

Top 5 Corticosteroids for Use in Emergency Settings

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Corticosteroids are a diverse group of medications used to treat a wide array of illnesses. At lower dose ranges, they provide anti-inflammatory effects, whereas higher doses are immunosuppressive. These properties make them valuable tools in the emergency and critical care setting. Clinicians must be familiar with the appropriate indications for each drug, along with their relative potencies and adverse effects. Following are the author's top 5 corticosteroids used in emergency settings.

1 Prednisone/Prednisolone
 Prednisone is used for both anti-inflammatory and immunosuppressive purposes because of its effectiveness, low cost, small tablet size, innocuous taste, and variable dose sizes.

When used for anti-inflammatory effects, prednisone is administered at 0.5-1.0 mg/kg/day, often for only a few days to limit local or systemic inflammation.¹⁻³ Inflammatory or traumatic disorders of emergency patients (eg, oropharyngeal trauma, oropharyngeal biopsy, decompensation secondary to laryngeal collapse or tracheal collapse) are often short in duration, and treatment with steroids for 2 to 3 days allows

TOP 5 CORTICOSTEROIDS FOR USE IN EMERGENCY SETTINGS

1. Prednisone/Prednisolone
2. Dexamethasone Sodium Phosphate
3. Hydrocortisone
4. Methylprednisolone Sodium Succinate
5. Fluticasone

the initial insult or exacerbation to subside. In patients with transient inflammatory disorders, the common side effects of steroids (see **Glucocorticoid Adverse Effects**) are mild because of the relatively low dose and short duration of treatment.³

Immunosuppressive doses of prednisone range from 1-2 mg/kg q12h.^{1,4} Some overlap of the dosing ranges for anti-inflammatory and immunosuppressive effects may be noted, most likely because those effects are not entirely distinct.

Steroids, particularly prednisone, are used to treat many autoimmune disorders, including immune-mediated hemolytic anemia, immune-mediated thrombocytopenia, and immune-mediated polyarthropathy. Because these diseases often require long-term treatment with high doses of steroids, adverse effects are more common. A second or third immunosuppressive agent is often used with prednisone to maintain immunosuppression and allow rapid reduction of prednisone doses to maintenance levels.

Because cats and animals with severe hepatic disease have difficulty converting prednisone into the active

metabolite prednisolone, some sources suggest that prednisolone may be a better choice in these patients.^{5,6}

2 Dexamethasone Sodium Phosphate

Dexamethasone is often used as the first-line steroid for urgent conditions because it has a rapid onset of action and can be administered parenterally.^{1,2} Most patients that require continued steroid therapy are switched to oral prednisone. Dexamethasone is approximately 7 times more potent than prednisone, so the prednisone dose should be approximately 7 times greater than an equivalent dexamethasone dose.^{1,2} For example, a patient receiving 5 mg dexamethasone would be switched to 30-35 mg prednisone.

When using different steroids, clinicians must be careful to recognize the relative glucocorticoid potency of each drug.^{1,2} Dexamethasone has a longer duration of action than other steroids.¹ When switching from injectable dexamethasone to an oral steroid, the oral steroid is usually started 24 hours after dexamethasone has been discontinued. Dexamethasone does not affect cortisol assays, so it can be administered to patients with suspected hypoadrenocorticism before an ACTH stimulation test or before blood is obtained for cortisol testing. However, continued use of dexamethasone (or any other steroid) will suppress the hypothalamic-pituitary-adrenal axis, which in turn will suppress endogenous cortisol concentrations.¹

3 Hydrocortisone

Many topical medications contain hydrocortisone as an anti-inflammatory agent. Even with topical application, some systemic absorption of hydrocortisone can occur.⁷ Hydrocortisone is used in shampoos and in various topical, ocular, and otic preparations to manage superficial irritation.

Hydrocortisone is also an appropriate treatment choice for critical illness-related corticosteroid insufficiency (CIRCI; formerly relative adrenal

GLUCOCORTICOID ADVERSE EFFECTS

- Polyuria/polydipsia
- GI ulceration
- Increased liver enzyme activity
- Muscle atrophy
- Weakness
- Insulin resistance and hyperglycemia
- Symmetric hair loss
- Panting
- Polyphagia
- Impaired wound healing
- Hypercoagulability/thromboembolism

insufficiency). CIRCI affects patients with severe sepsis that are hypotensive despite fluid therapy and vasopressor support. In some CIRCI patients, low doses of IV corticosteroids can improve blood pressure.^{8,9} Because there is no consensus on how best to diagnose this syndrome, an appropriate response to therapy is used as a surrogate for an objective diagnosis. The best treatment of CIRCI is not established, but hydrocortisone has been used at 0.5-1.0 mg/kg IV q6h or as a CRI at 2.5-3.0 mg/kg/day.^{9,10} If blood pressure improves within 24 hours of starting hydrocortisone, steroid supplementation should be continued at a tapering dose for approximately 1 week.^{9,10}

