The case:

A 25-year-old man presented with pain and stiffness in his right knee. He sustained a severe back injury 4 months prior to presentation. Plain radiographs were obtained (Figure 1).

Figure 1: AP (A) and lateral (B) radiographs.

Your diagnosis?

For answer see page 334
**Diagnosis:**

Reflex sympathetic dystrophy syndrome.

Jason McGill, MD*; Charles Wilson, MD†; W. Cameron Wright, MD*; Harry J. Griffiths, MD*

Clinical Findings

Reflex sympathetic dystrophy (RSD) is a controversial syndrome consisting of chronic neuropathic extremity pain disproportionate and remote to an inciting injury. Pain is spontaneous or manifest as hyperalgesia and allodynia. Motor, vasomotor (ie, skin color, temperature changes), pseudomotor (hyperhidrosis), and trophic (nail hypertrophy, hair changes) abnormalities usually are associated. The majority of cases are associated with trauma, surgery, or tissue injury such as stroke, myocardial infarction (shoulder hand syndrome), frostbite, or burn. More recently, RSD has alternatively been called complex regional pain syndrome (CRPS) type I. Unlike causalgia, or CRPS type II, no overt nerve injury is associated with RSD. Despite an abundance of research on RSD, pathophysiology, diagnostic criteria, and treatment remain unclear.

Numerous theories as to the pathophysiology of RSD have been proposed. At least some component of RSD is believed to occur from a reflex sympathetic response with abnormal coupling between sympathetic efferent postganglionic neurons and primary afferent nociceptors; however, this has yet to be scientifically proven. Indirect evidence indicates that RSD is sympathetically mediated such as increased density of alpha-adrenergic receptors in hyperalgesic skin, and sympathectomy for symptom relief has been reported. Additionally, a central component is thought to exist as evidenced by abnormal sympathetic vasoconstrictor response in the contralateral normal extremity and hyperhidrosis, which is under central control. An inflammatory etiology also is possible, as increased permeability of macromolecules from the vasculature, especially in patients with RSD for <5 months.

Due to the lack of sufficiently specific diagnostic tests, determination of RSD has been primarily clinically based. The current standard of diagnosis is based on a consensus of criteria determined by the International Association for the Study of Pain (IASP) (Table). However, the specificity of the IASP criteria has been questioned and a more stringent set of criteria has been...
offered in which signs and symptoms are divided into separate categories and sensory, vasomotor, pseudomotor/edema, and motor/trophic changes are each requisite. Yet, interobserver reliability using IASP or modified criteria may still be suboptimal and the sensitivity of the latter may be too low to be prudent in clinical practice.

A recent population-based study found the incidence of RSD to be 5.46 per 100,000 person years based on IASP criteria. Use of the modified criteria would have excluded 57% of those initially diagnosed. Mean duration was 11.6±12.4 months with a 74% resolution rate. Additionally, several similarities were noted compared to a large prospective analysis: median age was 42-46 years with a 3:4:1 female predominance and a 3:2 to 2:1 upper versus lower extremity predominance.

Reflex sympathetic dystrophy has been described to progress through three distinct stages: an acute, warm phase associated with increased vascularity and warm skin; a dystrophic phase associated with skin thickening, nail hypertrophy, and osteoporosis; and a cold, atrophic phase with further decreased muscle mass, vascularity, and bone density. However, no association exists between symptom duration and the degree of osteoporosis. Veldman et al found 13% of RSD cases began with a cold extremity and separate warm and cold subtypes.

**Imaging Studies**

**Plain Radiographs**

Five types of bone resorption have been described in RSD: trabecular, subchondral, subperiosteal, intracortical, and endosteal. Trabecular resorption in the metaphyses of affected bones with the subsequent appearance of periarticular osteopenia is classic. Periarticular osteopenia may appear similar to plain radiographic findings in primary inflammatory synovial arthritis but can be distinguished by preservation of joint space and lack of significant intra-articular erosions. Spotty or diffuse osteopenia was found increasingly in patients with RSD as the disease duration increased and was positive in 52% when RSD duration was >12 months. One prospective study found that fine-detail radiographs demonstrated asymmetric demineralization in 69% of patients with a definite, probable, or possible clinical diagnosis of RSD and rose to 81% when only patients with a definite diagnosis were considered. However, osteopenia as seen in RSD may be more aggressive and rapid in progression, distinguishing it from disuse osteopenia; furthermore, exercise fails to reverse and may exacerbate RSD.

Computed tomography confirms these findings (Figure 2).

**Three-Phase Bone Scan**

Three-phase bone scan sensitivity ranges between 50% and 100%. This wide variation is believed to be primarily due to different clinical criteria for the diagnosis of RSD. Other suspected causes include symp-
Magnetic Resonance Imaging

Early attempts at characterizing magnetic resonance imaging (MRI) findings in RSD suggested that evidence of marrow edema seen on MRI might effectively exclude RSD. Schweitzer et al.\(^\text{13}\) reported that of their 45 clinically confirmed cases of RSD, none demonstrated bone marrow edema. However, skin thickening and contrast enhancement were found in 31 of 35 patients with the warm phase of RSD. Synovial effusion may increase the sensitivity of MRI early in RSD.

More recent studies have found that short T1 inversion recovery (STIR) and fat saturation T2 spin echo sequences are more sensitive in identifying marrow edema in the warm form of RSD\(^\text{12}\) (Figure 4). In one retrospective study, periarticular marrow edema on STIR was 100% sensitive in detecting the warm form of RSD involving the lower extremity.\(^\text{12}\) Additionally, soft-tissue thickening was present in 67% and joint effusion in 49% of those cases. The cold form demonstrated no MRI abnormalities. Post-contrast imaging was not useful when STIR was used. Unfortunately, as no apparent control group was used in this study, specificity was not determined but was believed to be low.\(^\text{12}\)

**References**


**Figure 3:** Bone scan in a patient with the typical patchy uptake seen in RSD following a minor injury to the left ankle.

**Figure 4:** Coronal (A) and sagittal (B) T2-fat saturation sequences showing patchy increase in density in most of the visualized bones typical of RSD seen in a patient with a minor ankle injury.

**radiologic case study**