Practical Pain Management

Injections & Blocks

Volume 0, Issue 1

Corticosteroid Use in Pain Management

The basic properties, reactions and applications of corticosteroid use should be reviewed prior to treating patients.

CITE THIS ARTICLE
Lennard T. Corticosteroid Use in Pain Management. Pract Pain Manag. 2000;0(1).

Jan 28, 2012
Ted A. Lennard, MD

Corticosteroids are commonly used in the practice of pain management for their anti-inflammatory properties. These agents, produced by the adrenal cortex, are widely used in epidural, joint, peripheral nerve and various types of soft tissue injections. Corticosteroids can be classified as anti-inflammatory (glucocorticoids), androgenic/estrogenic and salt-retaining (mineralocorticoids). Despite these individual classifications, most corticosteroids have some overlapping properties with predictable adverse reactions. This article will review the mechanism of action of corticosteroids, basic properties of individual drugs, adverse reactions and applications in pain management.

Mechanism of Action

Corticosteroids inhibit the action of phospholipase and thus prevent the formation of arachidonic acid and subsequently the inflammatory mediators.

Corticosteroids also alter the function of lymphocytes. These drugs appear to alter the chemotactic or chemoattractant mechanism found in the inflammatory response after tissue injury.[4] An apparent retention of white blood cells in the lymphatic system indirectly limits their ability to migrate to the damaged tissue.[5] Lymphocytic function and availability is diminished to the point where a 70 percent reduction in circulating lymphocytes can be observed with a typical dose of the drug.[6] The effects of corticosteroids on lymphocytes differ between humans and laboratory animals such as rats and mice. Following a dose of corticosteroids, a transient elevation in the white blood cell count may be observed. In the absence of infection this elevation may be attributed to the demargination of neutrocytes from the endothelium and an increased rate of cellular release from the bone marrow.[7]

Interleukin 1 (IL-1) and tumor necrosis factor (TNF) are integral components to the cell mediated immune response to injury. The expression of these cytokines can be effectively inhibited by corticosteroids[8] IL-1 originates from macrophages, monocytes and various parenchymal cells and induce the production of endothelial based proteins. This results in thrombus formation and ultimately the activation of inflammatory and immune cells. IL-1 also affects procoagulant proteins, adhesive factors and the metabolism of arachidonic acid within the endothelial cell. TNF stimulates the production of various chemotactic mechanisms from neutrophils and granulocytic proteins.

Corticosteroids also affect the permeability of the vascular wall. This membrane stabilization effect alters fluid shifts and decreases cellular and fluid movement from the vascular space. Lysosomal enzymes are also prevented from being released.[9] The end result is alteration of fluid retention at the site of tissue damage.

Individual Agents

Many synthetic corticosteroids used in the treatment of painful conditions have been developed to optimize their anti-inflammatory properties and alter their duration of action

Comparison of Commonly Used Glucocorticoid Steroids[2, 10–15]

AGENT	Anti-Inflammatory Potency*	Salt Retention Property	Plasma Half Life (min)	Duration**	Equivalent Oral Dose (mg)
Hydrocortisone (Cortisol)	1	2+	90	S	20
Cortisone	0.8	2+	30	S	25
Prednisone	4-5	1+	60	I	5
Prednisolone	4-5	1+	200	I	5
Methylprednisolone (Medrol, Depo-Medrol)	5	0	180	I	4
Triamcinolone (Aristocort, Kenalog)	5	0	300	I	4
Betamethasone (Celestone)	25-35	0	100-300	L	0.6
Dexamethasone (Decadron)	25-30	0	100-300	L	0.75
*Relative to hydrocortisone **S=short, I=intermediate, L=long					

Table 1. *With Permission, Lennard, T, Fundamentals of Procedural Care, p. 6, in Lennard (ed), Physiatric Procedures in Clinical Practice, 1st edition, Hanley & Belfus, Philadelphia, 1995.*

