pain was elicited by actively or passively raising the arm or by rotating it in either direction. Marked tenderness was elicited by pressure over the shoulder point. Pain may be referred down the arm to the hand or upward to the shoulder girdle or the neck. Some observers believe that the pain is greater when tendinitis is present than when bursitis alone exists. In our experience we believe this to be true. The x-ray findings are the final proof of the presence of calcium deposits either in bursitis or tendinitis.

TREATMENT

The literature reports numerous treatments for bursitis with calcification, probably the most popular being x-ray therapy, irrigation and surgery. Those using surgery claim complete relief from pain following the surgical removal of the calcium. Those using x-ray therapy report relief from pain in from four to seven days following treatment in the acute cases, but it is found to be less effective in chronic cases. Guido8 quoting Chapman's experience with x-ray therapy reports a low percentage of good results, considering both acute and chronic conditions. Hedges18 referring to the use of x-ray therapy in bursitis and tendinitis states, "My personal experience with this form of treatment has been disappointing and I seldom use it." To evaluate the results of treatment one must keep in mind the duration of the disease, as the acute form, that is thirty days' or less duration, responds more satisfactorily than the chronic cases.

Excellent results have been reported with the use of irrigation with normal saline. McClannah13 treated 500 cases of acute bursitis with aspiration and irrigation and claims complete relief in a matter of from five to six days; however, the material must be of a consistency soft enough to be drawn through the aspirating needle and thus the treatment would be applicable to the early stage because the same treatment used in chronic cases gave relief in less than 50 per cent of the cases and less than 25 per cent obtained permanent relief. Furthermore, the results obtained would certainly depend to a large extent upon the skill of the operator in being able to place the needles correctly.

By experimentation it was found that degeneration, necrosis and calcification occurred in voluntary muscle fibers of animals fed on a diet deficient in vitamin E, whereupon Sutro and Cohen3 attempting to apply these findings treated thirty-four patients with high dosages of vitamin E and concluded that in chronic cases the injection of vitamin E results in
subjective improvement only." They further believe that "deficiency in vitamin E may lead to necrosis of tendinocapsular tissues with subsequent calcification. The ingestion of vitamin E does not have a specific effect on the deposited calcium." Magnesium sulfate ionization with the galvantic current was reported by Eckman who claims marked and rapid relief from pain after four treatments but who did not state the length of time required for these treatments. He follows with the use of long wave diathermy to facilitate absorption of the calcium.

Treatment of calcified bursitis and tendinitis as reported in 1941 by Dick, Hunt and Ferry, who used ammonium chloride in doses of 1 gm. four times daily with rest, physical therapy and the removal of foci of infection. The ammonium chloride was used to lower the hydrogen ion concentration of the blood and lymph. They claim rapid disappearance of pain and when not too dense the absorption of calcium deposits due to the mild acidosis produced by the ammonium chloride. It is seen from the foregoing reports that the treatment of calcified bursitis has not arrived at a satisfactory conclusion so far as evidenced by the many treatments devised and used without any one particular treatment giving consistent satisfactory results.

We present a new treatment for bursitis and tendinitis calcarea that we believe shows more promise in the treatment of these diseases than any of the methods discussed before. This treatment is ultraviolet blood irradiation in accordance with the Knott technic. The Knott technic of ultraviolet blood irradiation consists of withdrawing 1½ cc. of venous blood from the patient for each pound of the patient's normal body weight, citrating it as it is withdrawn, then returning it to the patient's vein through the Knott hemo-irradiator and en route irradiating it for ten seconds with selected ultraviolet rays produced by the Knott hemo-irradiator.

In our series we present a total of seventeen cases of bursitis and tendinitis calcarea. In all cases, with the exception of two, calcium deposits were demonstrated by x-ray.

The physiologic responses within the patient produced by ultraviolet blood irradiation that are of importance in the treatment of bursitis and tendinitis calcarea are (1) rapid relief of edematous processes, (2) the increased oxygen-carrying ability of blood and (3) vasodilatation effect with increased capillary flow.

