

WHAT IS CRPS?

Complex regional pain syndrome (CRPS) is a progressive disease of the Autonomic Nervous System whose pain is characterized as constant, extremely intense, and out of proportion to the original injury. The pain typically affects one or more of the four limbs but can occur in any part of the body. While it usually occurs after a traumatic injury - even a minor one - CRPS may be triggered by a clinical condition such as stroke, heart attack, burns, cancer, arthritis, polymyalgia, spinal cord injury, or infection. Finally, it can develop in the absence of a remembered inciting event or illness - in 30% of the cases the cause is unknown.

While CRPS may sound like a new condition to many of you, it is actually a new name for a more familiar condition known to most of you by names such as Reflex Sympathetic Dystrophy (RSD), causalgia, or sympathetically maintained pain (SMP).

What today is known as CRPS has been documented since the American Civil War under many different names. It was first studied by Dr. Weir Mitchell, who with his associates G.R. Moorehouse and W.W. Keen published a book called "Gunshot Wounds and Other Injuries of Nerves" in October of 1864. This book contained the account of the symptoms and signs of peripheral nerve injuries as they had observed them in Union soldiers at Turners Alne Hospital for Nervous Diseases in Philadelphia. Their description of this condition is both classic and vivid:

“In our early experience of nerve wounds, we met with a small number of men [who] were suffering from a pain which they described as ‘burning’ or as ‘mustard red-hot’ or as ‘red-hot file rasping the skin’ ... The seat of burning pain is very various; but it never attacks the trunk, rarely the arm or thigh, and not often the forearm and leg.

“Its favored site is the foot or hand. In these parts it is to be found most often where the nutritive skin-changes are met with; ... Its intensity varies from the most trivial burning to a state of torture, which can hardly be credited, but which reacts on the whole economy, until the general health is seriously affected.

“The part itself is not alone subject to a deep burning sensation, but becomes exquisitely hyperesthetic, so that a touch or tap of the finger causes pain. Exposure to the air is avoided by the patient with a care which seems absurd, and most of the bad cases keep the hand constantly wet, finding relief in the moisture rather than the coolness of the application...

“As the pain increases, the general sympathy becomes more marked. The temper changes and grows irritable, and the face becomes anxious, and has a look of weariness and suffering. The sleep is restless, and the constitutional condition, reacting on the wounded limb, exasperates the hyperesthetic state so that the rattling of a newspaper, a breath of air, the step of another across the ward, the vibrations caused by a military band, or the shock of the feet in walking, gives rise to an increase of pain.

“Perhaps few persons who are not physicians can realize the influence which long continued and unendurable pain may have on both the body and mind. Under such torments the temper changes, the most amiable become irritable, the bravest soldier becomes a coward, and the strongest man is scarcely less nervous than the most hysterical girl.”

In 1994, the International Association for the Study of Pain (IASP), after development of consensus by a group of pain medicine experts, suggested that the term complex regional pain syndrome (CRPS) should replace Reflex Sympathetic Dystrophy (RSD) and causalgia - CRPS type 1 for CRPS, and CRPS type 2 for causalgia. There is considerable overlap involving these two conditions - most of the definition of CRPS I (CRPS) can be applied equally well to CRPS II (causalgia). The important distinction between the two for our purposes is this:

► **Complex Regional Pain Syndrome Type I (CRPS I)**

CRPS type I is frequently triggered by tissue injury; the term describes all patients with the above-mentioned symptoms but with no underlying nerve injury.

► **Complex Regional Pain Syndrome Type II (CRPS II)**

Patients with CRPS type II experience the same symptoms, but their cases are clearly associated with a nerve injury.

Today, it is frequently seen in personal injury or workers' compensation cases in which the individual sustains an injury to an extremity resulting in severe pain, muscle spasms, hypersensitivity, and vasomotor and skin changes. What is striking is that 1) the injury may seem relatively mild in contrast to the intensity of pain experienced; 2) the pain may not manifest itself until sometime after the injury; and 3) the pain travels or spreads beyond the injured area of the affected limb. These three factors may mislead the naive, uninformed therapist or evaluator to suspect that the individual's chronic pain is factitious in nature or that the individual is a malingerer. A complete review of the literature on CRPS, from the late 1800s to present, has not supported the notion that psychological factors or particular personality characteristics have been predisposing factors for the development of CRPS.

