Cats can be difficult to safely anesthetize because of their small body size, fractious nature, and altered metabolism of anesthetic drugs. Furthermore, cats are frequently undertreated for pain. This occurs for a variety of reasons, including difficulty in recognizing pain in cats and lack of knowledge of analgesic therapy for cats. Cats are now the most popular pet in the United States, and it is imperative that we arm ourselves with safe, effective means of providing anesthesia and analgesia in cats.

**Anesthesia Techniques That Are NOT Recommended**

Induction to anesthesia with inhalant anesthetic drugs alone (“masking” or “boxing”) should be avoided in all but the direst circumstances. This technique is acceptable only for roughly 5% of feline patients—4% are so sick that they only need a “whiff” of gas to be completely anesthetized (and NO excitement or struggling will occur), and 1% are so aggressive that they can’t be anesthetized in any other way. Here are the reasons that induction to anesthesia with inhalant anesthetic drugs alone is absolutely not recommended:

1. **Masking/boxing down is dangerous to the patient**
   - Although inhalant anesthetic drugs are fairly safe, they do cause dose-dependent depression of the CNS, cardiovascular, and respiratory systems. Thus, a LOW dose of inhalant gas is safe, but the HIGH dose required to induce a patient to anesthesia when no concurrent drugs are administered is technically an overdose and is NOT safe.
   - The excitement that the patient goes through with the resultant increase in the release of catecholamines and all of the physiological changes that occur secondary to catecholamine release (e.g., tachycardia, hypertension, hyperventilation, etc.) is very dangerous and can result in complications in even healthy patients. These complications can be severe in compromised patients, and mortality from cardiac or pulmonary arrest has occurred.

   Paradoxically, mask or box induction is frequently reserved for sick and compromised animals, the group that is least likely to tolerate the high concentrations of inhalant anesthetic required to induce anesthesia.—Pete Hellyer DVM, MS, DACVA, Professor, College of Veterinary Medicine, Colorado State University

   - The release of catecholamines also delays induction to anesthesia and results in more drugs being administered to the patient before induction to anesthesia is achieved. By the time the patient is actually asleep, it may be so deeply anesthetized that it is on the verge of a “capture-type” death.
   - Masking/boxing is too slow, and for the duration of the induction the anesthetist is not in control of the patient. It is MUCH safer to stay in control of the patient by quickly inducing the animal to anesthesia with injectable drugs, rapidly intubating the patient, and starting the patient on inhalant drugs and oxygen.
   - The maintenance period of anesthesia is also more dangerous if inhalant anesthetic agents are the only drugs utilized. The patient has no basal level of analgesia and/or sedation to help blunt responses to surgical stimulus, and high concentrations of inhalant drugs are required to keep the patient asleep.

2. **Masking/boxing is dangerous to the staff**—no matter how tight the mask fits or how careful you are with the induction chamber, anesthetic gas will contaminate the environment, and the staff will be exposed to inhalant gas. Although anesthetic gases are very safe, chronic exposure has been shown to lead to headaches and irritability and may lead to more serious health issues. Why put your staff in danger?
3. Masking/boxing is not good for business.
   - Time is money! We waste a lot of time standing around waiting for the cat to go to sleep and more time trying to intubate a patient that keeps waking up every time its larynx is stimulated.
   - The high flow of oxygen and inhalant gas required to anesthetize the patient is no less expensive (and may be more) than a quick injection of ketamine/valeium (for example).

**Anesthesia Techniques That ARE Recommended**

Provision of sedation and analgesia in the preanesthetic period, followed by rapid induction to anesthesia with intravenous (IV) anesthetic agents, followed immediately by endotracheal intubation and the administration of an inhalant gas in oxygen is the safest way to provide anesthesia in most patients. Intramuscular (IM) administration of a combination of both sedative/analgesic and induction drugs is also acceptable in the cat (e.g., administration of buprenorphine + medetomidine + ketamine IM). When designing anesthetic protocols, consider the following principles:

1. No matter what anesthetic protocol is chosen, safe and successful anesthesia will be enhanced by the use of pre-anesthetic tranquilizers. This is evidenced by two facts:
   - Stress in the perioperative period is extremely dangerous physiologically. (Think about capture deaths that occur in wild animals.)
   - Tranquilizers allow reduction in the dose of both induction and maintenance agents, thus increasing the distance between “effective dose” and “dangerous or toxic dose” of drugs.

2. Also, no matter what anesthetic protocol is chosen, analgesia is imperative. The use of analgesic drugs improves anesthetic safety by allowing the use of lower dosages of induction and maintenance drugs. Analgesia is discussed in the next section.

3. Our goal should be the provision of balanced anesthesia. Using a variety of drugs allows us to capitalize on the synergism between the drugs while decreasing the dose of each drug. With our current knowledge of pharmacology and the availability of safe, effective anesthetic and analgesic agents, anesthetizing a patient with a single agent (e.g., no premedicant, inhalant induction, inhalant maintenance) is no longer appropriate. Nor is it safe.

