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Reflex Sympathetic Dystrophy Complex Regional Pain Syndrome (CRPS) For the Non-Physician

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In this paper I am going to explain, in laymen's terms, Reflex Sympathetic Dystrophy (RSD), its pathology, the new taxonomy (which includes Complex Regional Pain Syndrome, sympathetically maintained pain, sympathetically independent pain, and causalgia), and the rules for diagnosing these various and sundry neuropathic pain conditions, together with current methods of treatment.

Definition

The term RSD was first used by Evans in 1946 but has been applied to describe various clinical syndromes, such as Sudeck's atrophy, traumatic arthritis, minor causalgia, posttraumatic osteoporosis, post-traumatic pain syndrome, post-traumatic edema, posttraumatic angiospasm, shoulder-hand syndrome, etc. It was defined by the International Association for the Study of Pain as continuous pain in a portion of an extremity after trauma, which may include fracture but does not involve major nerves. It is associated with sympathetic nervous system changes but is not a disease of the sympathetic nervous system. Causalgia is left as a separate syndrome, although the symptoms and clinical presentation of the conditions overlap, as do their treatments. Pathology of causalgia is, by definition, damage to a major nerve trunk, whereas with RSD there is usually damage to some very minor nerves. It may also appear after certain medical problems, which will be noted later.

Clinical features and findings

Clinical features are symptoms and changes, which often start at the site of the precipitating event, presenting with a glove-and-stocking anatomical distribution (with a distribution just like a glove or a stocking) which does not usually follow dermatomal lines (areas of the body supplied by one spinal nerve.)

Clinical findings include: disturbances of autonomic (sympathetic system) regulation with alterations in blood flow; hyper- or hypohidrosis (sweating or dry skin); edema (swelling); sensory abnormalities, with hyper- or hypoesthesia (increased or decreased sensitivity of the skin); allodynia (extreme pain to the slightest stimulation) to mechanical or cold stimulation; motor dysfunction, with weakness or tremor; joint stiffness; trophic (degeneration) changes of the skin, hair and nails, and psychological reactive disturbances (including anxiety, depression or hopelessness).

The physiologic features manifest diffusely but not necessarily uniformly in the entire distal extremity; they may occur anytime after the onset of the syndrome, spreading proximally (towards the body) and distally (towards the feet or hands) and occasionally to other extremities as the syndrome progresses. Dominating symptoms are spontaneous pain, swelling, weakness and loss of function.)

Disease stages

There are three stages of RSD defined by deTakats, with later modifications by Bonica. RSD does *not* necessarily follow these stages, but this is a good, basic guideline from which to work.

Stage I: Beginning within a few days or weeks of the precipitating event, this stage is characterized by pain, and often by burning, in the area of the injury. There is frequently hyperesthesia as well. Movement worsens pain, and immobility of the limb is obvious by its protected position. There is usually accompanying edema, tenderness of the distal joints of the limb, and often local muscle spasm as well. The limb may be warm, red, and dry or cool and pale. This phase may resolve spontaneously or should respond rapidly to the appropriate treatment modality. The clinical picture varies from a few days to a few months.

Stage II: As the RSD progresses, pain can increase or decrease or remain unchanged. There may be beginnings of local hyperesthesia, paraesthesia (abnormal sensations), or allodynia. Edema spreads, local joints become stiff, muscle wasting in the region of the injury begins, and the skin may become cold, pale, cyanotic, and moist. The hair of the affected limb may become thickened and coarse. Also, the nails may become brittle. Osteoporosis progresses to a diffused form and increased blood flow on scintigraphy (a special X ray procedure) is seen. Appropriate treatments can still be effective, though patients in this stage will be more difficult to cure.