Early recognition of the disease, correct diagnosis, and proper treatment, are all essential in keeping CRPS from becoming a chronic condition. Treatment must begin within months of onset or else there will be a significant probability of long-term disability. Because there is no single test that correctly identifies the existence of CRPS in every patient the diagnosis must be made by the physician based on patient history and physical examination. It is essential to find a CRPS-educated physician to ensure an early and correct diagnosis.

Described as a burning or aching pain, the symptoms of CRPS persist long after the initial injury has healed, causing debilitating and continuous pain, and swelling, inflammation and hypersensitivity of the affected body part. The pain can be unrelenting and unbearable. A progressive disorder that gets worse over time, complex regional pain syndrome can leave sufferers unable to work and earn a living.

It is difficult to pinpoint the number of people who have CRPS, though some estimates put the number of people afflicted with this syndrome at 6 million in the United States and other

estimates claim between 5% and 10% of the population. CRPS is a major cause of disability, because only 20% of patients are able to fully resume prior activities. Investigators estimate that 2% to 5% of those with peripheral nerve injury and 12% to 21% of those with hemiplegia (paralysis of one side of the body) will suffer from CRPS.

CRPS occurs in both sexes and all ages but is reported to be more common in women (60% to 80% of cases) and although it is more common in the older age groups it often occurs in young to middle-aged adults. Risk may be somewhat greater for individuals with an existing neurological impairment such as carpal tunnel syndrome or for immobilized or chronically ill individuals.

Incidence and Prevalence: CRPS occurs in about 1% to 15% of all cases of peripheral nerve injury in conjunction with various fractures, sprains, and soft tissue injury. Incidence ranges from 10% to 30% after fractures and contusions. About 90% of individuals with CRPS have type I. Upper extremities are affected more than lower.

WHAT CAUSES CRPS?

Doctors aren't sure what causes CRPS. In some cases the sympathetic nervous system plays an important role in sustaining the pain. The most recent theories suggest that pain receptors in the affected part of the body become responsive to a family of nervous system messengers known as catecholamines. Animal studies indicate that norepinephrine, a catecholamine released from sympathetic nerves, acquires the capacity to activate pain pathways after tissue or nerve injury. Another theory is that post-injury CRPS (CRPS II) is caused by a triggering of the immune response, which leads to the characteristic inflammatory symptoms of redness, warmth, and swelling in the affected area. CRPS may therefore represent a disruption of

the healing process. In all likelihood, CRPS does not have a single cause, but is rather the result of multiple causes that produce similar symptoms.

Most often CRPS I is initiated by trauma to an extremity. Such injuries account for more than 90% of patients with CRPS I.

- Injuries precipitating the development of CRPS in decreasing order of frequency are as follows: (1) sprain/strain, (2) surgical wounds, (3) fractures, (4) contusion/crush injury, and (5) rarely, other injuries such as venipuncture, lacerations, burns, inflammatory processes, electric shock, and spinal cord injuries.
- Spontaneous cases/unknown causes account for approximately 5% of patients and often may be explained by minor injuries that have been forgotten.
- Unusual precipitating events supposedly accounting for CRPS I include visceral lesions, CNS lesions (e.g., stroke, tumors, brain injury, amyotrophic lateral sclerosis, meningitis, syringomyelia), peripheral vascular bypass procedures, arteriovenous graft for hemodialysis, carpal tunnel surgery, and spinal cord injury.

Other causes of CRPS include the following:

- Antituberculosis drug administration
- Barbiturate and other anticonvulsant drug administration
- Cardiac surgery
- Cerebrovascular disease with hemiplegia
- Cervical spine disease
- Convulsive disorder
- Fractures
- Hemiplegia

- Herpes zoster
- Hysterical personality
- Idiopathic
- Ischemic heart disease
- Nerve injuries
- Peripheral neuropathy
- Primary central nervous system disorders
- Pulmonary tuberculosis
- Rotator cuff lesions
- Spinal cord lesions
- Surgical trauma
- Trauma (sprains, lacerations, fractures, etc.)
- Tumors

SYMPTOMS

CRPS most often affects one of the extremities (arms, legs, hands, or feet) and is often accompanied by:

