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Reflex Sympathetic Dystrophy of the Knee

TREATMENT USING CONTINUOUS EPIDURAL ANESTHESIA*

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ABSTRACT: We retrospectively reviewed the cases of fourteen patients who had reflex sympathetic dystrophy of the knee. All fourteen were hospitalized, and epidural block anesthesia was instituted with an indwelling catheter for an average of four days, during which continuous passive motion, manipulation (as necessary), stimulation of muscles, and alternating hot and cold soaks were used. The average length of follow-up was thirty-two months. Eleven patients had complete resolution of the symptoms, two had sufficient intermittent aching with changes in the weather to need medication, and one had no relief.

The diagnosis was confirmed if the symptoms were relieved by a lumbar sympathetic block. Pain that was out of proportion to the severity of the injury was the most consistent finding, being present in all fourteen patients. However, variation in clinical severity is characteristic of the syndrome. Eleven of the fourteen patients had had a previous patellar operation. After the onset of the symptoms, nine patients had two or more arthroscopic examinations, without notable findings. All fourteen patients had had extensive physical therapy and medical treatment before the epidural block was performed.

The literature contains few reports on reflex sympathetic dystrophy of the knee, which is considered a rare entity^{5,9,18,25}. In 1984, Schutzer and Gossling defined the syndrome as an excessive or an exaggerated response to an injury of an extremity, manifested by four more-or-less constant characteristics: (1) intense or unduly prolonged pain, (2) vasomotor disturbances, (3) delayed functional recovery, and (4) various associated trophic changes. The clinical presentation varies and the clinical course is difficult to predict. Some authors have described the syndrome as self-limited^{5,19}, but many have asserted that complete spontaneous resolution is rare^{11,19,25}. In 1983, Poplawski et al. reported that most patients who did not have treatment were symptomatic after ten years of follow-up.

The clinical findings in reflex sympathetic dystrophy

of the knee have been described previously^{5,9,18,25}. Tietjen emphasized that all affected patients have pain that seems out of proportion to the severity of the original injury or to the operation that preceded the syndrome. Stiffness, mechanical complaints, atrophy, and diffuse tenderness were also consistently present in his patients. However, none had an effusion. The changes in the skin, burning sensations, and loss of motion that are usual when the syndrome affects the upper extremity were only variably present.

Ogilvie-Harris and Roscoe, as well as Katz and Hungerford, emphasized that the patellofemoral joint is consistently involved when the syndrome affects the knee. Katz and Hungerford reported more favorable results in patients who were treated within one year after the appearance of symptoms compared with patients who were treated after a longer interval. Ogilvie-Harris and Roscoe found that treatment within six months was necessary for a favorable outcome. However, both pairs of authors expressed frustration with the treatment of this disorder, and no single treatment protocol has been reported to be consistently beneficial^{5,9,18,25}.

We are reporting the cases of fourteen patients who had a confirmed diagnosis of reflex sympathetic dystrophy of the knee and who were treated in the hospital with epidural block anesthesia. The anesthesia was administered with an indwelling catheter. During the treatment, continuous passive motion, manipulation (as necessary), stimulation of muscles, and alternating hot and cold soaks were used. Our results were more favorable than those that have been previously reported^{9,18,25}.

Materials

We evaluated fourteen patients who were diagnosed as having reflex sympathetic dystrophy of the knee, and all fourteen were included in the study. The average age was twenty-nine years (range, twenty-one to thirty-nine years). There were six men and eight women. Eleven patients previously had had chondral shaving for the treatment of chondromalacia or had had a lateral release and realignment procedure for the treatment of malalignment. Nine patients had had two or more previous arthroscopic procedures, which had revealed no notable findings. All fourteen patients had had extensive physical therapy and medical treatment.

Radiographs were made of all fourteen knees. Thermograms were made for five patients and technetium bone scans, for seven.

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Diagnostic Findings

The diagnosis was suspected whenever a patient complained of pain that was considered to be out of proportion to the severity of the original injury, or to the expected postoperative course if an operation had preceded the symptoms. The symptoms and signs, in various combinations, consisted of a 1 degree Celsius decrease of the temperature of the skin, hypersensitivity to touch, atrophic changes of the skin, and stiffness or swelling.