These three physiologic effects of treatment result in the rapid relief of pain, the restoration of function and the favoring of calcium absorption. The pathologic condition producing pain in bursitis and tendinitis calcarea is not the presence of calcium alone but the inflammatory swelling and pressure associated with the process. By the foregoing effects of treatment, pain was rapidly relieved and the majority of patients felt comfortable in a matter of a few days. Motion was restored rapidly with the relief of pain, calcium absorption was favored, but complete absorption was not necessary to relieve the symptoms of pain and limited motion. It was found that pain was consistently relieved in a few days but calcium absorption required weeks to months.

We began this treatment five years ago for this condition and the patients treated at that time have remained symptom-free to date. Two cases of bursitis and tendinitis in our series were without calcium deposits. The symptoms were the same as those with calcium and the result of the treatment was the same demonstrating the relief of pain by ultraviolet blood irradiation in the absence of calcium.

Table I shows our result including acute and chronic cases and shows an 88.2 per cent complete relief. These cases have been followed up from two months to five years without return of symptoms. The one improved patient has less symptoms but minimal pain has persisted and no calcium absorption demonstrated on the x-ray. The one failure was an orthopedic surgeon who had extensive previous x-ray and other treatments before using three ultraviolet blood irradiation treatments. Possibly more treatments might have been advisable.

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CASE REPORTS

CASE I. R. D., a forty-one year old housewife, had severe pain in her right shoulder of three days' duration. There was no history of trauma or unusual activity. The arm could not be rotated or abducted without severe pain. The patient held her arm firmly to the side. Examination revealed marked tenderness at the shoulder point. X-ray diagnosis revealed bursitis and tendonitis calcarea.

The patient was given ultraviolet blood irradiation treatment the same day, August 26, 1948, using 187 cc. of the patient's blood which was irradiated ten seconds with the Knott hemo-irradiator. One week later, September 2, 1948, a second treatment was given as the pain was not completely relieved at that time. After the second treatment the patient improved markedly. One week later, September 7th, a third treatment was given with more improvement in symptoms. On September 14th a fourth treatment was given after which she could move her arm quite freely, was able to lie down and sleep without analgesics. On November 5, 1948, the patient returned with a severe respiratory infection. Pain in the shoulder became worse at this time. A fifth irradiation was given for both the respiratory infection and the increased shoulder pain. Pain was relieved in twenty-four to forty-eight hours. In February, 1949, the patient reported her shoulder was better, she still had some pain, but only at night, and she had full motion, except in extreme positions. Her shoulder has remained comfortable. X-rays showed complete absorption of calcium by the end of seven months. (Fig. IA to F.)

CASE II. D. L., a forty year old female secretary, had acute pain in her right shoulder of two days' duration. X-ray of the shoulder revealed a small amount of calcium in the subdeltoid bursa. No definite outline of the
tendinous cuff was noted in the x-ray. She was unable to raise her arm without acute pain in the shoulder and pain was referred down the arm. Physical examination revealed a normal, well-developed white female with acute pain in the right shoulder. Treatment consisted of blood irradiation, using 199 cc. of the patient's blood, irradiating ten seconds with the Knott hemo-irradiator, March 22, 1949. The patient was able to continue working and forty-eight hours later she reported that she was completely free of pain and symptoms and has remained symptom-free to the present date. X-rays taken two months later, May 20, 1949, showed the calcium deposit in the bursa to be practically all absorbed.

CASE III. A. K., a thirty-five year old male, had acute severe pain in his right shoulder. X-ray diagnosis was bursitis and tendinitis calcarea. This patient when first seen was complaining of very severe pain in the right shoulder. He stated that the pain began about nine days before, localizing to the bursa area in about three days. The patient was seen by an orthopedic surgeon who injected the bursa with novocain without relief. Past history was negative. Treatment consisted of two ultraviolet blood irradiation treatments two days apart. The treatments were given closer than usual because the patient lived about 500 miles away and was very anxious to return to his work. He responded very promptly, first treatment being March 13, 1948, the second March 15th. The patient returned to his home March 16th and work March 18th. An x-ray taken on March 16th showed beginning absorption of calcium in both the bursa and tendon as compared to the first x-ray of March 8, 1948. (Fig. 2A, B and C.)