- Intense burning pain
- Pain from mechanical stimulation or movement
- Abnormally acute skin sensitivity to stimulus (hot, cold, touch, pressure)
- Abnormal sensitivity to sounds/vibrations
- Diminished sensitivity to stimulus (both can occur in the same patient)
- Changes in skin temperature: warmer or cooler compared to the opposite extremity
- Changes in skin color: often blotchy, purple, pale, or red

- Changes in skin texture: shiny and thin
- Changes in nail and hair growth patterns
- Increased pain and symptoms at night
- Reactions to weather changes
- Abnormal sweating
- Anxiety
- Depression
- Intolerance to stress
- Intolerance to noise
- Muscle atrophy
- Tremors
- Muscle weakness
- Muscle spasms
- Osteoporosis
- Swelling and stiffness in affected joints
- Motor disability, with decreased ability to move the affected body part
- Range of motion often is limited secondary to motor deficit and/or pain
- Miscellaneous - dizziness, tinnitus, agitation, irritability, and/or visual disturbances such as blurriness, dry eyes and others.

The onset of symptoms is usually within hours or days of the initiating event, but it could also be delayed for several weeks or even months. As is seen often in flexion/extension injury cases, the greater the delay of the onset of symptoms, the greater the skepticism over the genuineness of the condition and/or its cause. Many people believe that if you are truly injured

by a traumatic event you feel it right away; insurance adjustors have embraced this erroneous assumption not because they believe it (they do know better) but because they know that most jurors do.

Not all patients have all the signs or symptoms of CRPS. Some days are better than others for CRPS patients. The pain ebbs and flows in intensity, but at its worst it has been compared to the pain of a ruptured disc, or of childbirth. The symptoms vary in severity and length, and the pain often spreads to include the entire arm or leg, even though the initiating injury might have been only to a finger or toe. Pain can sometimes even travel to the opposite extremity.

There are generally considered to be three stages of CRPS, although they are certainly not mutually exclusive. They are marked by progressive changes in the skin, muscles, joints, ligaments, and bones of the affected area, although this progression has not yet been validated by clinical research studies. These stages may be difficult to recognize in some individuals, and not everyone goes through them.

Stage one commends at the time of injury but may be delayed for weeks. It is thought to last from 1 to 3 months and is characterized by severe, spontaneous burning pain, usually aggravated by movement of the extremity, along with muscle spasm, joint stiffness, rapid hair growth, and alterations in the blood vessels that cause the skin to change color and temperature.

Stage two lasts from 3 to 6 months and is characterized by intensifying pain that may radiate proximally or distally from the injured site, in addition to which there may be swelling, decreased hair growth, cracked, brittle, grooved, or spotty nails, softened bones, stiff joints, and weak muscle tone. The extremity is moist, cyanotic, and the skin cold and shiny.

In stage three the syndrome progresses to the point where changes in the skin and bone are no longer reversible. Pain becomes unyielding and may involve the entire limb or affected area. There may be marked muscle loss (atrophy), severely limited mobility, and involuntary contractions of the muscles and tendons that flex the joints. There may be continued hair loss, contorted limbs, and osteoporosis.

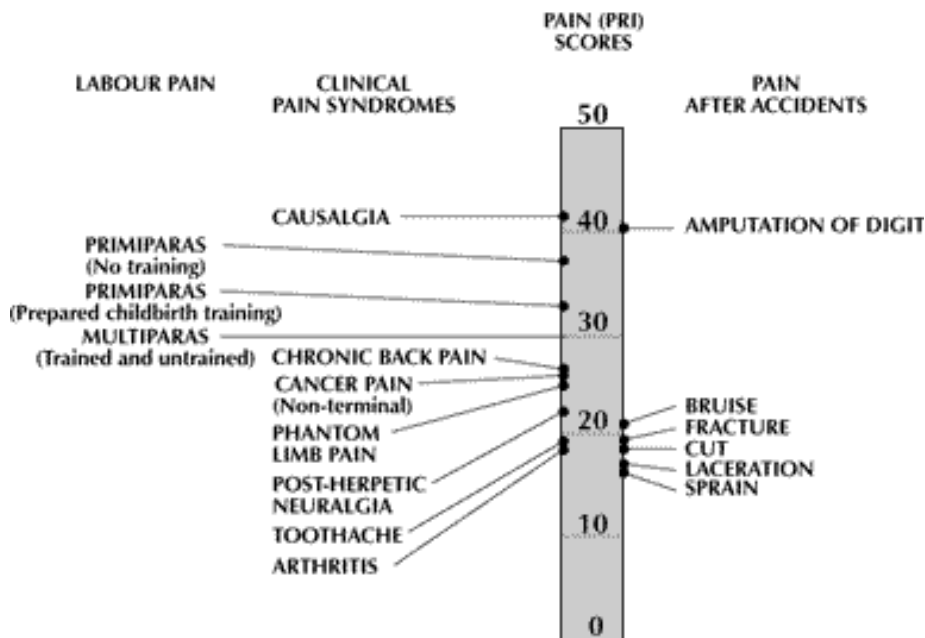
Pain is a constant feature throughout all stages of this condition. The pain that patients report is typically out of proportion to the severity of the injury and gets worse rather than better over time. This is somewhat counter-intuitive, since pain is usually considered proportional to the seriousness of an injury and is expected to decrease rather than increase over time. This feature is especially troubling to attorneys representing these victims: the same signs the physician sees as evidence of CRPS are seen by insurance companies as classic signs of false or highly exaggerated injury claims.

