Early Use of Regional and Local Anesthesia in a Combat Environment May Prevent the Development of Complex Regional Pain Syndrome in Wounded Combatants

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Complex regional pain syndrome (CRPS) is a relatively common disabling disorder of unknown pathophysiology. CRPS is a variable symptom complex that probably results from multiple causes through different pathophysiological mechanisms. Changes in peripheral, central, somatosensory, autonomic, and motor processing, accompanied by pathological interactions of sympathetic and afferent systems, are observed as underlying mechanisms. Standardized early interventions for patients with extremity wounds may prevent the onset of CRPS or at least reduce the severity or duration of the condition.

Introduction

Complex regional pain syndrome (CRPS) may develop as a disproportionate consequence of trauma affecting the limbs, without nerve injury (CRPS I or reflex sympathetic dystrophy) or with obvious nerve injury (CRPS II or causalgia). In the 18th century, Ambroise Pare presented the earliest description of CRPS, with severe burning pain following peripheral nerve injury, and Mitchell termed the condition causalgia (which means burning pain) in describing persistent symptoms following gunshot wounds to peripheral nerves in the U.S. Civil War in 1864. A significant number of extremity injuries are being seen in association with Operation Iraqi Freedom and Operation Enduring Freedom, which may lead to an increased number of patients with CRPS.

As of November 16, 2004, a total of 10,726 service members had suffered war injuries in Operation Iraqi Freedom. Of these, 1,361 died (1,004 were killed in action), 5,174 were wounded in action and could not return to duty, and 4,191 were less severely wounded and returned to duty within 72 hours. Blast injuries from improvised explosive devices are producing an unprecedented number of mangled extremities, with severe soft tissue, bone, and often vascular injuries. Since CRPS was first described in the 17th century, the medical community has attempted to understand and to treat this complex condition. The preponderance of early descriptions of the condition involved extremity wounds. The pathophysiology of the CRPS remains elusive, but most recent studies have shown a central mechanism for both the sensory features and the autonomic features. Peripheral mechanisms include tissue acidosis and neurogenic inflammation. Involvement of the immune system could imply the subsequent release of neuropeptides and proinflammatory cytokines, leading to complex cross-communication among primary and secondary mediators of inflammation.

Sources report the incidence of causalgia (CRPS II) after injury to a peripheral nerve as 1 to 5%. The incidence of reflex sympathetic dystrophy (RSD) (CRPS I) is 1 to 2% after various fractures and 2 to 5% after peripheral nerve injury. It is difficult to estimate, however, because the literature contains studies in which clinical criteria for the diagnosis of CRPS vary dramatically. For example, upper-extremity CRPS, as understood and treated by hand surgeons, is described differently than lower-extremity CRPS diagnosed by rheumatologists or hip CRPS described by obstetricians. Some authors suggest that 8 to 10% of patients with fractures develop CRPS, but the frequency is much lower in studies. The occurrence of CRPS with gunshot and projectile wounds is well documented and is a reality of war.

Symptoms

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 CRPS should replace RSD and causalgia, i.e., CRPS I for RSD and CRPS II for causalgia. The symptoms of CRPS are as follows.

Pain

Pain is reported by >90% of patients. Most patients describe worsening of pain or other symptoms after exercising the affected limb.

Edema

Vascular abnormalities, often abnormal vasodilation and skin warming in the early phase and vasoconstriction in later stages, are characteristic symptoms of RSD/CRPS I. Typically, patients with CRPS I exhibit a warm, vasodilated, affected extremity in the early stages and cold pale skin in the later stages.

Altersations in Motor Function

Although the IASP did not include motor dysfunction in the formal criteria for diagnosing CRPS (because it is not universal), it acknowledged that such dysfunction is common. The abnormal motor symptoms that are reported most classically in CRPS include an inability to initiate movement, weakness, tremor, muscle spasms, and dystonia of the affected limb. In one study, weakness was reported for 95% of patients, tremor of the affected limb for 49%, and muscular uncoordination for 54%. In chronic CRPS, severe spasms were present for 25% of patients.
Altered Sensory Function

Although the IASP decided not to include sensory dysfunction in the formal criteria for diagnosing CRPS (because of variability), such symptoms, including hypoaesthesia, hyperesthesia, and alldynia, may occur.

Psychological Dysfunction

The IASP also decided not to include psychological dysfunction in the formal criteria for diagnosing CRPS, because of ongoing debate regarding whether psychological dysfunction increases the risk of CRPS or the psychological dysfunction often seen among these patients is actually a result of CRPS. Psychological disturbances may include anxiety, hopelessness, and/or depression.

Prevention in the Combat Zone

The one thing that stands out in the prevention of CRPS is early intervention. Combat soldiers face unique circumstances in relation to medical treatment, i.e., (1) high energy and high lethality of wounding agents, (2) multiple causes of wounding, (3) preponderance of penetrating injuries, (4) persistence of threat in tactical settings, (5) austere, resource-constrained environments, and (6) delayed access to definitive care.