All of the patients had pain that was out of proportion to the severity of the initiating injury. The time from the initiating injury until we saw the patient ranged from three to fourteen months (average, 6.3 months).

At the time of presentation, the range of motion was full in seven patients, 120 to 140 degrees in three patients, 90 to 120 degrees in two patients, and less than 90 degrees in two patients. The temperature of the skin, as determined by a skin-temperature probe, was decreased by 1 degree or more in twelve patients.

In all of the patients, the patellofemoral joint was painful and osteopenic, as seen on radiographs. A technetium bone scan was positive in five of the seven patients in whom it was done. Thermography demonstrated a marked decrease in temperature on the affected side in three of the five patients who were so tested. Muscle strength was not measured.

The history suggested that the symptoms of reflex sympathetic dystrophy occurred before the first operation in nine of the eleven patients who had an operation.

Methods

Once the diagnosis was suspected, each patient was referred to the Pain Clinic at the University of Texas Health Science Center at San Antonio, where a diagnostic sympathetic block was performed. The symptoms had to be relieved by the sympathetic block for the diagnosis of reflex sympathetic dystrophy to be made. The pain was judged to be relieved if most of it disappeared for the duration of the action of the anesthetic agent that was used. The block was judged to be successful if it was followed by a documented minimum increase in the temperature of the skin of 1 degree Celsius.

After confirmation of the diagnosis by sympathetic block, the patient was hospitalized. An indwelling lumbar epidural catheter was inserted and a continuous-drip epidural block was instituted using bupivacaine followed by narcotics. After administration of the block, a regimen of continuous passive motion was instituted.

Bupivacaine provides a sympathetic, sensory, and motor block that is initially excellent for allowing increased range of motion without pain. It was used as the initial agent in all patients. The initial dose of bupivacaine was one milligram of a 0.5 per cent solution per kilogram of body weight. After this was administered, the continuous drip was set at 0.25 to 0.5 milligram per kilogram of body weight per hour, which was titrated to give complete epidural anesthesia.

Narcotic epidural agents provide pain relief without producing a motor block. This enables the patient to be up and walking while in the hospital. Each of the narcotics (morphine, Demerol [meperidine], and fentanyl) that was used has advantages and disadvantages. The selection of the narcotic was left to the discretion of the anesthesiologist (S. R.). Narcotic epidural agents were used only after the patient regained motion with the continuous-passive-motion machine, which was used while the patient was under the bupivacaine epidural block.

The switch to narcotics was instituted somewhat empirically, usually two or three days after the bupivacaine was started. The morphine was given as an intermittent bolus of 0.07 milligram per kilogram of body weight every ten to eighteen hours; the Demerol, as a bolus of 1.0 milligram per kilogram of body weight followed by continuous infusion of 0.1 milligram per kilogram of body weight per hour; and the fentanyl, as a bolus of 1.0 microgram per kilogram of body weight followed by infusion of 0.3 microgram per kilogram of body weight per hour. Because of its potential for respiratory depression, morphine was not infused continuously. The continuous infusion of Demerol or fentanyl provided consistent analgesia.

During the continuous epidural block, manipulation (if necessary), a continuous-passive-motion machine, muscle stimulators, alternating hot and cold soaks, and psychological evaluation (if necessary) were used. An arc of flexion of less than 90 degrees was considered to be an indication for manipulation under regional epidural anesthesia. Continuous passive motion was used for all patients. After the pain was relieved and motion was improved, the strength of medication and the frequency of its administration were tapered down over several days.

All patients were seen for a final follow-up examination by the senior one of us (J. C. D.), who documented the levels of pain and activity, the range of motion, and any need for analgesic or anti-inflammatory medication.

Results

The indwelling epidural catheter was maintained for an average of four days (range, two to seven days). The duration of hospitalization ranged from five to eight days. There were no complications. The length of follow-up ranged from seven to forty-eight months and averaged thirty-two months.

