Corticosteroids and Oral Surgery

Jason Bodnar, BS

Nova Southeastern University College of Dental Medicine, Fort Lauderdale, Florida

Winner of the 2001 Daniel F. Lynch Essay Award.

Inflammation is a normal and desirable consequence of surgical procedures. The pertinent clinical symptoms of inflammation are manifested as tumor (swelling), rubor (redness), calor (heat), and dolor (pain). Ideally, inflammation is regulated through humoral and cellular events that localize the injury, control infection, repair the tissue damage, and restore the function of the injured tissue.

Postoperative pain and inflammation can induce dental fear in the patient. Therefore, postoperative prevention of pain and inflammation is imperative to both the patient and physician. Although analgesics are commonly prescribed to control pain and inflammation following oral surgery, steroids have been found to be effective in reducing postsurgical pain and inflammation. The benefits and risks of corticosteroids as an adjunct for oral surgery procedures will be examined.

CORTICOSTEROID PHYSIOLOGY

Corticosteroids produced primarily by the adrenal cortex are classified as glucocorticoids, mineralocorticoids, or sex hormones. Glucocorticoids are steroid hormones secreted by the adrenal cortex under the regulation of the hypothalamic-pituitary-adrenal (HPA) axis. Glucocorticoids are named so because they promote mobilization of energy via carbohydrates. They also regulate protein and fat metabolism. Mineralocorticoids are under control of the renin-angiotensin system; this secretion is independent of the pituitary gland.

The control of glucocorticoid secretion by the adrenal cortex is initiated from the hypothalamus by the secretion of corticotropin-releasing factor. Elevated corticotropin in the blood stimulates the adrenal cortex to produce and release the glucocorticoids. The primary natural glucocorticoid is cortisol. Circulating cortisol feedback on the hypothalamus and pituitary regulates corticotropin-releasing factor and corticotropin secretion.

Glucocorticoids influence almost every body tissue to bring about certain physiological adaptations. Such adaptations include carbohydrate, protein, and fat metabolism and cardiovascular system, skeletal muscle, and nervous system function. An important action of cortisol is the suppression or prevention of inflammation by interfering with capillary dilation, edema formation, fibrin deposition, leukocyte migration, and phagocytosis.[1]

Although glucocorticoids are released in a daily rhythmic pattern, stressors, such as trauma, illness, infection, surgery, or physical exertion, alter HPA function and affect cortisol levels. Some synthetic corticosteroids have much greater anti-inflammatory potency than natural corticosteroids. Methylprednisolone is about 5 times as potent, whereas betamethasone and dexamethasone are about 20 to 30 times as potent.

POSTSURGICAL INFLAMMATION PHYSIOLOGY

Inflammation is manifested as hyperalgesia, edema, leukocytosis, leukocyte activation, alteration of blood flow, and increased permeability of microcirculation. This resulting plasma extravasation produces pressure on sensory nerve endings. In confined tissue spaces, such as dental pulp, pressure on sensory nerve endings is clinically expressed as pain.

Another important factor in inflammatory pain is the release of chemical mediators of the inflammatory response. In response to trauma or infection, tissues release chemical mediators, such as prostaglandins, histamine, kinins, and a series of chemotactic agents, that can lower the pain threshold of sensory nerve fibers.

Prostaglandins are synthesized from arachidonic acid by the enzyme cyclooxygenase. Prostaglandins cause an increased sensitivity to pain in the peripheral nerve endings. This hyperalgesia is associated with a decreased pain threshold and an increased magnitude of pain perception. Prostaglandins induce the release of neuropeptides from peripheral nerve endings that stimulate his-

Received July 1, 2000; accepted for publication July 11, 2001.

Address correspondence to Jason Bodnar, 1225 Tequesta St, Fort Lauderdale, FL 3312.

Anesth Prog 48:130–132 2001

ISSN 0003-3006/01/$9.50
SSDI 0003-3006(01)

tamine release from mast cells and induce plasma suffusion. Furthermore, peripheral nerves not only detect and signal the occurrence of tissue damage, but also are actively involved in the inflammatory process. A positive feedback loop is established, which prolongs the course of inflammation and exceeds it initial stimulation.[2]

ANALGESIC AND ANTI-INFLAMMATORY ACTION

Corticosteroids are an effective treatment for some types of neuropathic pain and complex regional pain syndromes.[3] However, there is limited and contradictory data on the analgesic effects of corticosteroids on nociception following surgery. There is some evidence that corticosteroids reduce postoperative pain through the reduction of edema rather than altering nociceptive thresholds.[4]

Corticosteroids inhibit all phases of inflammation. Corticosteroids block the increased capillary permeability produced by histamine and kinins and therefore decrease edema. Capillary dilation, leukocytosis, and phagocytosis are all decreased. Kinin generation is also inhibited. Corticosteroids block arachidonic acid formation. Therefore, the cascade for the formation of prostaglandins is inhibited. The inhibition of cyclooxygenase end products most likely accounts for the anti-inflammatory potency of steroids. In addition, corticosteroids diminish protein synthesis in skin, connective tissue, and muscle and therefore inhibit the formation of granulation tissue by retarding fibroblast proliferation and collagen synthesis.