Stage III: This stage is marked by severe trophic changes and resistance to treatment. The pain is variable, with increased spreading allodynia and disesthesia (mistaken sense of sensation, e.g. soft touch feels prickly.) The pain is usually a burning discomfort, which is often aching or throbbing. Exposure to cold air or a draft may aggravate the pain, as may damp weather. Extreme immobility of the limb is often present, and there may be ankylosis (complete immobility) of the joints, partly due to atrophy and contracting muscles. Often the edema has resolved with subcutaneous tissues becoming atrophied. The skin is smooth and shiny, cold, and often damp. The nails and hair are thickened and brittle. These patients are often anxious, tentative, and depressed, with all the vegetative symptoms of that state. X-ray examination will show diffuse osteoporosis (thinning of the bones). More advanced forms of treatment are needed to help patients with this sort of problem.

Causalgia can present in exactly the same way in all three stages.

Sympathetically maintained pain (SMP)

One of the factors common to RSD and causalgia is that almost all patients will respond to sympathetic blockade (blockage of the sympathetic nerves supplying the area with local anesthetics), which will take away their pain for a variable length of time. However, many patients do not present with the full-blown syndrome that includes all the signs listed above, but do respond to a sympathetic blockade. These patients' problem fits into the category called *sympathetically maintained pain*.

For example, a patient may come to a doctor with pain only. There may not be allodynia, there may not be swelling, there may not be muscle spasms or any of the other factors relevant to the diagnosis of RSD. However, a sympathetic blockade takes away their pain. In fact, patients can present with any of the symptoms of RSD on their own. They can present with just swelling, just allodynia, just burning pain, muscle spasm, etc., and if these people respond to sympathetic blocks, they are then defined as having sympathetically maintained pain or sympathetically maintained pain syndrome.

Sympathetically independent pain (SIP)

Some patients will present with the classic symptoms of RSD; however, sympathetic blockade does *not* take away their pain. This may be due in part to a disease process that we don't understand, or it may be that these patients have progressed so far along in their disease that the disease has become centrally maintained only (there are now changes in the nerve cells in the spinal cord), and sympathetic blocks have little or no effect on it whatsoever. Often in Stage III of RSD, patients start to suffer from SIP.

Complex Regional Pain Syndrome

There has been dissatisfaction with the term *reflex sympathetic dystrophy*. In 1995, therefore, a new taxonomy was formulated to include the terms *complex regional pain syndrome Type I* (formerly *reflex sympathetic dystrophy*) and *complex regional pain syndrome Type II* (formerly *causalgia*.)

Complex regional pain syndrome (CRPS) is a term that describes a variety of painful conditions which can follow injury, appearing regionally and having a distal predominance of abnormal findings that exceed in both magnitude and duration the expected clinical course of the inciting event. Such condition often results in significant impairment of motor function.

CRPS Type I (RSD)

In this syndrome, which develops after an initiating noxious event, continuing pain or allodynia/hyperalgesia occurs. It is not limited to the distribution of a single peripheral nerve, and it is disproportionate to the inciting event. There is or has been evidence of edema, skin blood flow abnormality, or abnormal sudomotor (sweating) activity in the region of the pain. If other conditions exist that would otherwise account for the degree of pain and dysfunction, this diagnosis is excluded.

CRPS Type II (Causalgia)

This syndrome develops after a nerve injury.

Sympathetically maintained pain (SMP)

Pain that is maintained by sympathetic efferent innervation or by circulating catecholamines (epinephrine and norepinephrine), SMP may be a feature of several types of painful conditions and is not an essential requirement of any one condition.

Pathophysiology

The hallmark of RSD is ongoing pain and allodynia, which is typically out of proportion to the injury. The causative event can vary widely from trivial injury to major trauma, or there may be no significant trauma at all. A theory proposed by Roberts, one which incorporates many of the observations noted in these patients, suggests that the allodynia and spontaneous ongoing pain in RSD is the result of a chronic maladaptive sensitization of wide dynamic range neurons (nerve cells) in the dorsal horn of the spinal cord, and is

not a heightened sympathetic tone. There *is*, however, a connection between the sympathetic system and these wide dynamic range neurons.