At the latest follow-up, ten of the fourteen patients had a symmetrical range of motion. In three patients, the involved knee had 20 degrees less flexion and in one, 40 degrees less flexion than the contralateral knee. After manipulation, the patients in whom the arc of flexion initially had been less than 90 degrees gained an average of 30 degrees of flexion.

At the latest follow-up, in eleven patients the symptoms had resolved completely, and they had no limitation of activity. Two of the remaining patients had intermittent aching with changes in the weather, and they needed medication. One patient had no relief of the symptoms.

Discussion

Clinical Findings

To our knowledge, reflex sympathetic dystrophy, as it specifically involves the knee, has not been widely discussed^{5,9,11,18,20,25}. Pain, atrophic changes in the skin, decreased temperature of the skin, hypersensitivity to touch, stiffness and swelling, and increased sweating are classic symptoms and signs of this syndrome^{17,24}.

When the lesion affects the upper extremity, the signs are often associated with neural injury or causalgia, or both¹⁷. However, most patients who have reflex sympathetic dystrophy of the knee do not have the classic combination of symptoms and signs. In them, there is a marked variation in the severity of the syndrome^{5,9,18}. Moreover, severe symptoms and signs are not associated with a severe initial inciting trauma^{5,9,11,18,22,25}. None of our fourteen patients had major trauma; in fact, most of them had a minor twisting or impacting injury, or the symptoms developed after an arthroscopic operation on the knee.

Pain that is out of proportion with the severity of the injury is a universal finding in patients who have reflex sympathetic dystrophy of the knee^{9,18,25}; it was present in all fourteen of our patients. This symptom alone should alert the clinician to a possible diagnosis.

In a report by Tietjen, all fourteen patients who had reflex sympathetic dystrophy of the knee had pain, loss of motion, and mechanical complaints. Other authors^{5,9,18} also reported that their patients commonly lost motion. Both flexion and extension have been reported as being lost. This loss of motion has been noted as an important feature for distinguishing sympathetic dystrophy of the knee from other patellofemoral arthralgias⁵. Restriction of motion was also a common finding in our patients: three patients lacked 20 degrees of flexion; two, 50 degrees; and two, more than 60 degrees. No patient had restriction of extension.

Previous authors have noted that when the knee is the central area of involvement, the patellofemoral joint always is affected^{5,9,18,25}. In all fourteen patients in our series, examination revealed tenderness and pain over the patellofemoral joint, and routine lateral radiographs revealed osteopenia of the patella. The skyline radiograph has been reported to be helpful in demonstrating demineralization of the medial pole of the patella²⁵. Osteopenia may be present in the medial femoral condyle or the tibial plateau, although this was not seen in our series.

A technetium bone scan showed increased activity in the patella in five of the seven patients in whom it was done. The patellofemoral joint was involved in all five patients who had a positive scan, and thermography revealed a local decrease in the temperature of the skin in three of the five. Bone scans and thermograms are not essential to the diagnosis of reflex sympathetic dystrophy. When the clinical diagnosis is unclear, they may be useful before a diagnostic sympathetic block is done, but the sympathetic block is the so-called gold standard for proof of the diagnosis.

Some authors^{5,11} suggested that a predisposing diathesis

or psychological profile, which has not been precisely defined, is important in the development of the syndrome of reflex sympathetic dystrophy of the knee. No formal psychological testing was routinely performed in our patients, so we have no data on this aspect of the condition.

The interval between the initiating injury and the institution of treatment has been implicated as an important prognostic factor for patients who have reflex sympathetic dystrophy of the knee^{5,9,18,20,25}. In the series reported by Katz and Hungerford, the results were much better for patients who received treatment within one year after the onset of the symptoms than for patients for whom the interval was longer.

Ogilvie-Harris and Roscoe divided their patients into three groups: those who received early treatment (less than six months after the onset of symptoms), those who received late treatment (more than six months after the onset of symptoms), and those who were treated after an operation. All of the patients had hypersensitivity to touch, atrophy of the quadriceps, and loss of motion. However, only one of the seven patients who had received early treatment had dystrophic changes, compared with ten of the twelve patients who had late or postoperative treatment.

