MELOXICAM Veterinary—Systemic

Some commonly used *brand names* are:

For veterinary-labeled product(s)—*Metacam*.

For human-labeled product(s)—*Mobic; Mobicox*.

Note: For a listing of dosage forms and brand names by country availability, see the *Dosage Forms* section(s).

Category: Analgesic; anti-inflammatory (nonsteroidal).

Indications

Note: Bracketed information in the *Indications* section refers to uses that either are not included in U.S. product labeling or are for products not commercially available in the U.S.

Accepted

Inflammation, musculoskeletal (treatment); or

Pain, musculoskeletal (treatment)—*Dogs:* Meloxicam oral suspension and meloxicam injection are indicated in the control of pain and inflammation associated with osteoarthritis.{R-1; 3; 4; 13; 15-17}

[Inflammation, postoperative (treatment)]; or

[Pain, postoperative (treatment)]—

Dogs: Meloxicam injection is indicated in the control of pain and inflammation following orthopedic and soft tissue surgery.{R-4; 18-21}

Cats[1]: Meloxicam injection is used in the control of pain and inflammation following orthopedic and soft tissue surgery.{R-9; 11}

Acceptance not established

Inflammation, musculoskeletal (treatment); or

Pain, musculoskeletal (treatment)—[*Cats*][1]: Meloxicam is used in the control of acute musculoskeletal inflammation and pain. There is evidence supporting its efficacy and safety with short-term administration.{R-9-11} Meloxicam is also used in the alleviation of chronic pain and inflammation; however, additional research would more clearly define dosage recommendations for cats.

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[1]Not included in Canadian product labeling or product not commercially available in Canada.

Regulatory Considerations

U.S. and Canada—

Meloxicam is labeled for use only by or on the order of a licensed veterinarian.{R-1; 3; 4}

Chemistry

Chemical group: An oxicam derivative.{R-5}

Chemical name: 4-Hydroxy-2-methy-*N*-(5-methyl-2-thiazolyl)-2*H*-1,2-benzothiazine-3-carboxamide 1,1-dioxide.{R-1}

Molecular formula: $C_{14}H_{13}N_3O_4S_2$.{R-6}

Molecular weight: 351.40.{R-6}

Description: A yellow solid. {R-5} The commercial oral formulation is a yellowish viscous suspension with the odor of honey.{R-1}

pKa: 1.1 and 4.2. {R-5}

Solubility: Practically insoluble in water, in strong acids, and in bases; slightly soluble in methanol.{R-5}

Other characteristics: Partition coefficient—0.1 in *n*-octanol/buffer pH 7.5. {R-5}

Pharmacology/Pharmacokinetics

Mechanism of action/Effect: Anti-inflammatory—Meloxicam is a nonsteroidal anti-inflammatory drug (NSAID) of the oxicam group.{R-1; 3; 4} It is a potent inhibitor of prostaglandin synthesis.{R-3; 4}

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Absorption: Oral bioavailability—*Dogs:* Approaches 100% when administered with food.[R-1]

Distribution: *Dogs*—Volume of distribution: 0.32 ± 0.07 L/kg.[R-14]

Protein binding: *Dogs*—97%.[R-1; 14]

Half-life: Elimination—*Dogs:* With a dose of 0.2 mg per kg of body weight (mg/kg)—
Intravenous administration: 24.0 ± 6.3 hours.[R-22]
Oral: 23.7 ± 7.1 hours.[R-22]
Subcutaneous: 23.7 ± 4.3 hours.[R-22]
Note: When dogs are treated with meloxicam for more than 45 days, there is evidence that terminal elimination half-life may be extended and drug accumulation enhanced.[R-1]

Peak serum concentration: *Dogs*—With a dose of 0.2 mg/kg:
Oral administration—0.464 mcg/mL at approximately 7.5 hours.[R-1; 22]
Subcutanous—0.734 mcg/mL at approximately 2.5 hours.[R-14; 22]

Elimination: *Dogs*—Clearance: 0.17 ± 0.02 mL/min/kg. [R-22]

Precautions to Consider

Reproduction/Pregnancy/Lactation

Dogs: The safety of administering meloxicam to dogs during breeding, pregnancy, or lactation has not been studied.[R-1; 3]

Pediatrics

Dogs: The safety of administering meloxicam to dogs younger than 6 months of age has not been studied.[R-1] Canadian product labeling advises caution if considering administration of a nonsteroidal anti-inflammatory drug to animals less than 6 weeks of age because of a potential for increased risk.[R-4]

Drug interactions and/or related problems

The following drug interactions and/or related problems have been selected on the basis of their potential clinical significance (possible mechanism in parentheses where appropriate)—not necessarily inclusive (» = major clinical significance):

Note: Combinations containing any of the following medications, depending on the amount present, may also interact with this medication.