The output from the skin touch receptors, (low threshold mechanoreceptors), is via large diameter A beta nerve fibers, and this is influenced by activity of the sympathetic nerves in the area. These touch receptors discharge afferent impulses (messages to the spinal cord) that maintain at a rate proportional to the sympathetic tone. Under normal circumstances, these sensory invoked impulses from touch fibers have insufficient magnitude to provoke a response from the wide dynamic range cells. However, when a wide dynamic range cell becomes sensitized (as happens following an injury and in RSD, SMP, et.), the threshold of stimulation falls sufficiently so that it responds to the sympathetically maintained impulses evoked from nociceptive afferent A beta fibers and converts this information to noxious (unpleasant sensory) impulses destined for the brain. If the level of norepinephrine (which is normally secreted by the sympathetic nerves) circulating in the area of the mechanoreceptors is reduced, then their output is reduced and the pain goes away.

This is how sympathetic blockade takes away the pain of RSD and sympathetically maintained pain syndromes. Injection of norepinephrine to these areas makes the pain worse. This theory does not explain all the things that occur with RSD and sympathetically maintained pain. But this is good basic theory from which to work. It is thought that as the disease progresses due to the barrage of impulses coming in from the periphery into the dorsal horn, cell death occurs to cells in the dorsal horn and chronic pain state develops that now may not respond to sympathetic blockade. This is called sympathetic independent pain (SIP). This is a relatively simplistic view but serves to cover the majority of the evidence we have at this time.

Diagnosis of RSD

First of all, the presentation will be burning pain, allodynia, possible muscle spasm, and lancinating (shooting) pain, as well as a temperature and all possible color changes in the extremity, edema, and skin, hair and nail growth changes. The patient may have one or all of these symptoms. By the time skin, hair and nail growth changes are seen, it's a sign that somebody has missed the diagnosis, and the patient is proceeding into a chronic pain state. It is interesting to note here that the typical RSD patient will be able to tell you when it's going to rain with greater predictive accuracy than the weather service, since pain begins to get worse as rain approaches. The patient is also likely to have pain that is not easily controlled with systemic narcotics and have *greater* difficulty sleeping because the pain gets *worse* at night.

Clinical Testing

The backbone test for this disease is a sympathetic block. In over 95% of patients, the blockade will take away their pain.

Additional tests are:

1. Thermography
2. Quantitative sweat test
3. Triple phase bone scan
4. Cold and mechanical allodynia
5. IV phentolamine test

Incidence and epidemiology

Various papers have been published on the incidence and causality of RSD in the general population. Most of the cases of causalgia were in adult males aged 20 to 40, because they had received bullet wounds in combat, but as regards RSD, there is a tendency for more patients to be women than men and to be in the 20 to 50 age group (although RSD has occurred in children and in people over 70).

Blunt trauma may cause RSD, as may myocardial infarction (heart attack), with a few papers published reporting patients with RSD of the hand, and either shoulder-hand syndrome or RSD of the hand following myocardial infarction. It may also occur after ischemic heart disease, radiculopathy (irritation or injury to a single spinal nerve), spinal cord injuries, CVA's (strokes), diabetic neuropathy, cancer, multiple sclerosis, cerebral lesions, infections and vascular disease. RSD-type symptoms are seen *very commonly* after wrist fractures. This is possibly due to damage to the median nerve that carries most of the sympathetic fibers to the hand. This is usually a self-limiting disease, but it is commonly noted that people with wrist fractures have a very difficult time rehabilitating their wrists with physical therapy and seem to have excessive amounts of pain. These people respond very well to a few sympathetic blocks done just before physical therapy, and this enables them to resume full use of their wrist sooner.

The spread of RSD

RSD and sympathetically maintained pain syndromes do spread, usually to a contralateral (the opposite side) limb. This supposedly occurs in 25% of cases, if left untreated. They can also spread up the spine from a leg to an arm, and they commonly spread from an arm up into the head, typically with headaches, sinus problems, or malfunctioning of the eye. Since the cervical sympathetic chain is involved, cardiac problems can also occur with syncopal (fainting) attacks and angina-type syndromes (chest pain.)