Prevention is based on the importance of efficient preoperative, perioperative, and postoperative analgesia and anesthesia. During the acute phase, freedom from pain at rest and regression of edema must be achieved. CRPS is not a simple exaggeration of post-traumatic inflammation. If CRPS is mediated in part by an increase in the density of voltage-sensitive sodium channels in injured axons and the dorsal root ganglion of injured axons, then desensitization via regional blockade is essential. It has been reported that regional anesthesia, by allowing the preoperative onset of sympathetic blockade, is the appropriate anesthetic choice for preventing the development of postoperative CRPS.

The use of regional blocks, local wound infiltration with local anesthetics, and effective analgesia has already found its place in combat; special operations medics have been using these techniques. For the injured soldier, analgesia not only is a matter of comfort but also may allow the soldier to remain quiet when noise discipline is at a premium. It allows the patient to continue to move, thus avoiding detection and potentially permitting the mission to carry on. Regional anesthetics provide an alternative to systemic medications and thus may avoid alterations in the sensorium, limit narcotic administration, and provide superior pain relief. These techniques can be used and are being used to some extent at the unit level, including forward surgical teams, medical clearing companies, and combat support hospitals (CSHs), to begin wound desensitization.

Forward surgical teams carry three lightweight, deployable rapid assembly shelter ("drash") tents that can be attached to one another to form a 900-ft² facility. Supplies to immediately resuscitate and operate on the wounded arrive in five backpacks (i.e., an intensive care unit pack, a surgical technician pack, an anesthesia pack, a general surgery pack, and an orthopedic pack), with three general surgeons, one orthopedic surgeon, two nurse anesthetists, and three nurses, as well as medics and other support personnel. Local infiltrations of wounds, as well as regional blocks, can be and are often performed at this level without slowing the evacuation process. When the patient reaches the CSH, epidural, regional, and plexus blocks and epidural catheter placement, with continuous infusion or periodic dosing, provide more-effective, longer-lasting, pain relief and perpetuate the desensitization process. This can allow the patient to have reduced pain, with nerve desensitization, while being evacuated for more-definitive care. There is no need for sympathetic ganglion blocks at this level of evacuation, because that procedure acts more as a diagnostic tool than as a treatment for CRPS. Increased training in the area of regional blockade can reduce the possibility of infections and poor outcomes.

Furthermore, during evacuation and preoperative, perioperative, and postoperative treatment, the use of gabapentin (GBP) may be helpful in continuing this desensitization process. GBP is an antiepileptic drug that has been approved by the Food and Drug Administration for neuropathic pain; it increases γ-aminobutyric acid concentrations in the brain, possibly by enhancing the rate of synthesis from glutamate, binds to subunits of voltage-dependent calcium channels, and inhibits branched-chain amino acid transferase, reducing glutamate concentrations. GBP has also been found to be an excellent analgesic. Studies showed that preoperative oral GBP therapy decreased pain scores in the early postoperative period and postoperative morphine consumption among spinal surgery patients.

Risks

The 31st CSH reported an epidural abscess after an epidural steroid injection. Could this have been attributable to the dirty environment of the CSH or were other factors in play? Epidural abscesses have been reported at a frequency of 1 case per 505,000 patients with epidural treatment (the frequency is 2 cases per 10,000 patients among those without regional anesthesia). A large proportion of epidural injections are performed in outpatient and office facilities, not in surgical suites. A study reviewing 5,334 outpatient epidural injections showed no post-procedural infections. Remote infection, with resultant bacteremia and seeding of the epidural space, causes as many as 65% of cases of epidural abscess. Skin and soft tissue infections represent the most commonly implicated sources. Not knowing the preprocedural status of the patient at the 31st CSH makes it hard to determine whether the cleanliness of the CSH had an impact on the formation of an epidural abscess. With appropriate training, the risk of infection attributable to techniques or environment could be greatly reduced, improving overall procedural outcomes.

Conclusions

With a 90% survival rate for wounded military personnel, preparation for improved recovery is essential. The efforts of medical personnel in treating wounded soldiers in the war on terror are commendable if not miraculous, given the level of violence in which they work. Establishing a standardized training program and uniform operational procedures to address this specialized form of treatment is essential. Although anesthesiologists and nurse anesthetists are capable of performing these procedures, many do not have experience in their use on a daily
basis or have not established a level of comfort with these procedures. Attempts to research and to develop enhanced equipment to accommodate these efforts should improve care and recovery. Simply surviving the battle is not sufficient if steps can be taken to improve outcomes. Early measures with respect to CRPS may improve veterans’ quality of life and decrease their level of disability.

References