Fundamentals of ORTHOPEDIC PHYSIOTHERAPY

A Simplified Approach, Rationale and Rehabilitation

Previously Known as
Simplified Approach to Orthopedic Physiotherapy Rationale and Rehabilitation

Mukesh Sharma

2nd Edition

JAYPEE

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CHAPTER

Complex Regional Pain Syndrome

INTRODUCTION

Complex regional pain syndrome (CRPS) is a chronic and progressive neuroinflammatory condition characterized by a group of symptoms including severe burning pain, tenderness, swelling, warmth or coolness, stiffness, and discoloration of the skin of an extremity. Initially, it may affect a single extremity, but gradually, it spreads throughout the body **(Fig. 13.1)**.

It is also known as **reflex sympathetic dystrophy, causalgia, shoulder-hand syndrome, Sudeck's reflex neurovascular dystrophy, posttraumatic pain syndrome, algodystrophy, neurodystrophy, post-traumatic dystrophy, and transient migratory osteoporosis**.

Fig. 13.1: Complex regional pain syndrome.

Epidemiology

- Females are more affected than males, with a ratio of 3:1.
- Usually appears between 40 and 60 years old.
- It may affect any region, but the extremities are more often affected. In adults, the upper limb is more affected than the lower limb.
- It may appear unilateral or bilateral.
- In type I CRPS, 91% of cases occur post-surgically, and only 5% of cases are post-traumatic.

Etiology

The specific etiology is unknown; however, the symptoms commonly appear after:

- **Trauma:** Any accidental injuries, such as sprains, fractures, crush injuries, or cuts.
- **Surgical trauma,** such as the excision of tumors, scarring, and organ manipulation.
- **Disease:**
  - **Visceral disease,** such as myocardial infarction.
  - **Neurological diseases,** such as tumors, brachialgia, cerebrovascular accidents, and nerve entrapment.
  - **Vascular diseases**, such as atherosclerotic conditions.
  - **Musculoskeletal diseases,** such as degenerative muscle and bone disorders.
  - **Drugs** such as TB medications and barbiturates.

Pathophysiology

There is no single pathophysiological mechanism that can explain the diversity and heterogeneity of symptoms. Therefore, it is now accepted that multiple mechanisms are

involved, and the presentation depends on the relative contribution of each mechanism. Pathophysiological mechanisms believed to contribute to CRPS include altered cutaneous innervation, central and peripheral sensitization, neurogenic inflammation, an increased level of local and systemic inflammatory cytokines, a lower systemic level of anti-inflammatory cytokines, sympathetic nervous system overactivity, and genetic and psychological factors.

Types of CRPS

CRPS type I: It accounts for 90% of all instances. It is traumatic in origin and develops after a noxious event such as a fracture, sprain, or other injury. It has two subtypes:

1. **Major:** It occurs after any skeletal injuries, such as fractures.
2. **Minor:** It occurs after soft tissue injuries such as sprains and strains.

CRPS type II: It is also known as **"Causalgia."** It develops after a nerve injury. It has two subtypes:

1. **Major:** It occurs due to the involvement of mixed nerves.
2. **Minor:** It occurs due to the involvement of sensory nerves.

Clinical Presentation (Fig. 13.2)

- **Due to sensory disturbances:**
  - *Hypersensitivity:* The patient may experience sensations like allodynia (pain from a stimulus that normally does not provoke pain), hyperalgesia (increased sensitivity to pain), hyperpathia (abnormal pain response to a stimulus, especially repetitive, repetitive stimulus), paresthesia (an abnormal sensation, such as numbness, burning, tingling or pins and needle sensation), or hyperaesthesia (increased sensitivity to a stimulus includes allodynia and hyperalgesia).
  - *Pain:* Patients often complain of severe, constant, or burning pain.
    - The intensity of the pain is disproportionate to the inciting event.
    - Pain increases with dependent positions, activities, physical conditions, or emotional disturbances.