Because moving or touching the limb can often be intolerable, the joints can eventually become stiff from disuse with atrophy of the skin, muscles, and bone. The skin becomes drawn and the muscles and other tissues become wasted and contracted, in many cases permanently, and joint movement is greatly impaired. The pain is typically continuous and may be heightened by emotional stress, creating a continuing circle of pain causing stress causing more pain and so on.

The nature of this kind of pain can be difficult for insurance adjustors and juries to believe, particularly when the victim describes intense pain from such things as a breeze running over their skin, air conditioning, a light touch, or the brushing of clothing or bedding against the skin. It is frequently characterized as a burning, aching, searing pain, which may initially be

localized to the site of injury or the area covered by an injured nerve but spreads with time, often involving an entire limb.

In terms of intensity, the pain from causalgia (CRPS II) is rated 42 on the 50-point McGill Pain Index (see chart below). The McGill Pain Index is a 50 point scale established in 1971 to be used as a guideline to judge the quality of pain. This guideline is also used by many insurance companies and the Social Security Administration to determine disability benefits. Many doctors use the McGill Pain Scale as a reference for the appropriate types of pain medication to be administered to the patients. Reflex Sympathetic Dystrophy was added to the McGill Pain Index in 2001. The Social Security Administration added it to their schedule of disabilities in 2002.



DIAGNOSIS

CRPS is diagnosed primarily through observation of the signs and symptoms. But because many other conditions have similar symptoms, it can be difficult for doctors to make a firm diagnosis of CRPS early in the course of the disorder when symptoms are few or mild. Or,

for example, a simple nerve entrapment can sometimes cause pain severe enough to resemble CRPS. Diagnosis is further complicated by the fact that some people will improve gradually over time without treatment.

Since there is no specific diagnostic test for CRPS, the most important role for testing is to help rule out other conditions. Some clinicians apply a stimulus (such as touch, pinprick, heat, or cold) to the area to see if it causes pain. Doctors may also use triple-phase bone scans to identify changes in the bone and in blood circulation. Other criteria are sometimes employed with the observance of other factors, such as characteristic hand or arm positioning, signs of carpal tunnel syndrome, dystrophic skin changes, and muscle weakness suggestive of a neurological cause. Psychological or emotional factors may also be observed. However, CRPS remains a controversial diagnosis.

Early diagnosis of CRPS is considered essential for effective management of the syndrome before the development of any permanent disability. Because symptoms may vary dramatically among individuals, and also vary from day to day, the combination of the individual's medical record, self-reported symptoms, clinical observation, and supportive testing and diagnostic imaging will be needed to confirm a diagnosis of CRPS. Positive findings may support a diagnosis of CRPS but the absence of positive findings (e.g., negative results of x-ray, bone scan or sympathetic nerve block) does not necessarily rule out the condition.

History: The approach to diagnosing CRPS begins with a detailed medical history, with an emphasis on any recent injury, as well as prior illnesses and injuries. The individual may report intense, constant, burning pain that occurs without stimulation or movement, and beyond the territory of a single peripheral nerve, often with spreading of pain away from the original site (distally) or next to it (proximally). The pain is often disproportionate to the inciting event.