Sedatives and analgesic agents often used as premedicants in cats include acepromazine, medetomidine, dexmedetomidine, diazepam, midazolam, and opioids (e.g., butorphanol, buprenorphine, morphine and hydromorphone). Induction agents include ketamine/diazepam, propofol, and tiletamine/zolazepam, and maintenance agents include isoflurane and sevoflurane. Some sample protocols are listed following the discussion on analgesia.

**Management of Acute Pain**

Pain is described in Stedman’s Medical Dictionary as, “suffering, either physical or mental; an impression on the sensory nerves causing distress or, when extreme, agony.” The sensation of pain is perceived and processed by peripheral receptors, afferent pathways to the spinal cord, discrete neurological tracts ascending the spinal cord, and terminal modulating and perceptual areas in the brain. The anatomical components of this pathway are present in all mammals, from human beings to horses, and we should be certain that animals do indeed feel pain. As veterinarians, we take an oath to “use scientific knowledge and skills for the . . . relief of animal suffering,” and the prevention and/or relief of both acute and chronic animal suffering should be a common objective of each and every veterinarian and veterinary nurse or technician.

However, not all of our patients receive the best pain management that we can provide. Cats, the most popular pet in the United States, are frequently undertreated for pain. This occurs for a variety of reasons, including difficulty in recognizing pain in cats and lack of knowledge of analgesic therapy for cats. Recognition of pain can be difficult in this species since they rarely demonstrate pain overtly. However, since they have the same pain pathway that human beings have, we can be certain that cats do indeed feel pain, and we should treat based on the anticipated pain rather than waiting for pain to be exhibited. Furthermore, although few drugs are currently licensed by the FDA for relief of pain in cats in the United States, a number of available analgesic drugs can be safely and effectively used in this species.
**Principles of Pain Management**

“Preemptive analgesia,” or analgesia administered prior to the painful stimulus, prevents or alleviates the hypersensitization of the pain pathways. Hypersensitization, or “wind up,” occurs in response to a painful stimulus and makes the resulting pain more difficult to control. This can lead to a painful response that is heightened over what is expected from the stimulus or even to a painful response to a normally innocuous stimulus. Preempting pain will decrease the overall intensity of the pain sensation and will increase the effectiveness of analgesic drugs. The dose and frequency of analgesic drugs required to control pain that was preempted are minimal compared to the dose and frequency required to control pain that was allowed to develop unchecked. Because animals hide pain for as long as they possibly can, we can be certain that, once an animal is exhibiting pain, the hypersensitization process has begun and pain will be more difficult to treat. Thus, our primary goal should be to prevent pain rather than to treat pain.

From the recent research concerning the mechanisms of nociception, it is clear that it is better to prevent pain than to treat it. This is a somewhat novel idea when applied to treating pain, but the idea of prevention is clearly entrenched in other medical disciplines. Many animals are vaccinated to prevent them from suffering the pain related to particular disease even though the prevalence of many of these diseases is low. We know that every surgical procedure causes some pain to the patient and that some procedures are more painful than others. With the idea of prevention in mind, we must first do everything possible to reduce the factors that potentiate pain perception.—Peter Pascoe, Anesthesiologist, University of California, Davis (Vet Clin NA 2000)

Along with preemptive analgesia, **multimodal analgesia** should be considered, since analgesia is generally best provided by using a combination of analgesic drugs and/or analgesic techniques. This practice capitalizes on the additive or synergistic effects of analgesic drugs and allows us to provide analgesia that is more intense and of longer duration than analgesia provided with any one drug used alone. Examples of multimodal analgesia are listed in the protocols section at the end of this manuscript.

Finally, pain must be addressed even after the patient has been discharged from the hospital. Many veterinarians feel that animals do not need analgesic drugs once they have left the hospital because the patients tend not to exhibit pain at home. However, we know that animals instinctively hide pain and that pain, even from elective procedures, does not just magically go away once the animal is no longer in the hospital. Instead, the pain dissipates gradually over a period of days to weeks (depending on the severity of the disease, injury, or surgery), and the pain that the animal experiences in that time should be addressed. Even if the animal appears “okay,” as scientists we know that we severed nerves, caused tissue trauma, and induced inflammation, and that these sources of pain will undoubtedly cause some discomfort that only we can address.

The optimum duration of analgesic therapy after major surgery in companion animals is unknown. In an animal that is receiving analgesics, the apparent absence of pain or distress does not by itself justify discontinuation of therapy. This would be analogous to discontinuing antibiotic treatment the moment a patient’s fever breaks.—Bernie Hansen, Analgesic Therapy, The Compendium (July 1994): 868–875.

**What Analgesic Drugs Are Available for Acute Pain?**

**Opioids** are the most potent analgesic drugs available and should be used for all types of pain, especially pain that is moderate to severe. Opioids suitable for cats include full opioid agonists like morphine, hydromorphone, oxymorphone, and fentanyl. Full opioid agonists are very useful in cats and are generally administered with a sedative (e.g., acepromazine or detomidine) to avoid excitement.