4 Methylprednisolone Sodium Succinate

IV methylprednisolone sodium succinate (MPSS) is often administered to dogs and cats with acute spinal cord injury before and after a decompressive spinal surgery. Strong opinions for and against the use of MPSS (and other steroids) exist within the veterinary community, despite the lack of evidence to support its benefits.^{11,12} The human literature also shows little consensus regarding the use of MPSS for acute spinal cord injury.² The potential benefits of MPSS are likely associated with the limitation of ischemic and oxidative damage in the area of the damaged spine.² Side effects of aggressive MPSS therapy include diarrhea, vomiting, melena, hematemesis, and anorexia.¹³ MPSS should be considered only when it can be administered within 8 hours of the initial injury.^{2,14} The author suggests 2 protocols for administration of MPSS. Both require an initial loading dose of 30 mg/kg IV followed either by a decreased dose (15 mg/kg) in 2 hours and then 8 hours after the initial bolus or by a CRI of 5.4 mg/kg/hr for 24 hours.²

5 Fluticasone

Fluticasone is the most commonly used inhaled steroid of those available.¹⁵ Because they can be delivered directly to the site of inflammation with minimal systemic absorption, inhaled steroids are used to efficiently

treat inflammatory pulmonary diseases in dogs and cats (eg, asthma, chronic bronchitis, eosinophilic bronchopneumopathy).¹⁵⁻¹⁷

Although it can take 1 to 2 weeks for inhaled steroids to decrease inflammation, clinicians commonly begin this course of therapy at the time of diagnosis, which is often in the emergency room.¹⁵ Most of these inflammatory pulmonary conditions are initially managed with oral steroids, but treatment is switched to inhaled steroids as soon as possible to avoid side effects. Pet owners should be shown how to use the inhaler and delivery chamber (preferably species-specific) while their pet is still in the clinic to provide them with multiple opportunities for supervised practice. Hands-on instruction can increase owner confidence in performing this technique at home and can hasten the transition from oral to inhaled steroids. Fluticasone is available through human pharmacies.

Conclusion

Corticosteroids comprise a broad group of pharmacologic agents with a choice of administration routes. In the critical care setting, these drugs treat conditions ranging from allergic reactions to acute soft tissue inflammation, autoimmune disease, asthma, spinal cord injury, and vasopressor nonresponsive hypotension in sepsis. Corticosteroids cause predictable dose-dependent side effects but remain a valuable drug class for use by critical care and emergency clinicians. ■

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Corticosteroids cause predictable dose-dependent side effects but remain a valuable drug class for use by critical care and emergency clinicians.