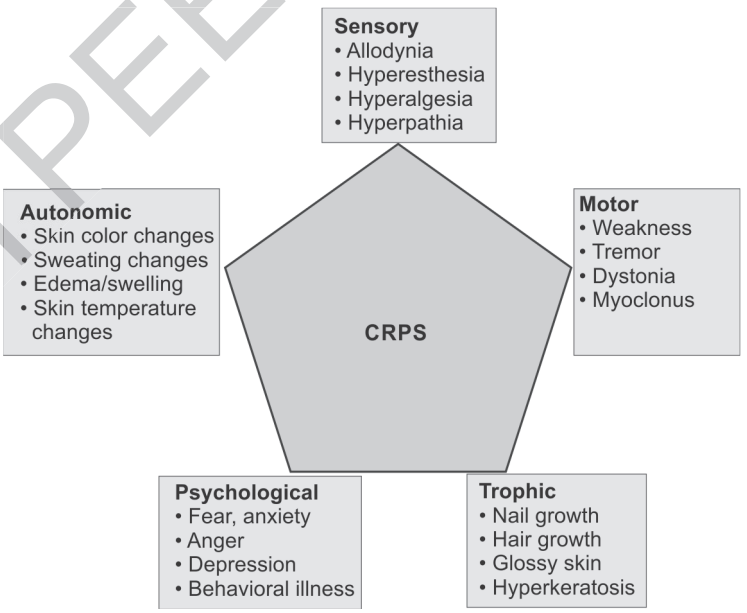

Fig. 13.2: Symptoms of CRPS.

- **Due to autonomic dysfunction:**
  - *Swelling:* Swelling may be localized or generalized, fusiform or hard.
  - *Asymmetry of skin temperature:* The skin of the affected extremity becomes warm and sweaty at times and cold and clammy at others.
  - *Asymmetry of skin color:* Skin may become pale to pink or even bluish in color.
  - *Asymmetry of sweating:* The patient may experience changes in sweating like hyperhidrosis or dryness of the affected extremity.
- **Due to motor dysfunction:**
  - Muscle weakness or atrophy of the affected extremity.
  - The patient may experience tremor, dystonia, and coordination deficits.
  - The patient may experience decreased ROM of the affected extremity due to increased stiffness.
- **Trophic changes:**
  - The patient may have thick, brittle, or rigid nails.
  - The skin of the affected extremity becomes thin and glossy.
  - The patient may have increased or decreased hair growth.

Stages of Progression

Stage I: Acute Inflammatory Phase (Lasts for 0–3 months)

- **Pain:** Constant burning and severe pain, along with hypersensitivity.
- **Edema:** Soft and localized edema.
- **Skin temperature:** Asymmetry of skin temperature switching between warm or cold.
- **Skin texture and color:** Skin progressively becomes blotchy, purple, pale, or red, thin, shiny, and sweaty.
- **Hair and nail growth:** Faster hair and nail growth.
- Presence of muscle spasm and joint pain.
- **X-ray:** Patchy bone thinning.

Stage II: Dystrophic Phase (Lasts for 3–9 months)

- **Pain:** More marked pain and sensory disturbances.
- **Edema:** Edema becomes hard and causes joint stiffness.
- **Skin changes:** Continued skin changes.
- **Hair and nail growth:** Slower hair growth and thin and rigid nails that crack or break easily.
- Muscle weakness and joint stiffness.
- **X-ray:** Cortical thinning and subchondral bone erosion represent osteoporosis.

Stage III: Atrophic Phase (Lasts for 9–18 months)

- **Pain:** Pain spreads proximally and occasionally to the entire body.
- **Edema:** The hardening of edema occurs gradually.
- **Skin changes:** Skin becomes dry, cooler, thin, shiny, and cyanotic.
- Fingertips and toes become atrophic, and a possible contracture may present.
- Restricted joint ROM because of tightened muscles and tendons (contracture)
- Muscle wasting
- **X-ray:** Demineralization and ankylosis of bones

Diagnosis

A clinical diagnosis is based on the patient's signs and symptoms.