Adverse Reactions

Local adverse reactions of corticosteroids usually occur at well localized areas in the skin, soft tissue or periarticular regions as a result of injections. Alterations in skin pigmentation can be noted in some cases when closely observed, especially in dark skinned individuals. Atrophy of the subcutaneous and periarticular tissue occurs where repeated injections have been given. This is commonly seen after repeat injections at both the medial and lateral epicondylar regions, the suboccipital regions after greater and lesser occipital nerve blocks or trigger point injections, and occasionally in spinal regions where repeat corticosteroid containing trigger point injections are given. These effects can be diminished or eliminated by carefully flushing the needle with saline or anesthetic prior to exiting the skin with the needle. Reports of tendon rupture, tendon attrition, cartilage damage, crystal-induced arthritis and pericapsular calcification are found in the literature.[16]

Systemic reactions to corticosteroids have been reported in all organ systems and are well documented in the medical literature.[10–11,17] The most common reported problems are fluid and electrolyte imbalances, bone demineralization, gastrointestinal disease and impaired glucose metabolism (See Table 2). In a healthy state, the fluid and electrolyte problems may be non-existent or simply result in transient swelling of the extremities or face. Patients often complain of transient facial flushing. Caution, however, is advised when administering these drugs to patients with heart disease due to the risk of congestive heart failure. Chronic corticosteroid intake often demineralizes bone causing osteoporosis with resulting fractures common to the spine, wrist and hip. These fractures are typically seen in patients taking oral steroids such as prednisone for chronic medical conditions including respiratory disease, rheumatological disorders and skin diseases. Gastrointestinal disease, such as nausea, vomiting, diarrhea, indigestion, ulcerative colitis with impending abscess or perforation and peptic ulcer disease have been reported. Known diabetics or those with impaired glucose metabolism who receive corticosteroids will typically note a rise in serum glucose. These patients should be forewarned of this potential problem and closely monitored for changes in their serum glucose levels to make appropriate doseage adjustments in their hypoglycemic agents.

Common Systemic Adverse Reactions to Corticosteroids

SYSTEMIC REACTION	CLINICAL SYMPTOMS

Allergic reactions to corticosteroids have been reported.[18] If delayed release formulatons are given, the allergic response may not occur until one to two weeks following the doseage. These allergic reactions may be manifested as skin lesions such as rashes, hives or eruptions, or various respiratory complaints. One should be cognizant of the potential for additives and preservatives often found in corticosteroid mixes to also cause these same types of allergic reactions. Caution should be used before labeling a patient allergic to a corticosteroid for, often, the symptoms may simply be an adverse reaction.

One of the more serious complications from corticosteroid intake is adrenal cortical insufficiency. This condition is a result of suppression of the hypothalamic-pituitary-adrenal axis. When this axis has been suppressed, an individual's ability to respond to stressful situations such as infections or surgery is jeopardized. Although less common than the other adverse reactions listed previously, it is usually associated with chronic intake of high corticosteroid doses. One other potentially serious side effect from corticosteroid use is impaired wound healing. This occurs through inhibition of collagen synthesis and fibroblastic function.[19]

Concommitent drug intake should be carefully scrutinized prior to prescribing or injecting a corticosteroid. A number of drug interactions have been reported that often potentiate or diminish the drugs clearance and half-lives. Non-steroidal anti-inflammatory drugs, oral contraceptives and other exogenous estrogens are known to increase the potency of corticosteroids. Macrolide antibiotics such as erythromycin and azithromycin may increase the potency of methylprednisolone by decreasing its clearance. In contrast rifampin, phenobarbital, carbamazepine, and phenytoin often increase drug clearance and decrease the anti-inflammatory effect of the corticosteroid. Oral anti-coagulants and theophylline have varying effects.[15] The physician would be prudent in making doseage adjustments accordingly when patients are discovered to be consuming these drugs.