Anticoagulants[R-3; 4]
(because nonsteroidal anti-inflammatory drugs [NSAIDs] have been associated with inhibition of platelet aggregation and with the potential for gastrointestinal ulceration or bleeding, concurrent administration with an anticoagulant could increase the risk of adverse effects; however, studies in dogs have indicated that effects on thromboxane A_2 [as measured by thromboxane B_2] are minimal, making antiplatelet effects unlikely when administered at recommended dosages;[R-23] also, it has been reported that no change in buccal mucosal bleeding time occurs in healthy dogs with a single 0.2 mg/kg dose[R-14])

Anti-inflammatory drugs, nonsteroidal (NSAID) or Corticosteroids
(concurrent administration of more than one NSAID or of corticosteroids with a NSAID may greatly increase the risk of adverse effects)[R-1-4]

Diuretics
(animals on diuretic therapy could have an increased risk of renal toxicity with NSAID administration)[R-1]

Nephrotoxic medications
(NSAIDs have been associated with renal toxicity; therefore, administration with other nephrotoxic medications should be viewed with caution)[R-1]

Medical considerations/Contraindications

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The medical considerations/contraindications included have been selected on the basis of their potential clinical significance (reasons given in parentheses where appropriate)—not necessarily inclusive (» = major clinical significance).

Except under special circumstances, this medication should not be used when the following medical problems exist:

Bleeding disorders[R-3; 4]
(because nonsteroidal anti-inflammatory drugs [NSAIDs] have been associated with inhibition of platelet aggregation and with the potential for gastrointestinal ulceration or bleeding, their administration to animals with bleeding problems, including coagulation or platelet function disorders, could increase the risk of adverse effects; however, studies in dogs have indicated that effects on thromboxane A_2 [as measured by thromboxane B_2] are minimal, making antiplatelet effects unlikely when administered at recommended dosages;[R-23] also, it has been reported that no change in buccal mucosal bleeding time occurs in healthy dogs with a single 0.2 mg/kg dose[R-14])

Cardiovascular disease or
Hepatic dysfunction or
Renal dysfunction
(because NSAIDs have been associated with renal toxicity, risk to patients with cardiovascular, hepatic, or renal compromise may be increased) [R-1; 3; 4]

Dehydration[R-1]
(dehydration could increase the risk of renal toxicity with NSAID administration)

Gastrointestinal bleeding or ulceration[R-3]
(many NSAIDs are known to increase the risk of gastrointestinal disease, particularly ulceration;[R-1] therefore, the presence of lesions before treatment may put an animal at risk of exacerbation or perforation)

Hypersensitivity to meloxicam[R-1; 2; 3; 14]

Hypersensitivity to peroxicam[R-24]

Hypersensitivity to aspirin or other NSAIDs[R-2]
(previous development of adverse effects from meloxicam may be an indication of increased risk of future sensitivity; caution is advised when an animal has previously reacted to other anti-inflammatory medications)

Patient monitoring

The following may be especially important in patient monitoring (other tests may be warranted in some patients, depending on condition; » = major clinical significance):

Blood chemistry and
Complete blood count (CBC)
(bloodwork pretreatment and periodically during treatment is recommended)[R-1]

Physical exam
(a physical exam and history are recommended before treatment)[R-1]

Side/Adverse Effects

The following side/adverse effects have been selected on the basis of their potential clinical significance—not necessarily inclusive:

Note: Nonsteroidal anti-inflammatory drugs (NSAIDs) that inhibit cyclooxygenase have been associated with gastrointestinal and renal toxicity. Susceptibility to side effects varies among individual animals. As with other NSAIDs, gastrointestinal toxicity is the most frequently reported adverse effect with meloxicam administration in dogs.[R-1; 3]