Budapest Clinical Diagnostic Criteria for CRPS: It is a diagnostic guideline used for the diagnosis of CRPS. Budapest criteria differentiate between signs that are seen or felt by the person carrying out the examination and symptoms that are reported by the patient.

The following criteria must be met in order to make a clinical diagnosis:

- Continuing pain, which is disproportionate to any inciting event.
- The patient must report one symptom in three of the following four categories:
  - *Sensory:* Report of hyperesthesia and/or allodynia.
  - *Vasomotor:* Report of temperature asymmetry and/or skin color changes and/or skin color asymmetry.

  - *Sudomotor/edema:* Report of edema and/or sweating changes and/or sweating asymmetry
  - *Motor/trophic:* Report of decreased ROM and/or motor dysfunction (weakness, tremor, dystonia) and/or trophic changes (hair, nail, skin).
- Must display at least 1 sign at the time of evaluation in 2 or 3 or more of the following categories:
  - *Sensory:* Evidence of hyperalgesia (to prick) and/or allodynia (to light touch and/or deep somatic pressure and/or joint movement).
  - *Vasomotor:* Evidence of temperature asymmetry and/or skin color changes and/or skin color asymmetry.
  - *Sudomotor/edema:* Evidence of edema and/or sweating changes and/or sweating asymmetry.
  - *Motor/trophic:* Evidence of decreased ROM and/or motor dysfunction (weakness, tremor, dystonia) and/or trophic changes (hair, nail, skin).
- Finally, it is important that there should be no other diagnosis that better explains the signs and symptoms.

Management

Conservative Treatment

- **NSAIDs** (ibuprofen) **and COX-2 inhibitors** (celecoxib) **are used** to reduce pain and inflammation in the acute stage.
- **Analgesics** like opioids (acetaminophen) are used for severe pain.
- **Antidepressants** (amitriptyline) **or anticonvulsants** (dilantin) help to manage nerve pain and sleep disturbances.
- **Corticosteroids** help reduce pain and inflammation.
- **Bone loss prevention medications,** such as calcium modulating drugs (calcitonin), bisphosphonates (alendronate), etc.
- **Regional anesthesia technique:** This technique is used in patients with moderate to severe pain who do not respond to pharmacological treatment. It involves blocking the activation of sympathetic nerves along the spine. The sympathetic nervous system mostly regulates unconscious actions such as heart rate, blood flow, and sweating. To inhibit the local activity of the sympathetic nervous system, a local anesthetic drug is injected around the sympathetic neural structures that serve the affected limb(s), such as the stellate ganglion (for the upper extremity) or the lumbar sympathetic chain (for the lower extremity).
- **Spinal cord stimulation technique:** Spinal cord stimulation (SCS) is often considered a pain treatment option when conservative or less invasive therapies prove ineffective. In this technique, an SCS electrode is implanted in the epidural space of the spinal canal through a percutaneous approach or surgical laminotomy, and low intensity electrical pulses are delivered that help inhibit pain.

Physiotherapy Treatment

Acute Phase

Immobilization of the affected limb and contralateral therapy should be initiated in the acute phase due to marked pain and hypersensitivity. Intensive, aggressive treatment in the acute phase may worsen the condition.

Chronic Phase

- **For pain relief:** Pain must be controlled before progressing to other treatment techniques.
  - TENS
  - Heat or cold application
  - Contrast bath
  - Whirlpool therapy has a soothing and relaxing effect and controls vasomotor function.
  - Relaxation technique.
- **To decrease edema:**
  - Ultrasound is used to reduce inflammation and break down adhesions.
  - Elevation of the limb is advised because it helps reduce arterial hydrostatic pressure and assists lymphatic and venous drainage.

- Light self-adhesive compression wraps or compression garments
- Active ROM exercises
- *Caution:* The therapist should avoid passive retrograde massage and passive ROM initially, as they may induce an inflammatory response that can worsen the condition.