Treatment

1. Physiotherapy
2. Sympathetic blockade

3. Medications
4. Tens unit
5. Acupuncture
6. Biofeedback
7. Psychotherapy
8. Removal of trigger areas
9. Sympathectomy
10. Dorsal column stimulators
11. Intrathecal (intraspinal) narcotics

The *primary modalities* for treatment for RSD and sympathetically maintained pain syndromes are *physiotherapy* and *sympathetic blockade*. Commonly we will do a sympathetic block and send the patient for physical therapy. The therapy should be done, if possible, whilst the sympathetic block is working. This forms the basis for initial treatment. Provided the patient is improving, this modality of treatment should be continued. (Some people may have a frozen shoulder or restricted joint condition. This may necessitate blockade of nociceptive (those that transmit normal pain sensations) pain fibers in order for the physical therapist to be able to manipulate the joints.

The primary task is to rehabilitate the joint or joints which are not functioning properly, strengthen the muscles, and do this while the sympathetic blockade is in effect and wide dynamic range neurons are being rested.

1. Physiotherapy

The basis of therapy is passive range of motion and isometric strengthening. Heat (NOT ice!) works in 90% of patients.

2. Sympathetic Blockade

A. Upper Extremity:

1. Stellate ganglion block
2. Cervical epidural sympathetic block
3. Interscalene and brachial plexus blocks
4. Intravenous regional (Bier) block

B. Lower Extremity:

1. Lumbar sympathetic block
2. Lumbar epidural sympathetic block
3. Femoral, sciatic, or three-in-one block

4. Intravenous regional (Bier) block

C. Other blocks

1. Intravenous phentolamine infusions
2. Intravenous lidocaine infusions

3. Medications; combination of:

A. Analgesics (e.g., Vicodin, morphine, fentanyl)

B. Relaxants (e.g., Soma, Baclofen)

C. Antidepressants (e.g., Elavil, Trazodone)

D. Hypnotics (e.g., chloral hydrate)

E. NSAIDS (e.g., Motrin, Voltaren, etc.)

F. Steroids (e.g., Medrol dose pack)

G. Adrenergic alpha-1 and alpha-2 blocking drugs (e.g., phentolamine, yohimbine)

H. Calcium channel blockers (e.g., Procardia)

I. Oral local anesthetics (e.g., Mexiletene)

J. Anticonvulsants (e.g. Tegretol, Neurontin)

4. Tens units

Using electrodes on the skin electric impulses are transmitted over the areas of pain .

These will sometimes help, particularly if there is nociceptive (normal pain caused by injury) pain (e.g., following manipulating a frozen shoulder).

5. Acupuncture

This works only while the needles are inserted and being stimulated; the end results are poor.

6. Biofeedback

This is the technique of making unconscious or involuntary bodily processes perceptible to the senses (as by the use of an oscilloscope) in order to manipulate them by conscious mental control. Biofeedback helps 15% of patients who are in a chronic pain state. It is not usually used in the early treatment of RSD (SMP).

7. Psychological disturbance

RSD patients are expected to be depressed in more than 75% of cases. Most of them are anxious, suffering from insomnia, irritability, agitation, and poor judgment. These manifestations appear after the RSD and not before. In too many cases, patients are labeled as malingerers, psychotic, or neurotic. In fact, this is not the case. A review of the literature reveals no evidence indicating there is a certain personality trait that predisposes one to develop RSD. The changes in personality develop after the development of RSD and not before.