The following events were reported in dogs during two *field safety studies* involving a combined total of 306 dogs. One study of 224 client-owned dogs compared placebo with meloxicam, administered by an initial subcutaneous injection of 0.2 mg per kg of body weight (mg/kg) on the first day, followed by 0.1 mg/kg orally once a day for 13 days. The second study, of 82 dogs, used the same dosage regimen, except that the initial dose was administered orally.[R-8 ; 13]

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Incidence more frequent

Dogs

Diarrhea—reported in 12% of dogs treated with meloxicam and 7% of placebo-treated dogs;[R-1] ***vomiting***—reported in 25% of dogs treated with meloxicam and 15% of placebo-treated dogs[R-1]

Incidence less frequent

Dogs

Inappetance—3% of dogs treated with meloxicam and <1% of placebo-treated dogs[R-1]

Incidence rare—<1% of animals treated with meloxicam

Dogs

Bleeding gums after dental procedure; bloody stool; epiphora; lethargy; swollen carpus

The following are drawn from *postmarketing reports* of suspected adverse drug reactions (SADRs) monitored worldwide since 1995:[R-3]

Incidence unknown

Dogs (categories listed in decreasing order of frequency)

Gastrointestinal effects (vomiting, diarrhea, inappetence, melena, hematemesis, gastrointestinal ulceration); ***central nervous system/behavioral effects*** (ataxia, personality change, seizures, sleepiness, hyperactivity, depression, trembling, lethargy in a nursing puppy[R-1]); ***renal effects*** (elevated creatinine and blood urea nitrogen, acute renal failure); ***dermatologic effects*** (pruritis, eczema, focal alopecia, pyotraumatic moist dermatitis [hot spots], pyoderma[R-1]); ***hypersensitivity*** (urticaria, allergic dermatitis); ***hematologic effects*** (immune-mediated hemolytic anemia, immune mediated thrombocytopenia); ***hepatic effects*** (elevated liver enzymes, jaundice); ***polyarthritis***[R-1]

Overdose

For more information in cases of overdose or unintentional ingestion, **contact the American Society for the Prevention of Cruelty to Animals (ASPCA) National Animal Poison Control Center** (888-426-4435 or 900-443-0000; a fee may be required for consultation) **and/or the drug manufacturer**.

Clinical effects of overdose

The following effects have been selected on the basis of their potential clinical significance (possible signs in parentheses where appropriate)—not necessarily inclusive:

Dogs

With an oral dose of 0.3 to 0.5 milligram per kilogram (mg/kg) a day for 6 weeks, the following were reported during the treatment period:[R-1]

Renal changes

Note: This study of twenty-four dogs (six per treatment group) compared untreated dogs with dogs given the labeled maintenance dose (0.1 mg/kg a day), 3 times the labeled dose (0.3 mg/kg a day), or 5 times the labeled dose (0.5 mg/kg a day). Gastrointestinal signs and histopathology were similar among the groups. There were no changes in hematology, blood chemistry, urinalysis, clotting time or buccal mucosal bleeding times associated with meloxicam treatment. Two of six dogs receiving 0.3 mg/kg a day and two of six receiving 0.5 mg/kg a day developed renal enlargement. When the kidneys were examined microscopically, degeneration or slight necrosis at the tip of the papilla was noted in three dogs receiving 0.5 mg/kg a day.[R-1; 8]

With an oral dose of 0.3 to 0.5 mg/kg a day for 6 months, the following were reported in some dogs during the treatment period:[R-1]

Albumin, decreased—reported in dogs administered 0.5 mg/kg a day, ***anemia, regenerative; blood urea nitrogen, increased***—reported with 0.5 mg/kg a day; ***hematocrit, decreased; neutrophilia; red blood cell count, decreased***

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Note: Like the study described above, this study of twenty-four dogs (six per treatment group) compared untreated dogs with dogs given meloxicam at a dose of 0.1, 0.3, or 0.5 mg/kg a day, but for a more prolonged period of time. No significant clinical adverse effects were demonstrated.[R-1; 3; 4] Gastrointestinal signs were noted in all groups, including the dogs not given meloxicam. Gastric endoscopy results and gross gastrointestinal changes at necropsy were similar among groups. No gross or microscopic renal changes were observed.[R-1]

With an intravenous dose administered every two weeks, the first two doses being 2 mg/kg, the second two, 6 mg/kg, and the final two 12 mg/kg, the following were reported during the treatment period:[R-8]
Pyloric gastric ulceration or perforation (fecal blood loss increasing as dose increases; frequent vomiting; lethargy; recumbence)

With an intravenous dose of 0.2 to 0.6 mg/kg a day for 3 days: [R-14]
Gastrointestinal effects; renal changes
Note: Histologic examination of the kidneys showed *renal changes* in some dogs that included dilated medullary and cortical tubules, interstitial inflammation, and renal papillary necrosis.
Other changes noted on histology in some dogs included *gastrointestinal* superficial mucosal hemorrhages, congestion, and erosions as well as mesenteric lymphadenopathy.