- **To maintain joint ROM and prevent stiffness:**
  - **Active ROM** activities should focus on improving function with the affected hand (such as drinking from a cup, turning the knob of a door, or using a knife) and with the affected leg (such as walking or stair climbing).
  - **Strengthening exercises** should be initiated following the restoration of ROM and reduction in muscle guarding.
- **Sensory integration training:**
  - *Left-right discrimination:* CRPS patients gradually lose the capacity to distinguish between left and right. In rehabilitation, static and motion images of different parts of the body are shown, and the patient is asked to identify left and right.
  - *Motor imagery program:* It is a mental process in which an individual rehearses or simulates a given action in his mind without actually performing the movement. It helps reduce pain and improve ROM and strength.
  - *Mirror visual feedback therapy:* In CRPS, reduced movement of the affected limb due to pain alters the sensory feedback from the limb, resulting in a cortical reorganization of the body's representation in the brain that causes pain. In mirror therapy, this reorganization is changed by alternative sensory input using visual illusions, thereby decreasing pain. In this therapy, a mirror is used to get visual feedback. For example, in hand therapy, the affected hand is placed behind the mirror. The non-affected hand is then moved, and the patient receives visual feedback that both hands are moving without pain. This therapy helps with cortical reorganization.
  - *Body perception awareness:* In CRPS, the patient lacks awareness about the affected part of the body. Because of severe and persistent pain in the affected limb, the patient exhibits symptoms of neurological neglect, expresses negative emotions about the affected limb, pays little attention to the limb, and feels that the limb is not part of his body. In Body Awareness Therapy, patients are encouraged to look, feel, and think about the affected limb in order to increase their awareness of the affected limb and to perceive it as a normal part of the body.
- **For the desensitization of hypersensitive areas:** Desensitization is the systematic application of non-noxious stimuli to peripheral tissues in order to retrain the nervous system. This involves gradually exposing the affected area to different sensations over time. This helps the brain acclimate to the sensations, retraining the nervous system and thereby reducing pain and associated symptoms. Techniques that can be used in desensitization therapy include:
  - *Touch stimulation*—giving stimuli of different pressure (light or deep), temperature (hot or cold), and with different fabrics (cotton, silk, etc.).
  - Dipping the affected area in the bowl of dry rice, sand, kidney beans, etc.
  - *Electrical stimulation*—initiate with mild intensity and gradually progress to more intense stimulation to decrease the sensitivity of the area.
  - *Massage* like tapping or percussion.
  - *Contrast bath:* Place the painful part in cold water for 30 seconds, then warm water for 2 minutes, and repeat the process for 5 minutes.

- **Stress loading program:** This approach involves loading the affected limb to tolerance and progressively increasing the frequency and duration to allow the neural system to acclimatize to the stimuli. This acclimation gradually desensitizes the hypersensitivity and allows the nervous system to reset itself, allowing the stimulus to be perceived as a normal sensation. Stress-loading programs consist of two components: scrubbing and carrying. These activities load the affected limb and provide inhibitory proprioceptive inputs to the nervous system.
  1. *Scrubbing:* It applies constant force to the affected area for a progressively increasing period of time. Scrubbing for the upper limb is given using a towel or scrub brush, and scrubbing for the lower limb is given by wearing socks or by a deck brush fixed by a strap.
  2. *Carrying:* It involves loading the affected limb by carrying a weighted object for an extended period of time. For the upper limb, carrying a heavy bag is effective here, just as for the lower limb, loading can be done by weight bearing and walking.

Surgical Treatment

Surgical procedures have no place in the treatment of CRPS, as studies have not yet demonstrated the effectiveness of surgery (and chemical sympathectomy) in CRPS. Furthermore, these techniques are linked to significant problems, and as a result, they are not currently indicated in the treatment of CRPS. Surgery, on the other hand, can help with the treatment of nerve-related nociceptive foci.