All of the patients of Ogilvie-Harris and Roscoe were treated with non-steroidal anti-inflammatory drugs, analgesics, and intensive physical therapy. Those who did not respond to these measures were managed with sympathetic blocks, manipulation, and continuous passive motion. Because use of the continuous-passive-motion machine was often painful, epidural morphine was used as well. Only the patients who received early treatment, most of whom responded to physiotherapy, had a good result. For the patients who received late or postoperative treatment, the result was "most unsatisfactory".

For all of our fourteen patients, at least one course of physical therapy and conservative treatment failed. However, in eleven patients, the symptoms were completely relieved by our treatment protocol. Although it is difficult to make direct comparisons, we believe that our patients were similar to those in the late and postoperative-treatment groups of Ogilvie-Harris and Roscoe. Because a course of conservative treatment had failed in all of them, it seems that our patients were likely to be refractory to treatment. Our patients had had symptoms for an average of 6.3 months before treatment was initiated. The three patients who did not obtain complete relief from our program had had symptoms for an average of eleven months before treatment was initiated. This finding supports the belief that patients who have an early diagnosis and prompt treatment have a better chance for a successful outcome^{9,18,19,20,25}.

In patients who are treated for reflex sympathetic dystrophy of the knee after an operation, the operation might have been the inciting trauma that led to the syndrome, but it also is possible that the operation (for example, diagnostic arthroscopy) was performed after the onset of the symptoms, which were then recognized as being due to reflex sympathetic dystrophy. An operation may exacerbate symp-

toms. Tietjen reported that three of his fourteen patients had had an arthroscopy and five, an arthrotomy. He did not mention if these procedures preceded the onset of symptoms, but he did think that the patients who had had an arthrotomy "improved more slowly" than the others in his series. This finding was supported by others^{9,18}.

After the onset of symptoms in thirteen of his fourteen patients, Tietjen performed diagnostic arthroscopy to "determine whether there was any intra-articular disease". Ogilvie-Harris and Roscoe performed diagnostic arthroscopy in all of their patients after the diagnosis of reflex sympathetic dystrophy was considered. They also thought that it was important to rule out serious intra-articular pathological changes, as many of their patients seemed to have a locked knee at the time of the initial examination. However, no serious intra-articular lesions were found in their patients.

Eleven of our fourteen patients had had a patellar operation before the diagnosis of reflex sympathetic dystrophy was made, and for nine of them the history suggested that the reflex sympathetic dystrophy had begun before the operation. Thus, a surgeon should look for symptoms of a reflex sympathetic dystrophy before considering any surgical treatment to the knee. In retrospect, the fact that eleven of our fourteen patients had had an operation for the treatment of symptoms about the patellofemoral joint hints that the symptoms should have been suggestive of reflex sympathetic dystrophy. That diagnosis might have been made before arthroscopy was done. Surgical intervention seemed to have exacerbated the symptoms in these patients.

Great caution should be exercised when considering diagnostic arthroscopy of the knee in a patient who has had prolonged pain that is out of proportion to the severity of the injury. Clearly, when mechanical symptoms and the results of the clinical examination are consistent with an intra-articular lesion, arthroscopy is warranted. Because of the great variation in the clinical severity of this syndrome, one should not casually perform diagnostic or operative arthroscopy when the diagnosis and clinical findings are unclear. Arthroscopy may only aggravate the reflex sympathetic dystrophy.

Treatment

The traditional treatment of reflex sympathetic dystrophy has included physical therapy, oral administration of medication, alternating hot and cold soaks, multiple sympathetic blocks^{5,9,11,12,18-20,22}, and sympathectomy. Poplawski et al. reported very favorable results after employing regional blocks by intravenous infiltration of Xylocaine (lidocaine) and Solu-Medrol (methylprednisolone sodium succinate), but they did not treat any patients who had reflex sympathetic dystrophy of the knee. Reider and Rattenborg reported excellent results in patients who were treated with chemical lumbar sympathectomy using bupivacaine or alcohol. Lankford and Thompson recommended surgical sympathectomy if the patient has had four sympathetic blocks without complete relief of symptoms.