**Cat Dosages:**
- Morphine 0.1–0.25 mg/kg IM
- Hydromorphone 0.1–0.2 mg/kg IM, IV, SQ

Other opioids include the agonist-antagonist butorphanol and the partial agonist buprenorphine. These drugs are not as potent as full agonists, and butorphanol has a very short duration of action (45–90 minutes). Buprenorphine has a fairly long duration of action (6–12 hours) and can be administered buccally in cats, both in-hospital and for at-home therapy.
**Cat Dosages:**
- Buprenorphine 0.01–0.03 mg/kg IM, IV, SQ, buccal (transmucosal)
- Butorphanol 0.2–0.4 mg/kg IM, IV, SQ

*Non-steroidal anti-inflammatory drugs* (NSAIDs) are one of the few groups of drugs available that actually treat the *source* of the pain (inflammation) as well as the pain itself. Because of this impact on the pathology that is causing the pain, NSAIDs should be considered at any time that pain of inflammation is present—and most of the pain we treat involves some degree of inflammation (e.g., surgery, trauma, osteoarthritis, cancer, etc.). Both injectable meloxicam (approved in the United States) and injectable carprofen (approved in other countries but not the United States) are used as a one-time injection to treat acute pain in cats.

**Dosage:** Meloxicam 0.2 mg/kg SQ, one time

**Local anesthetic agents** are inexpensive, easy to administer, and extremely effective. The most commonly used local anesthetic agents include bupivacaine (5-minute onset, 4-hour duration) and lidocaine (2-minute onset, 60–90 minute duration).

**Dosage:** 1–2 mg/kg of either drug. The low end of the dose is generally used in cats.

**Alpha-2 adrenergic agonists** (*medetomidine, dexmedetomidine*) provide moderate analgesia, can provide anything from light to deep sedation, and are reversible. However, these drugs cause cardiovascular changes that are well-tolerated in patients with healthy hearts but are not appropriate for patients with cardiovascular disease.

**Cat Dosages:**
- Medetomidine 80–100 microg/kg IM as premed and for rough recovery
- Dexmedetomidine 20–30 microg/kg IM as premed and for rough recovery

**NMDA receptor antagonists** (*ketamine*) can be used to treat “wind-up” or hypersensitivity but are not true analgesic agents and must be administered as a constant rate infusion (CRI); the dosage is 2–10 microg/kg/min.

**Commonly Used Anesthesia/Analgesia Protocols in Cats**

**Quiet, healthy cats:**
- PREMED: 0.4 mg/kg butorphanol or 0.03 mg/kg buprenorphine + 10–15 microg/kg dexmedetomidine IM;
- INDUCTION: Ketamine/va1ium 1:1 ratio and administered at 1 ml/10 kg IV OR 2-4 mg/kg propofol IV OR 2–5 mg/kg tiletamine/zolazepam (or one of the various tiletamine/zolazepam combinations);
- MAINTENANCE: isoflurane or sevoflurane to effect
  OR
  PREMED/INDUCTION: 0.1–0.2 MLS/4.5 kgs of each of these three drugs (butorphanol or buprenorphine + ketamine + dexmedetomidine) combined in the same syringe and administered IM;
- MAINTENANCE: isoflurane or sevoflurane to effect

**Quiet, unhealthy cats:**
- PREMED: 0.4 mg/kg butorphanol or 0.03 mg/kg buprenorphine alone or with 0.2 mg/kg midazolam IM
- INDUCTION: Ketamine/va1ium 1:1 ratio administered at 1 ml/20 kg IV OR 1-2 mg/kg propofol OR 0.1 mg IV valium + 1 mg/kg propofol;
- MAINTENANCE: isoflurane or sevoflurane to effect

**Fractious, unmanageable cats:**
- PREMED/INDUCTION: 0.1-0.2 MLS/4.5 kgs of each of these three drugs (butorphanol or buprenorphine + ketamine + dexmedetomidine) combined in the same syringe and administered IM OR various tiletamine/zolazepam combinations;
- MAINTENANCE: isoflurane or sevoflurane to effect

**Additional Analgesia**
Use of opioids with NSAIDs is a good example of the use of multimodal analgesia. However, even these two drug classes used together may not be able to control moderate to severe pain. In this instance, other analgesic techniques should be added to the analgesic protocols. Ideas for additional analgesia include:
• Use of local anesthetic blocks. Utilize local anesthesia for onychectomy (ring, 3-point, or digit block), dental/oral surgery (infraorbital and maxillary blocks), forelimb surgery (brachial plexus block), incisional pain (local infiltration), etc.

• Use of regional anesthetic techniques like epidurals. Epidurals are fairly easy and provide effective analgesia for pain in the caudal portion of the patient (e.g., use for rear limb orthopedic surgeries, bladder and urethra surgeries, surgeries on the tail, etc.).

• Use of constant rate infusions. Constant rate infusions are extremely easy to administer and very effective for controlling pain. Consider using opioids, ketamine, and alpha-2 agonists.