Physical signs and symptoms may be described by the individual as coming and going. A limb may be normal temperature one moment and cold the next, making the patient's self-reported history an important diagnostic tool.

Physical exam: Clinical signs of CRPS found on physical examination should satisfy diagnostic criteria for CRPS adopted by the International Association for the Study of Pain (IASP) in 1994, stated as follows:

(1) the presence of an inciting noxious event (or nerve injury for type II) or a cause of immobilization (although not required for diagnosis since 5% to 10% of patients will not have this);

(2) continuing pain, allodynia, or hyperalgesia in which pain is disproportionate to any known inciting event;

(3) evidence at some time of edema, changes in skin blood flow, or abnormal sudomotor activity in the region of pain (sign or symptom);

(4) the recognition that this diagnosis is excluded by the existence of other conditions that would otherwise account for the degree of pain and dysfunction.

The IASP advises further that if the condition is seen without major nerve damage, it should be diagnosed as CRPS I, whereas if it is seen with major nerve damage, it should be diagnosed as CRPS II.

Laboratory Studies:

- No specific blood workup is indicated for CRPS I. The following tests are used for routine screening to rule out infections or rheumatologic disease:
 - CBC
 - Complement fixation

- Erythrocyte sedimentation rate
- Antinuclear antibody
- Rheumatoid factor

Imaging Studies:

- Plain radiographs show patchy demineralization of the epiphyses of long bones and also of the bones of the hands and feet. These findings cannot be appreciated until the syndrome is advanced. The sensitivity and specificity have been reported to be 69% and 71%, respectively.
- Three-phase bone scanning enables evaluation of total extremity perfusion, which typically is increased in stage 1, normalized in stage 2, and decreased in stage 3. The sensitivity and specificity are reported to be 60% and 86%, respectively.

Other Tests:

- Thermography has a debatable value in the evaluation of CRPS I.
- EMG/NCS can help differentiate early phases of CRPS type 1 and type 2.
- Quantitative sudomotor axon reflex test demonstrates abnormal function of sudomotor reflex loops in CRPS. Abnormal findings on this test are highly predictive of a positive response to sympathetic blocks.
- Laser Doppler flowmetry may demonstrate changes in the skin blood flow.

Differential Diagnoses:

- Alcohol (ethanol) related neuropathy thoracic outlet syndrome
- Diabetic neuropathy
- Toxic neuropathy

- Lyme Disease
- Traumatic peripheral nerve lesions
- Median neuropathy
- Ulnar neuropathy
- Neurosarcoidosis
- Nutritional neuropathy
- Peroneal mononeuropathy

Other Problems To Be Considered:

- Chronic arterial insufficiency
- Hysterical conversion
- Irritative lesions of peripheral nerve
- Malingering
- Neurotic compulsive postures
- Peripheral nerve entrapment
- Peripheral nerve neuroma
- Phlebothrombosis
- Plexopathies
- Polyneuropathies
- Raynaud disease
- Rheumatologic disease
- Soft-tissue infection

TREATMENT

This is no cure for CRPS, but treatment in the first three to six months after onset with nerve blocks, medications and physical therapy has been reasonably effective. After six months treatment becomes more difficult and there is a diminishing success rate the longer the condition goes untreated.

Because there is no cure for CRPS, treatment is aimed at relieving painful symptoms so that people can resume their normal lives. The following therapies are often used:

- Physical therapy: A gradually increasing exercise program to keep the painful limb or body part moving may help restore some range of motion and function. Weight bearing, range of motion, and strengthening exercises are necessary to bring the patient back to recovery.
- Psychotherapy: CRPS often has profound psychological effects on people and their families. Those with CRPS may suffer from depression, anxiety, or post-traumatic stress disorder, all of which heighten the perception of pain and make rehabilitation efforts more difficult.
- Sympathetic nerve block: Some patients will get significant pain relief from sympathetic nerve blocks, also called Lumbar Blocks, Cervical Blocks, Bier Blocks, and more. They are used to administer medication directly on the spine in an attempt to reduce nerve activity. Sympathetic blocks can be done in a variety of ways. One technique involves intravenous administration of phentolamine, a drug that blocks sympathetic receptors. Another technique involves placement of an anesthetic next to the spine to directly block the sympathetic nerves.
- Medications: Many different classes of medication are used to treat CRPS:

- analgesic drugs that act locally on painful nerves, skin, and muscles
- antiseizure drugs
- antidepressants: originally used only to treat depression, studies have shown that these medications can alleviate pain in certain situations.
- corticosteroids
- non-steroidal anti-inflammatory drugs (NSAIDs)
- anticonvulsants
- antispasmodics
- antidepressants
- anti-hypertensives
- vasodilators

However, no single drug or combination of drugs has produced consistent long-lasting improvement in symptoms.