HPA SUPPRESSION AND CONTRAINDICATIONS

When exogenous corticosteroids are administered for medical purposes, HPA axis suppression and adrenal atrophy have been documented.[5] Abrupt discontinuation of corticosteroid use in these patients does not permit the HPA axis to respond to situations where there is a need for increased cortisol (illness, stress, or surgery).[6] The degree of HPA suppression and subsequent method of discontinuation depends on the corticosteroid, dose, dosing interval, time of administration, length of therapy, and route of administration. Daily single morning doses produce less HPA suppression than divided daily doses. This mimics the body's normal circadian release of cortisol.[5]

When the patient's status permits discontinuation of corticosteroid use, the patient should be aware of the potential time required for the HPA axis to return to baseline. Patients who have undergone only a short course of therapy of up to 3 weeks usually can discontinue therapy abruptly with few withdrawal effects.[6] Long-term therapy may require close monitoring for periods of up to a year before HPA axis returns to normal.

Because of their immunosuppressant effects, corticosteroids are contraindicated for patients with bacterial, fungal, viral, or parasitic infection or a history of tuberculosis or ocular herpes simplex. Increased intraocular pressure is associated with corticosteroid use. Therefore, patients with primary glaucoma should not be prescribed corticosteroids.[7] Also, some patients experience euphoric or mood-altering effects following corticosteroid use.

ORAL SURGERY

Several authors have examined the effects of corticosteroids for prevention of pain and edema associated with oral surgery. Beirne and Hollander[8] used corticosteroids after removal of third molars. This double-blind, randomized, patient-controlled investigation demonstrated that patients administered a single intravenous dose of 125 mg of methlyprednisolone immediately before surgery had significantly less pain and edema than the control patients. Milles and Desjardins[9] examined the effects of a single preoperative dose of 20 mg of methylprednisolone. They found a 42% reduction in edema on the first day after surgery, but noted only 19% less edema after the third postoperative day. By using a single intravenous dose of 1 mg/kg of methlyprednisolone immediately before surgery, Schaberg et al[10] observed a 62% decrease in swelling on the first day after orthognathic surgery, but noted no significant difference after the second postoperative day. Gersema and Baker[11] provide a good review of studies that have examined the effect of a single dose of steroids.

Krasner and Jackson[12] reported that corticosteroids could be an effective adjunct for pain reduction following endodontic treatment. Patients administered corticosteroids reported significantly less postoperative pain than subjects that received placebo.

CONCLUSION

Initiation of various natural defense mechanisms and resulting edema following oral surgical procedures can cause discomfort and interfere with proper healing. Evidence exists that glucocorticoids can be used as an adjunct to oral surgery due to their ability to prevent these homeostatic defense mechanisms from overshooting and compromising tissue healing. Therefore, corticoste-

roids appear to be an effective method of reducing pain and edema following oral surgical procedures. However, more studies must be conducted in this area before any conclusions can be made.

REFERENCES

1. Schimmer BP, Parker KL. Adrenal corticotropic hormone and adrenal corticotropic steroids. In: *The Pharmacological Basis of Disease.* 9th ed. New York, NY: McGraw-Hill; 1994:1459–1486.

2. Trowbridge HO, Emling RC. *Inflammation: A Review of the Process.* 5th ed. Chicago, Ill: Saunders; 1997.

3. Kingery WS. A critical review of controlled clinical trials for peripheral neuropathic pain and complex regional pain syndromes. *Pain.* 1997;73:123–139.

4. Kingery WS, Castellote JM, Maze M. Methylprednisolone prevents the development of autotomy and neuropathic edema in rats, but has no effect on nociceptive thresholds. *Pain.* 1999;80:555–566.

5. Helfer EL, Rose LI. Corticosteroids and adrenal suppression: characterizing and avoiding the problem. *Drugs.* 1989;38:838–845.

6. Byyny RL. Withdrawal from glucocorticoid therapy. *N Engl J Med.* 1976;295:30–32.

7. Herfindal ET, Gourley DR, Hart LL. *Clinical Pharmacy and Therapeutics.* 5th ed. Baltimore, Md: Williams & Wilkins; 1992.

8. Beirne OR, Hollander B. The effect of methylprednisolone on pain, trismus, and swelling after removal of third molar. *Oral Surg Oral Med Oral Pathol.* 1986;61:134–138.

9. Milles M, Desjardins PJ. Reduction of postoperative facial swelling by low-dose methylprednisolone. *J Oral Maxillofac Surg.* 1993;51:987–991.

10. Schaberg SJ, Stuller CB, Edwards SM. Effect of methylprednisolone on swelling after orthognathic surgery. *J Oral Maxillofac Surg.* 1984;42:356–361

11. Gersema L, Baker K. Use of corticosteroids in oral surgery. *J Oral Maxillofac Surg.* 1992;50:270–277.

12. Krasner P, Jackson E. Management of posttreatment endodontic pain with oral dexamethasone: a double-blind study. *Oral Surg Oral Med Oral Pathol.* 1986;62:187–190.