8. Removal of trigger areas

It may be necessary to remove a trigger zone (e.g. neuroma removal). Those commonly found are small neuromas (nerve tumors) on peripheral nerves, which may be removed through the use of:

- A. Surgery
- B. Phenol
- C. Alcohol
- D. Radio frequency
- E. Cryoneurolysis (freezing) (the best method)

9a. Sympathectomy (surgical)

At this time, surgical sympathectomy (removal of the sympathetic nerve supply) is discouraged in the treatment of sympathetically maintained pain and RSD. It would seem that logically it would work, but in practical terms, 30-50% of those who have had a sympathectomy get a type of pain, which is not amenable to sympathetic blockade or treatment, leaving them worse off than before. Also, the sympathectomy often fails because of all the sympathetic nerves that come across from the other side.

9b. Sympathectomy (non-surgical)

Chemical, radio frequency, and cryogenic sympathectomies are done because 1) they will allow a temporary sympathectomy to take place in the region without the post-sympathectomy pain; 2) their targets will re-grow in three to four months; and 3) they give the wide dynamic range neurons a chance to rest and thereby help the patient to combat the disease. It is hoped the disease will eventually burn itself out or the wide dynamic range neurons will revert to their original functioning during the rest period (plasticity of the spinal cord), thereby eliminating the disease.

10. Spinal cord stimulators

Spinal cord stimulators can be used, and work well after an initial trial period with the stimulator lead in place while a stimulator is placed external to the body. If the pain is then reduced by 70% or more, an internal stimulator is implanted subcutaneously with the electrodes inside the spine. It is about the size of a pacemaker and functions rather like a Tens unit placed over the dorsal column of the spinal cord. It causes tingling sensations to be sent to the brain rather than pain sensations. It works somewhat similarly to the principle of the gate theory proposed by Melzak and Wall. These are now being used more commonly in the earlier stages of the disease allowing diminution of pain easier physiotherapy and more rapid reversal of the disease process.

11. Intrathecal Narcotics

For intractable pain not amenable to any of the above, intrathecal (into the spinal fluid) infusion of narcotics may be needed, and the implantation of a morphine (or some narcotic) pump may be necessary. It should be noted that narcotics do not work well peripherally (i.e., by mouth or injection) on patients with sympathetically maintained pain. However, given intrathecally, the medications do work much better. These pumps about the size of a small hockey puck are implanted under the skin of the abdomen and can afford a patient with intractable R S D a much more pleasant life style.

Plan of action

1. Assume that any patient who is suffering from pain that's excessive, given the size of the injury, and who possesses any of the sequelae mentioned above, has SMP or RSD. until proved otherwise.
2. Go to a good pain management specialist for diagnosis.
3. Work with the pain specialist to get blocks medications and physiotherapy done, and use the correct forms of physiotherapy.

4. Have the RSD treated before any operations are done. Be operated on ONLY IF YOU MUST.

5. If surgery **really** is necessary, then it must be done under a block anesthetic to minimize the nociceptive (normal pain) input, thereby minimizing the chance of the RSD returning. Have the pain management specialist follow postoperatively to do sympathetic blocks should the sympathetically maintained pain recur. Do expect to require sympathetic blockades postoperatively and, very likely, during the rehabilitation period.

6. Remember, the longer RSD is left without direct medical intervention, the more difficult it becomes to effect a short-term cure. Research is going on continually and a good RSD pain treatment center will keep you apprised of developments in this potentially devastating disease.

7. One should always look for a precipitating factor, such as irritated median nerve with a Colles' fracture, trauma to small nerve terminals at the site of the portals after arthroscopy. Providing that these sites can be found early and dealt with in an appropriate manner (such as freezing a neuroma, should one have occurred), the sympathetically maintained pain can be rapidly eliminated.

Summary

Whenever people exhibit pain out of proportion to any injury they have suffered, it should be assumed that the source is RSD (CRPS) or sympathetically maintained pain until proven otherwise. RSD may well present as RSD, causalgia, or one of the components of these diseases. The patient should go immediately to a pain center which specializes in the treatment of these conditions.

The backbone of treatment for the disease is:

BLOCKS

PHYSICAL THERAPY

DRUGS

PSYCHOLOGICAL COUNSELING