Reserpine and guanethidine, given intravenously, may produce transient chemical sympathectomy for as long as three or four days, during which therapy may be employed^{7,8,15}. Systemic corticosteroids and propranolol have also been reported to be useful in patients who have reflex sympathetic dystrophy^{1,6,10,23}. Ficat and Hungerford achieved variable results with core decompression and did not recommend it as the sole treatment for this syndrome. We have no experience with any of these three techniques.

Tietjen reported improved results in eight of fourteen patients after the use of medication, physical therapy, and occasional local injections. None of the patients received a regional sympathetic block. Katz and Hungerford treated thirty-six patients with sympathetic blocks and sympathectomy, if necessary, and the results were much better in the patients who were treated within one year of the onset of symptoms.

Because of the variation in the severity of clinical symptoms, we believe that it is crucial to confirm the diagnosis by lumbar sympathetic block. It has been emphasized that if a sympathetic block does not temporarily relieve the symptoms, a diagnosis other than reflex sympathetic dystrophy should be considered^{9,11,18,21,26}. A sympathetic block does not provide somatic anesthesia, but if the diagnosis is correct, it will relieve the pain.

We established a treatment algorithm on the basis of our experience. When the clinical findings suggest reflex sympathetic dystrophy of the knee and the symptoms have been present for less than six weeks, we proceed with a trial of non-steroidal anti-inflammatory medication, gentle pain-free physical therapy to increase motion, alternating hot and cold soaks, and progressive weight-bearing. We use this six-week waiting period so that patients who have had symptoms for a short duration have a chance to respond to less expensive and less aggressive treatment. If there is no relief of pain or no increase in motion, or if symptoms suggesting reflex sympathetic dystrophy have clearly been present for more than six weeks and are progressing, we proceed with a diagnostic sympathetic block. If the diagnosis is confirmed by the block, the patient is hospitalized and a continuous-drip epidural block is administered. Bupivacaine is used for the first two or three days, followed by epidural administration of narcotics; this allows the patient to walk. While the pain is completely relieved, the joint is mobilized, using continuous passive motion and manipulation as indicated by the range of motion.

To our knowledge, this is the first report of treatment of reflex sympathetic dystrophy of the knee using epidural anesthesia. Epidural blockade has several advantages over sympathetic blockade. A sympathetic block may relieve the pain initially, but when the stiff joint is aggressively mobilized the pain usually recurs and the pain cycle is reconstituted. Epidural blockade allows pain-free mobilization because it blocks sympathetic pain fibers as well as somatic pain fibers. An epidural block is easy to perform, and a lumbar epidural catheter may be left in for five to seven days. This technique also allows manipulation of the knee,

as needed, and application of continuous passive motion, both of which have been helpful in increasing the restricted range of motion.

The indwelling continuous-drip epidural block eliminates the need for repeated sympathetic blocks, which can be difficult to apply and may be painful. When the catheter is in place, the patient is free of pain throughout the course of treatment. This breaks the vicious cycle of reflex sympathetic dystrophy. In none of our patients was the pain exacerbated by manipulation or by continuous passive motion. The development of tolerance to the medication is a theoretical disadvantage of epidural blockade with narcotics. However, this was not a problem in our series. The symptoms resolved completely in eleven of the fourteen patients. At the time of writing, two patients had intermittent aching with changes in the weather. Only one patient had no relief of symptoms.

All three of our patients in whom the treatment failed had had symptoms for longer than six months. One subsequently had a total knee replacement, a total hip replacement, and a laminectomy, but he still had persistent pain in the affected knee.

In conclusion, the diagnosis of reflex sympathetic dystrophy must be considered in any patient who has pain that is out of proportion to the severity of the injury, atrophic changes of the skin, decreased temperature of the skin, hypersensitivity to touch, stiffness and swelling, or a combination of these symptoms. Early diagnosis and treatment, involving hospitalization with an epidural blockade, continuous passive motion, alternating hot and cold soaks, stimulation of the muscles, and manipulation as necessary, can lead to complete resolution of symptoms in a high percentage of patients. That treatment protocol was effective in managing this difficult problem in our series.

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