Feline Health Topics

for veterinarians

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Anesthesia for the Old Cat

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In and of itself, age is not a contraindication for anesthesia in any animal, but for a number of reasons the aged cat can be an anesthetic challenge. In terms of behavior, it is not unusual for the aged cat to be somewhat of a "grouch." For the most part, old cats enjoy relaxing and basking in their favorite quiet spot. They do not take kindly to being poked and prodded, and needles are definitely not appreciated. As a result, it is not unusual for the aged cat to aggressively resist physical examination or restraint, and the ensuing struggle can be stressful for all concerned. The implication for anesthetic management is that stress causes an increase in circulating catecholamines that sensitize the heart to arrhythmias. Furthermore, if over time the aged cat has compensated for diminished physiologic function due to age-related processes, the stress of handling and restraint, needle sticks and a strange or unpleasant environment may make the animal less able to tolerate the stresses normally associated with anesthesia and especially surgery.

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Cardiopulmonary disease is certainly not uncommon in the older patient. A proper physical examination with special attention given to the cardiopulmonary system is necessary. It is important to use drugs that either minimally affect or have positive effects on cardiac function. Anticholinergics such as atropine or glycopyrrolate can be used to prevent bradycardia and to dry up airway secretions. Glycopyrrolate may be better for cardiac patients than atropine because it does not produce as much tachycardia. Anticholinergics need not be used in every patient. For example, an anticholinergic should not be given to a scared cat with a heart rate greater than 180 beats per minute. (Refer to Tables 1, 2 and 3.)

Xylazine, although well-tolerated in the young fit cat, is not an ideal drug to use in older cats because of its profound cardiopulmonary effects, including bradyarrhythmias, decreased cardiac output, and transient hypoxemia. For older cats with cardiopulmonary disease, opioids such as oxymorphone, or neuroleptanalgesics such as Innovar, are excellent premedicants to prepare a cat for anesthesia.

At Cornell University, we use oxymorphone (0.05 to 0.07 mg./kg., intramuscular [IM] or subcutaneous [SQ]) for very old cats, cats with significant systemic disease, or for those cats in which we wish to provide more analgesia in addition to that provided by the primary anesthetic. For example, ketamine does not provide sufficient analgesia to completely block pain of visceral origin. For cat castrations and

Table 1 - Comparison of the cardiovascular effects of premedicants used in cats

DRUG	HR	BP	CO	MVO2	RHYTHM
Acepromazine	+	-	+	+	Antiarrhythmic
Butorphanol	-	NC	NC/-	NC	+ Vagal tone
Diazepam	NC	NC	NC	NC	NC
Innovar®	-	NC	NC/-	NC	+ Vagal tone
Ketamine	+	+	+	+	Sinus tachyarrhythmia
Meperidine	-	-	NC/-	NC	+ Vagal tone
Midazolam	NC	NC	NC	NC	NC
Morphine	-	NC/-	NC/-	NC	+ Vagal tone
Oxymorphone	-	NC	NC/-	NC	+ Vagal tone
Telazol®	+	+	+	+	Sinus tachyarrhythmia
Xylazine	-	+/-	-	-	Arrhythmogenic

+ = increase in this parameter compared to the resting state; - = decrease in this parameter compared to the resting state; NC = no change; HR = heart rate; BP = blood pressure; CO = cardiac output; MVO2 = myocardial oxygen consumption

onychectomies we use ketamine as our primary anesthetic, but we provide additional analgesia by using opioids, typically oxymorphone. All of our spays are done under general inhalant anesthesia which provides sufficient anesthesia and analgesia for the surgical procedure. (See Table 4 for a listing of drugs and dosages used at Cornell University.)

Innovar (1 ml./10 kg., SQ) is used for neuroleptanalgesia in cats, especially those cats that are fractious and difficult to handle, old cats, and cats with a variety of systemic diseases. We have found it to be particularly useful in cats with cardiac disease such as hypertrophic cardiomyopathy. The drug will sting when injected. After 25 minutes it is not unusual for the cat to show signs that are not typically associated with sedation. In fact, the cat may appear to be quite alert and may vocalize when approached and picked up. However, if handled gently but firmly, and especially if they are scratched around their ears, these cats tolerate restraint and intravenous catheterization very well. Innovar has enabled us to use very low concentrations of inhaled anesthetics such as isoflurane. In some instances, anesthesia with isoflurane has been maintained with vaporizer dial settings of less than 0.5%. One would expect to be able to achieve similarly low concentrations with halothane.

The old cat may have diminished renal function as a normal result of the aging process or due to disease. In the cat, ketamine is largely excreted unchanged through the kidneys. Therefore, inadequate renal function will prolong its duration of effect.

Table 2 - Comparison of the cardiovascular effects of anesthetic induction drugs used in cats

DRUG	HR	BP	CO	MVO2	RHYTHM
Diazepam and ketamine	+	+	+	+	Sinus tachyarrhythmia
Etomidate	NC	NC	NC	NC	NC
Thiamylal	+	-	-	+	Arrhythmogenic
Thiopental	+	-	-	+	Arrhythmogenic
Telazol®	+	+	+	+	Sinus tachyarrhythmia

See Table 1 for abbreviations.