With an intravenous dose of 1 mg/kg a day for 3 days: [R-13; 14]
Gastrointestinal effects (including fecal blood loss); ***renal compromise; renal failure, acute***
Note: Dogs developed *renal compromise,* showing significant urinary protein excretion and increases in blood urea nitrogen and creatinine. Dogs with significantly elevated creatinine developed *acute renal failure* by the fourth day of the study.

Client Consultation

A tear-off client information sheet attached to the product insert is provided by the United States manufacturer for clients administering oral meloxicam to their dogs.[R-2]

In providing consultation, consider emphasizing the following selected information:

Keeping water readily available during the treatment period to avoid dehydration

Never exceeding the prescribed daily amount without veterinary consultation; contacting a veterinarian if more than the daily dose is consumed[R-2]

Familiarizing clients with signs that an adverse reaction may be occurring, including vomiting, change in behavior, change in bowel movements, change in drinking habits, change in the skin, change in urination habits, a change in appetite, or yellowing of the gums, skin or white of the eyes.[R-2] Instructing them to discontinue medication and contact their veterinarian if a reaction is suspected

Not administering nonsteroidal anti-inflammatory drugs labeled for human use to animals without guidance from a veterinarian; human dosages may be toxic or fatal for animals

Veterinary Dosing Information

Oral administration

Meloxicam has almost complete bioavailability when adminstered orally with food. Administration with food is recommended for accurate dosing in small dogs (see *Oral Dosage Forms* below).[R-1; 2]

For perioperative administration

Perioperative fluid therapy was administered to adult dogs in clinical trials that demonstrated the safety of perioperative administration.[R-4]

General health and age of the animal are considered in the decision to use a nonsteroidal anti-inflammatory drug perioperatively. Potential

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factors include pre-existing debilitation or stress; the concurrent administration of other medications, including those used for anesthesia, that may lower blood pressure or increase the risk of hepatic or renal toxicity; or surgery that may lead to reduced tissue perfusion.[R-4]

Canadian product labeling lists protocols that have been used for anesthetizing dogs treated perioperatively with meloxicam.[R-4] No adverse effects were reported when the following combinations were used with meloxicam:

Acepromazine + Butorphanol/Thiopentone sodium/Halothane
Acepromazine/Ketamine + Diazepam/Halothane
Acepromazine/Thiopentone/Isoflurane
Diazepam/Propofol/Isoflurane

Oral Dosage Forms

Note: Bracketed information in the *Dosage Forms* section refers to uses that either are not included in U.S. product labeling or are for products not commercially available in the U.S.

MELOXICAM ORAL SUSPENSION

Usual dose:

Inflammation, musculoskeletal; or
Pain, musculoskeletal—*Dogs:* Oral, 0.2 mg per kg of body weight as an initial dose, followed by 0.1 mg per kg of body weight every twenty-four hours.[R-1; 3]

Note: The manufacturer gives specific instructions for administering meloxicam to dogs with the tools provided,[R-1] as follows:

Shake the bottle well before using.

Be aware that in the United States, the dropper bottle delivers 0.05 mg of meloxicam per drop while in Canada, as of early 2004, the dropper bottle delivers 0.1 mg per drop. The Canadian dropper is expected to change in 2004 so that it delivers the same amount per drop, 0.05 mg, as the dropper marketed in the United States.[R-12] The concentration delivered by a particular dropper can be found in the product labeling.

For dogs weighing less than 2.3 kg (5 pounds), the dose is measured by using the dropper bottle to count the appropriate number of drops onto the food. It should not be administered into the dog's mouth.