Surgical Interventions

- **Surgical repair or release:** The surgeon has to carefully examine the nerve, the underlying tissue bed, and the overlying skin/scar. The nerve should be thoroughly examined using an extensible incision and should be free of all adhesions. In patients with secondary compression neuropathies, the affected nerve should be completely released. Internal neurolysis should be avoided. In patients with a nerve transection or a neuroma-in-continuity, a tension-free repair should be performed, and nerve grafts should be utilized if necessary. A scarred bed can be resurfaced using local fat, muscle, or fascial flaps. A Z-plasty, local transposition flaps, or a distant flap can be used to treat adhesions between the skin and the nerve.
- **Surgical or chemical sympathectomy:** A sympathectomy is a destructive procedure that disrupts the sympathetic nervous system. The use of chemical and surgical sympathectomy in the management of CRPS has an extremely high rate of failure and is based on very little high-quality evidence. In clinical practice, sympathectomy should be used with caution in carefully selected patients and perhaps only after other treatment options have failed. Chemical sympathectomies use alcohol or phenol injections to destroy sympathetic nervous tissue (the so-called "sympathetic chain" of the nerve ganglia). Surgical ablation of the sympathetic chain is performed either through open removal or electrocoagulation (tissue destruction with high-frequency electrical current) or through minimally invasive methods, including thermal or laser ablation.

Fundamentals of
ORTHOPEDIC PHYSIOTHERAPY
A Simplified Approach, Rationale and Rehabilitation

Fundamentals of Orthopedic Physiotherapy: A Simplified Approach, Rationale and Rehabilitation is a classical textbook on orthopedic physiotherapy and rehabilitation that is drafted to satisfy the quest for knowledge on clinical orthopedic conditions.

The second edition of the book has been organised based on the physiotherapy course curricula for both undergraduate and postgraduate students. The comprehensive overview of the musculoskeletal condition, as well as its assessment, investigations, medical/surgical treatment, conservative or postoperative physiotherapy, and rehabilitation, has been developed in accordance with recent advancements in clinical orthopedic physiotherapy.

In addition to being a valuable academic tool for students during exams, this book can also serve as a valuable reference for clinical physiotherapists. Numerous illustrations, flowcharts, and pictorial presentations have been utilized to help the reader comprehend the concepts effectively. Additionally, the simple language employed makes this otherwise complex topic accessible even to inexperienced readers.

Encompassing a wide range of orthopedic conditions, such as soft-tissue injuries, fractures, postural deformities, arthropathies, spinal disorders, peripheral nerve injuries, and amputation, categorized into different sections, such as epidemiology, etiology, pathogenesis, clinical presentations, investigations, and physical examination with specialized tests, provides essential knowledge and skills for planning appropriate management. This book is certain to prove to be a rational fundamental basis of orthopedic physiotherapy for future physiotherapists.

Mukesh Sharma BPT MPT (Musculoskeletal Disorders) MIAP has drafted the book titled *Fundamentals of Orthopedic Physiotherapy: A Simplified Approach, Rationale and Rehabilitation*. Born in "1981" to an army family, grit and confidence are her natural attributes. She has done her Masters in Musculoskeletal Disorders from HNB Garhwal University in 2005. She is a life member of IAP. She is also the Board Member at Pt Bhagwat Dayal Sharma University of Health Sciences, Rohtak, Haryana, along with being an Examiner at Guru Jambheshwar University of Science and Technology, Hisar, Haryana. She has been in academics and clinical Physiotherapy for around 20 years. Her vast encounter with patients having a variety of musculoskeletal conditions, coupled with years of academic teachings, has been the very basis of her extensive knowledge and grasp over the subject of orthopedic physiotherapy. She believes in updating her knowledge by attending national and international conferences, workshops, and seminars. Her keen interest in evidence-based physiotherapy practice has also triggered her to pursue clinical research. She has published many research papers and articles in reputed national and international journals. She is also the author of the books *Essentials of Exercise Therapy, Fundamentals of Amputation and its Rehabilitation* and *High Tens or Low Tens—What Works Better*.

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