CASE IV. A female, age twenty-nine stated that she had pain in her left shoulder of one week's duration. She had a history of pain in her right shoulder fifteen months previously which was similar in nature to the pain in her left shoulder. X-ray of both shoulders showed the right to be clear but a small calcium deposit was present in the left shoulder in the deltoid bursa area. This patient was given one ultraviolet blood irradiation treatment and was reported pleased with the result. Pain was relieved within two to three days and was completely gone in two weeks. The patient has felt well since and can move her arm in all directions. X-ray revealed the calcium deposit in the left bursa area to have disappeared with the exception of a small trace which appeared to be in the area of the musculotendinous cuff. X-ray was taken nearly eight months after the ultraviolet blood irradiation treatment. (Fig. 3A and B.)

Four typical case histories are herewith presented with accompanying x-rays, demonstrating the absorption of calcium.

COMMENTS

The pathologic process leading to bursitis and tendinitis calcarea begins in the tendon as result of trauma, diseases or age changes. Calcium is deposited in the degenerated or necrotic areas and later rupture from the

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tendon into the sheath or bursa. Tissue reaction from the process produces edema, tension and pressure which produces the symptom of pain and limited motion of the arm. As to why calcium occurs in the degenerated and necrotic tendon is not known but seems to be nature's response to heal the injured tendon.

Ultraviolet blood irradiation has been used in fifteen cases of bursitis and tendinitis calcarea and two cases with the same symptom syndrome but without calcium deposits. The same results were obtained in the absence of calcium. These two cases were included to demonstrate this fact.

The rational use of ultraviolet blood irradiation in relieving pain in this condition is the result of ultraviolet effect in decreasing edema, increasing the oxygen-carrying power of the blood, vasodilatation with capillary flow increased and certain biochemical changes.

Calcium deposits are not the cause of the pain primarily, as pain was consistently relieved in a few days by ultraviolet blood irradiation treatment, but the calcium deposits may remain for a few weeks to months after symptoms have disappeared.

Our results show 88.2 per cent complete relief of symptoms, including both acute and chronic forms of the process. Of the patients treated one was a complete failure and another had some improvement.

**SUMMARY**

1. A brief discussion of pathology, symptoms and treatment of bursitis and tendinitis calcarea has been presented.

2. The use of ultraviolet blood irradiation in treating bursitis and tendinitis calcarea has been presented and discussed in seventeen cases with 88.2 per cent complete relief of symptoms.

3. The modus operandi of this treatment is based on relief of edema, increased oxygenation of the blood, vasodilatation and certain biochemical effects.

4. Even though our series is small and our report preliminary, we hope the result will encourage others to use this treatment freely in this condition.

**REFERENCES**

9. GUIDO, F. R. Acute calcified subacromial sub-
10. LIPPMAN, R. K. Frozen shoulder: periarthritis: 
11. ROXO NOBRE, M. O. and DE ARAUJO CINTRA, R. R. 
12. WINCHESTER, J. W. and MEKIE, E. C. Tendinitis of 
13. MCCLANAHAN, H. H. Jr. Medical treatment of 
14. KAPLAN, I. W. and HAWKINS, B. L. Infiltration 
therapy of subacromial bursitis with calcification. New Orleans M. & S. J., 98: 123-125, 
1945.
15. BREWER, A. A. and ZINK, O. C. Radiation therapy 
17. LAPIDUS, P. W. Infiltration therapy of acute 

Dr. Miletti spoke in Bologna, Italy, on the value of cerebral arteriography in the differential diagnosis of over 200 cases of endocranial tumors. In half the cases this procedure was of no value in differentiating benign from malignant growths, but in the remaining cases it was of distinct value. The doctor concludes that cerebral arteriography is occasionally superior to ventriculography and, at all events, it is an important diagnostic adjunct to this latter procedure and ought to be used more extensively by brain surgeons. (Richard A. Leonardo, M.D.)