- Surgical sympathectomy: The use of surgical sympathectomy, a technique that destroys the nerves involved in CRPS, is controversial. Some experts think it is unwarranted and makes CRPS worse; others report a favorable outcome. Sympathectomy should be used only in patients whose pain is dramatically relieved (although temporarily) by selective sympathetic blocks.
- Spinal cord stimulation: The placement of stimulating electrodes next to the spinal cord provides a pleasant tingling sensation in the painful area. This technique appears to help many patients with their pain.
- Intrathecal drug pumps: These devices administer drugs directly to the spinal fluid, so that opioids and local anesthetic agents can be delivered to pain-signaling targets in the

spinal cord at doses far lower than those required for oral administration. This technique decreases side effects and increases drug effectiveness

While medications can be helpful, there is no single proven treatment for CRPS. The most important intervention appears to be appropriate, aggressive, active and passive physical therapy with cognitive behavioral therapy as part of the treatment plan. Other modalities may be used but a coordinated functional restoration approach is critical.

The duration and intensity of rehabilitation varies among individuals. CRPS may take up to 1 to 2 years to resolve, and it is not uncommon for residual deficits to persist. The first goal of rehabilitation during the inflammatory stage is to decrease pain and swelling of the affected body part. In combination with pharmacological management, thermal modalities can be used to relieve symptoms. During this stage, some common findings associated with CRPS may include local discoloration, sweating, and changes in hair distribution.

Once pain and swelling have decreased, the second goal is to prevent any loss of functional ability and possibly to improve function. Rehabilitation should include gentle range of motion and strengthening exercises, progressed according to the individual's tolerance. Efforts should be made to promote full range of motion and prevent contractures. In addition to supervised rehabilitation, individuals should be instructed in an independent home exercise program to be performed daily.

If a functional deficit is evident the individual may be evaluated for assistive devices. A home assessment may be beneficial to determine the need for modifications. An ergonomic evaluation may help to maintain the individual's employment status.

The more extreme interventions, with nerve stimulators, for example, are a relatively recent development. In some cases the results are tremendous, and in others the technique doesn't succeed.

PROGNOSIS

What is the prognosis? The prognosis for persons with CRPS varies from person to person. Remission from symptoms occurs in certain individuals; others have unremitting pain and crippling, irreversible damage in spite of treatment. About 30% of individuals will have spreading of symptoms to other extremities and ongoing musculoskeletal discomfort due to changes that occur with dysfunction of one limb. Research suggests that prognosis improves with early treatment. Long duration of symptoms and signs, the presence of trophic changes, and the presence of primarily cold CRPS are associated with higher chances of poor outcome and disability.

- Approximately 80% of the patients with CRPS type 1/CRPS have complete spontaneous relief of signs and symptoms within 18 months. However, no criteria have been established to predict from the very beginning who will have a spontaneous cure and who will not. Some of the patients whose symptoms do not resolve spontaneously still may be cured by treatment.
- Of patients who develop refractory CRPS type 1/CRPS, 50-80% have disability secondary to pain and/or limited range of motion. The main disabilities are limitations in activities of daily living (ADL).

Will CRPS go into remission? Unfortunately, not very likely. The incidence of remission is extremely low. It is highest for teens, especially if they are diagnosed within 1 to 12 months and treated aggressively. For adults, the need for quick diagnosis is even more urgent;

within the first 3 to 6 months is imperative and that must be followed with aggressive therapy. For some, their pain goes away completely but they still need the medication to keep it away. Newer treatments, especially the ketamine infusion in-hospital 5 day awake technique, are proving successful in more than half of the patients treated and many are experiencing complete pain relief for up to 1 to 2 years or more. As the study of CRPS continues and more is learned the hope is that more patients will be able to experience longer periods of pain relief.