References

1. Feldman EC, Nelson RW. Glucocorticoid therapy. In: Feldman EC, Nelson RW. *Canine and Feline Endocrinology and Reproduction*. 3rd ed. St. Louis, MO: Saunders; 2004:464-483.
2. Aharon MA, Pritt JE, Buriko K. A review of associated controversies surrounding glucocorticoid use in veterinary emergency and critical care. *J Vet Emerg Crit Care (San Antonio)*. 2017;27(3):267-277.
3. Shmuel DL, Cortes Y. Anaphylaxis in dogs and cats. *J Vet Emerg Crit Care (San Antonio)*. 2013;23(4):377-394.
4. Plumb DC. Prednisone. In: Plumb DC, ed. *Plumb's Veterinary Drug Handbook*. 8th ed. Ames, IA: Wiley-Blackwell; 2015:1202-1208.
5. Center SA, Randolph JF, Warner KL, Simpson KW, Rishniw M. Influence of body condition on plasma prednisolone and prednisone concentrations in clinically healthy cats after single oral dose administration. *Res Vet Sci*. 2013;95(1):225-230.
6. Graham-Mize CA, Rosser EJ. Bioavailability and activity of prednisone and prednisolone in the feline patient. *Vet Dermatol*. 2004;15(Suppl 1):7-10.
7. Thomas RC, Logas D, Radosta L, Harrison J. Effects of a 1% hydrocortisone conditioner on haematological and biochemical parameters, adrenal function testing and cutaneous reactivity to histamine in normal and pruritic dogs. *Vet Dermatol*. 1999;10(2):109-116.
8. Durkan S, de Laforcade A, Rozanski E, Rush JE. Suspected relative adrenal insufficiency in a critically ill cat. *J Vet Emerg Crit Care*. 2007;17(2):197-201.
9. Peyton JL, Burkitt JM. Critical illness-related corticosteroid insufficiency in a dog with septic shock. *J Vet Emerg Crit Care (San Antonio)*. 2009;19(3):262-268.
10. Burkitt Creedon JM. Critical illness-related corticosteroid insufficiency. In: Silverstein DC, Hopper K, eds. *Small Animal Critical Care Medicine*. 2nd ed. St. Louis, MO: Elsevier Saunders; 2015:376-379.
11. Kube SA, Olby NJ. Managing acute spinal cord injuries. *Compend Contin Educ Vet*. 2008;30(9):496-504.
12. Coates JR, Sorjonen DC, Simpson ST, et al. Clinicopathologic effects of a 21-aminosteroid compound (U74389G) and high-dose methylprednisolone on spinal cord function after simulated spinal cord trauma. *Vet Surg*. 1995;24(2):128-139.
13. Boag AK, Otto CM, Drobatz KJ. Complications of methylprednisolone sodium succinate therapy in dachshunds with surgically treated intervertebral disc disease. *J Vet Emerg Crit Care*. 2001;11(2):105-110.
14. Olby N. Current concepts in the management of acute spinal cord injury. *J Vet Intern Med*. 1999;13(5):399-407.
15. Padrid P. Use of inhaled medications to treat respiratory diseases in dogs and cats. *J Am Anim Hosp Assoc*. 2006;42(2):165-169.
16. Kirschvink N, Leemans J, Delvaux F, et al. Inhaled fluticasone reduces bronchial responsiveness and airway inflammation in cats with mild chronic bronchitis. *J Feline Med Surg*. 2006;8(1):45-54.
17. Bexfield NH, Foale RD, Davison LJ, Watson PJ, Skelly BJ, Herrtage ME. Management of 13 cases of canine respiratory disease using inhaled corticosteroids. *J Small Anim Pract*. 2006;47(7):377-382.

Heartgard® Plus

(ivermectin/pyrantel)

CHEWABLES

CAUTION: Federal (U.S.A.) law restricts this drug to use by or on the order of a licensed veterinarian.

INDICATIONS: For use in dogs to prevent canine heartworm disease by eliminating the tissue stage of heartworm larvae (*Dirofilaria immitis*) for a month (30 days) after infection and for the treatment and control of ascarids (*Toxocara canis*, *Toxascaris leonina*) and hookworms (*Ancylostoma caninum*, *Uncinaria stenocephala*, *Ancylostoma braziliense*).

DOSAGE: HEARTGARD® Plus (ivermectin/pyrantel) should be administered orally at monthly intervals at the recommended minimum dose level of 6 mcg of ivermectin per kilogram (2.72 mcg/lb) and 5 mg of pyrantel (as pamoate salt) per kg (2.27 mg/lb) of body weight. The recommended dosing schedule for prevention of canine heartworm disease and for the treatment and control of ascarids and hookworms is as follows:

Dog Weight	Cheewables Per Month	Ivermectin Content	Pyrantel Content	Color Coding On Foil Backing and Carton
Up to 25 lb	1	68 mcg	57 mg	Blue
26 to 50 lb	1	136 mcg	114 mg	Green
51 to 100 lb	1	272 mcg	227 mg	Brown

HEARTGARD Plus is recommended for dogs 6 weeks of age and older. For dogs over 100 lb use the appropriate combination of these chewables.

ADMINISTRATION: Remove only one chewable at a time from the foil-backed blister card. Return the card with the remaining chewables to its box to protect the product from light. Because most dogs find HEARTGARD Plus palatable, the product can be offered to the dog by hand. Alternatively, it may be added intact to a small amount of dog food. The chewable should be administered in a manner that encourages the dog to chew, rather than to swallow without chewing. Chewables may be broken into pieces and fed to dogs that normally swallow treats whole.

Care should be taken that the dog consumes the complete dose, and treated animals should be observed for a few minutes after administration to ensure that part of the dose is not lost or rejected. If it is suspected that any of the dose has been lost, redosing is recommended.