Application in Pain Management

The use of corticosteroids is widespread in pain management. These drugs may diminish or eliminate a painful foci by virtue of their anti-inflammatory properties. These medications are

training is commonplace and necessary for the clinician to learn injectable procedures in order to place a corticosteroid or anesthetic into a desired target site. This may include injections into the intra-articular space, trigger point, ligament, peritendon region, perineural region and the epidural space. The use of fluoroscopy has now made it easier and common for most areas in the axial and appendicular skeleton to be accessed by needle injection. When these precise injections are administered, in combination with small doses of anesthetics, diagnosistic information regarding one's pain generator can also be obtained.

Epidural Injections

Epidural steroid injections are considered standard in the non-operative treatment of many cervical, thoracic and lumbosacral spinal disorders. This includes midline, paramedian and transforaminal approaches. In the lumbosacral region, a caudal or trans-sacral approach can also be used. Each of these approaches require considerable skill and manual dexterity and carry unique risks. These are well described in other sources.[21] Although not without controversy, epidural steroid injections are used worldwide with varying results for the management of the painful spine.[22–26] When used in the framework of a comprehensive rehabilitation program, these procedures often diminish a patient's pain while allowing them to increase their level of function. Otherwise, without localized adequate pain relief functional issues cannot be addressed and the patient remains focused on the pain treatment phase of rehabilitation.

> *"The indications for corticosteroid use are extensive, but often met with controversy and misunderstanding."*

Epidural injections are used in most painful spinal conditions including a multitude of disc abnormalities: herniations, bulges, internal disc disruption, degeneration, etc., as well as stenosis and radiculopathies. The route of administration of the corticosteroid is usually dictated by the patient's symptoms and the underlying differential diagnosis. These procedures can also be used to assist in the diagnosis of a painful disc or nerve root. Anesthe-tic is added to the corticosteroid solution and injected selectively following contrast dye confirmation under fluoroscopy. The patient's preinjection condition is then

ccs of solution. Larger joints, such as the knee, hip and sacro-iliac joints, may require 4-8 ccs of corticosteroid and anesthetic solution with 2 ccs of corticosteroid and the remainder with anesthetic.

Soft Tissue Injections

Soft tissue injections encompass the wide category of injections into muscle (trigger points), ligaments and peritendons. Perhaps the most common type of injections for pain, these structures are very amenable to needling. As with other types of injections, corticosteroids are commonly mixed with anesthetics and injected in small aliquots into muscle, ligaments or around tendon structures. When injecting trigger points, one often uses the above combinations or can perform dry needling techniques.[28] These injections are often given in conjunction with a well designed stretching program.

Perineural Injections

Perineural injections or nerve blocks are frequently given for neurogenic pain. These injections are primarily anesthetic in composition, but often corticosteroid will be added. These procedures are commonly used to assist in the diagnosis of a painful region. For example, if one suspects a spinal facet joint to be the putative source of pain, the medial branch (MB) of the posterior primary ramus of the spinal nerve that innervates that joint can be blocked and the patient's response recorded. This may lead the pain management clinician to conclude the basis of the patient's spinal pain and may ultimately recommend additional procedures such as radiofrequency lesioning to that MB. In other cases a peripheral nerve may be supect as a patient's primary source of pain, i.e. inflammatory neuritis, cubital tunnel syndrome, carpal tunnel syndrome, etc., and a corticosteroid may be injected adjacent to the nerve involved. Care should be taken that an intraneural injection is avoided. (See Figure 1)

intraneural injury. ***Illustration by Suzanne B. Lennard***

Conclusion

The use of corticosteroids is widespread among pain management clinicians. One should be familiar with their mechanism of action, basic drug properties, adverse reactions and use with injections. The indications for corticosteroid use are extensive, but often met with controversy and misunderstanding. Clinicians should educate their patients and peers on the judicious and proper use of corticosteroids.

REFERENCES

Notes: This article was originally published May 16, 2011 and most recently updated January 28, 2012.