For dogs weighing between 2.3 and 4.5 kg (5 and 10 pounds), the medication is also administered onto the food, rather than into the mouth. However, the dose can be measured by using either the dropper bottle or the syringe provided. Using the dropper, the dose is measured by the number of drops for the dog's weight, as described above. With the syringe available in the U.S., the dose is measured by increments marked for each 5 pounds of body weight, rounded down to the nearest 5 pounds.[R-1] In Canada, the syringe is marked in increments based on kilograms of body weight.[R-3] In both countries, the syringe is scaled to deliver the maintenance dose of 0.1 mg/kg.[R-1; 3]

For dogs weighing more than 10 pounds, the medication may be administered on the food or into the mouth, using either the dropper bottle or syringe, as described above.[R-1]

Note: [*Cats*][1]—Although there is evidence to support the safety and efficacy of the short-term (less than one week) administration of meloxicam to cats,[R-9-11] there are insufficient data to establish the best recommendation for long-term administration in the treatment of pain and inflammation. Therefore, clinicians have recommended beginning treatment with a dose of 0.1 mg per kg of body weight and, depending on clinical response, extending the time between doses so that the medication is given every other day or every third day.

Because of limited data, there is no consensus on the minimum effective dose; however, some clinicians will begin with the dose of 0.1 mg per kg of body weight a day and gradually taper it to a daily dose as low as 0.03 to 0.05 mg per kg of body weight, sometimes administered as 0.1 mg per cat a day. There are anecdotal reports of

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successful management in some cats, even when this low dose is given every other day or every third day.

For dosing recommendations in the control of postoperative inflammation and pain in cats, see *Meloxicam Injection* below.

Strength(s) usually available:

U.S.—{R-1}

Veterinary-labeled product(s):

1.5 mg per mL (Rx) [*Metacam*].

Canada—{R-3}

Veterinary-labeled product(s):

1.5 mg per mL (Rx) [*Metacam*].

Caution: Keep out of the reach of children.{R-1}

Packaging and storage: Store between 15 and 30 °C (59 and 86 °F){R-1}, unless otherwise specified by manufacturer.

USP requirements: Not in USP.{R-7}

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[1]Not included in Canadian product labeling or product not commercially available in Canada.

MELOXICAM TABLETS

Usual dose: See *Meloxicam Oral Suspension.*

Strength(s) usually available:

U.S.—{R-1}

Veterinary-labeled product(s):

Not commercially available.

Human-labeled product(s):

7.5 mg (Rx) [*Mobic*].

15 mg (Rx) [*Mobic*].

Canada—{R-3}

Veterinary-labeled product(s):

Not commercially available.

Human-labeled product(s):

7.5 mg (Rx) [*Mobicox;* GENERIC].

15 mg (Rx) [*Mobicox;* GENERIC].

Packaging and storage: Store between 15 and 30 °C (59 and 86 °F), in a dry place, unless otherwise specified by manufacturer.

USP requirements: Not in USP.{R-7}

Parenteral Dosage Forms

Note: Bracketed information in the *Dosage Forms* section refers to uses that either are not included in U.S. product labeling or are for products not commercially available in the U.S.

MELOXICAM INJECTION

Usual dose:

Inflammation, musculoskeletal; or

Pain, musculoskeletal—*Dogs:* Intravenous or subcutaneous, 0.2 mg per kg of body weight as an initial dose. Product labeling recommends that meloxicam oral suspension be used for continuation of treatment, administered orally at a dose of 0.1 mg per kg of body weight every twenty-four hours.{R-4; 14}

[Inflammation, postoperative]; or

[Pain, postoperative]—

Dogs: Intravenous or subcutaneous, 0.2 mg per kg of body weight, administered before surgery.{R-4}

Note: Perioperative fluid therapy was administered to adult dogs in clinical trials that demonstrated the safety of perioperative administration.{R-4}

Cats[1]: Subcutaneous, 0.2 mg per kg of body weight, administered as a single dose.{R-11}

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Strength(s) usually available:

U.S.—[{R-14}]

Veterinary-labeled product(s):

5 mg per mL (Rx) [*Metacam*].

Canada—[{R-4}]

Veterinary-labeled product(s):

5 mg per mL (Rx) [*Metacam*].

Caution: Keep out of the reach of children.[{R-4}]

Packaging and storage: Store at or below 25 °C (77 °F)[{R-4}], unless otherwise specified by manufacturer.

USP requirements: Not in USP.[{R-7}]

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[1]Not included in Canadian product labeling or product not commercially available in Canada.

Developed: 2/6/04

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