HEARTGARD Plus should be given at monthly intervals during the period of the year when mosquitoes (vectors), potentially carrying infective heartworm larvae, are active. The initial dose must be given within a month (30 days) after the dog's first exposure to mosquitoes. The final dose must be given within a month (30 days) after the dog's last exposure to mosquitoes.

When replacing another heartworm preventive product in a heartworm disease preventive program, the first dose of HEARTGARD Plus must be given within a month (30 days) of the last dose of the former medication.

If the interval between doses exceeds a month (30 days), the efficacy of ivermectin can be reduced. Therefore, for optimal performance, the chewable must be given once a month on or about the same day of the month. If treatment is delayed, whether by a few days or many, immediate treatment with HEARTGARD Plus and resumption of the recommended dosing regimen will minimize the opportunity for the development of adult heartworms.

Monthly treatment with HEARTGARD Plus also provides effective treatment and control of ascarids (*T. canis*, *T. leonina*) and hookworms (*A. caninum*, *U. stenocephala*, *A. braziliense*). Clients should be advised of measures to be taken to prevent reinfection with intestinal parasites.

EFFICACY: HEARTGARD Plus Chewables, given orally using the recommended dose and regimen, are effective against the tissue larval stage of *D. immitis* for a month (30 days) after infection and, as a result, prevent the development of the adult stage. HEARTGARD Plus Chewables are also effective against canine ascarids (*T. canis*, *T. leonina*) and hookworms (*A. caninum*, *U. stenocephala*, *A. braziliense*).

ACCEPTABILITY: In acceptability and field trials, HEARTGARD Plus was shown to be an acceptable oral dosage form that was consumed at first offering by the majority of dogs.

PRECAUTIONS: All dogs should be tested for existing heartworm infection before starting treatment with HEARTGARD Plus which is not effective against adult *D. immitis*. Infected dogs must be treated to remove adult heartworms and microfilariae before initiating a program with HEARTGARD Plus.

While some microfilariae may be killed by the ivermectin in HEARTGARD Plus at the recommended dose level, HEARTGARD Plus is not effective for microfilariae clearance. A mild hypersensitivity-type reaction, presumably due to dead or dying microfilariae and particularly involving a transient diarrhea, has been observed in clinical trials with ivermectin alone after treatment of some dogs that have circulating microfilariae.

Keep this and all drugs out of the reach of children.

In case of ingestion by humans, clients should be advised to contact a physician immediately. Physicians may contact a Poison Control Center for advice concerning cases of ingestion by humans.

Store between 68°F - 77°F (20°C - 25°C). Excursions between 59°F - 86°F (15°C - 30°C) are permitted. Protect product from light.

ADVERSE REACTIONS: In clinical field trials with HEARTGARD Plus, vomiting or diarrhea within 24 hours of dosing was rarely observed (1.1% of administered doses). The following adverse reactions have been reported following the use of HEARTGARD: Depression/lethargy, vomiting, anorexia, diarrhea, mydriasis, ataxia, staggering, convulsions and hypersalivation.

SAFETY: HEARTGARD Plus has been shown to be bioequivalent to HEARTGARD, with respect to the bioavailability of ivermectin. The dose regimens of HEARTGARD Plus and HEARTGARD are the same with regard to ivermectin (6 mcg/kg). Studies with ivermectin indicate that certain dogs of the Collie breed are more sensitive to the effects of ivermectin administered at elevated dose levels (more than 16 times the target use level) than dogs of other breeds. At elevated doses, sensitive dogs showed adverse reactions which included mydriasis, depression, ataxia, tremors, drooling, paresis, recumbency, excitability, stupor, coma and death. HEARTGARD demonstrated no signs of toxicity at 10 times the recommended dose (60 mcg/kg) in sensitive Collies. Results of these trials and bioequivalency studies, support the safety of HEARTGARD products in dogs, including Collies, when used as recommended.

HEARTGARD Plus has shown a wide margin of safety at the recommended dose level in dogs, including pregnant or breeding bitches, stud dogs and puppies aged 6 or more weeks. In clinical trials, many commonly used flea collars, dips, shampoos, anthelmintics, antibiotics, vaccines and steroid preparations have been administered with HEARTGARD Plus in a heartworm disease prevention program.

In one trial, where some pups had parvovirus, there was a marginal reduction in efficacy against intestinal nematodes, possibly due to a change in intestinal transit time.

HOW SUPPLIED: HEARTGARD Plus is available in three dosage strengths (See DOSAGE section) for dogs of different weights. Each strength comes in convenient cartons of 6 and 12 chewables.

For customer service, please contact Merial at 1-888-637-4251.



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