Older cats may have endocrine disease, the most common of which is hyperthyroidism. Endocrine diseases can significantly affect the function of vital body organs and drug metabolism. The hyperthyroid cat has increased oxygen consumption and the heart is more sensitive to catecholamine or thyroid hormone-induced cardiac arrhythmias. The implications for anesthetic management are that these cats do not tolerate even brief periods of apnea, and stress-related hormones such as epinephrine, can induce tachycardia and cardiac arrhythmias, all of which adversely affect cardiac function.

In the older patient all drugs, including anesthetic drugs, are metabolized more slowly and their duration of effect may be prolonged, thus increasing the likelihood that an adverse drug reaction will occur.

Monitoring the Patient

Monitoring is the foundation of safer anesthesia. Elaborate and expensive monitoring techniques and equipment are not necessary. Variables to monitor include heart rate and rhythm, pulse rate and pressure, respiratory rate and tidal volume, mucous membrane color and capillary refill time, core body temperature, temperature of extremities and ears, jaw tone, and palpebral reflex. Monitoring indirect blood pressure with a doppler flow probe (Parks Electronics, Aloha, Oregon) is a very useful and inexpensive technique to use with cats. With the price of pulse oximeters progressively getting cheaper this may be a very effective technique for monitoring cardiopulmonary function in the cat.

Feline Health Topics

A publication for veterinary professionals

The ultimate purpose of the Cornell Feline Health Center is to improve the health of cats everywhere, by developing methods to prevent or cure feline diseases, and by providing continuing education to veterinarians and cat owners. All contributions are tax-deductible.

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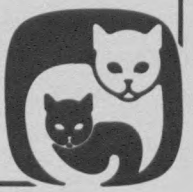

Maintaining fluid balance during anesthesia is important in any anesthetized patient, but it is crucial in the aged cat in order to maintain adequate intravascular volume and perfusion of vital organs that may have diminished function due to age-related changes. Any balanced salt solution such as normal saline (0.9% sodium chloride) or lactated Ringer's solution will suffice. However, cats with electrolyte disturbances or glucose imbalances will require fluid therapy directed at correcting these imbalances. Cats with heart disease should not receive fluids high in sodium content as the sodium can lead to intravascular overload and acute heart failure. The fluids of choice are half-strength lactated Ringer's plus 2.5% dextrose, or 0.45% sodium chloride plus 2.5% dextrose, or 5% dextrose in water. Adequacy of hydration can be determined by monitoring blood pressure, packed cell volume and plasma proteins, capillary refill time, and urine output. For the patient with cardiac disease, a fluid rate of 10 ml./kg./hr. or less should be used.

Anesthesia does not end when the vaporizer is turned off. The effects of anesthetics can, and do, continue well into the recovery period. As a general rule, the cat should be observed during recovery to make sure that it is progressively returning to the same behavioral state that it was prior to anesthesia, and that it is doing so in a timely fashion. More specifically, it is important to keep the cat warm, to make sure that it is not having any airway problems and, if necessary, provide additional oxygen. It may be necessary to continue fluid therapy during recovery depending on the cat's health status. If opioids or alpha2-adrenergic agonists have been used during anesthesia it is possible to shorten the duration of recovery by administering specific antagonists. Naloxone (0.02 mg./kg., intravascular [IV] or IM) can be used to reverse the effects of opioids. However, naloxone will also reverse opioid-induced analgesia, and if the cat has a problem that is particularly painful, reversal may cause the cat to become violently excited and stressed. For some patients it may be preferable to support the recovery process by taking the steps mentioned above rather than resorting to the use of antagonists.

Xylazine frequently is reversed because of its prolonged duration of effect and its cardiopulmonary effects. Xylazine can be reversed with either yohimbine (0.1 mg./kg., IV or IM) or tolazoline (1.0 to 2.0 mg./kg., IV or IM). ■

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Tables 1-3 were adapted from Mason D.E., Atkins C. E., 1991. Anesthesia for the cardiac patient. In *Small Animal Medicine*,. Dana G Allen (Ed), pp 365-380, Philadelphia: J. B. Lippincott.

Table 3 - MAC and a comparison of the cardiovascular effects of inhalant anesthetics in cats

DRUG	MAC	HR	INOTROPY	CO	SVR	ARRHYTHMIA
Halothane	1.1	-	-	-	-	+++
Isoflurane	1.6	+	NC/-	NC/-	-	NC
Methoxyflurane	0.23	NC/-	-	-	-	++
Nitrous oxide	255	NC	NC/-	NC/-	NC	NC

+ = increase in this parameter compared to the resting state; - = decrease in this parameter compared to the resting state; NC = no change; HR = heart rate; CO = cardiac output; SVR = systemic vascular resistance; MAC = minimum alveolar concentration

Table 4. Drugs and Dosages used to Anesthetize Cats at the College of Veterinary Medicine Cornell University

A. *PREMEDICANTS*

1. Parasympatholytic: (anticholinergic)

Atropine Sulphate	0.04 mg./kg. IM or SQ
	0.01-0.02 mg./kg. IV
Glycopyrrolate	0.01 mg./kg. or 0.005 mg./lb. or 1 ml./40 lbs. IM, SQ, IV

2. Analgesics:

Butorphanol (Torbugesic)	0.05 - 0.1 mg./kg. IM, IV, SQ
Morphine Sulfate	0.1 mg./kg. IM, SQ
Meperidine HCL (Demerol)	2 - 4 mg./kg., IM, SQ *(not IV)* duration 45 min.
Oxymorphone HCL (Numorphan)	0.05 - 0.1 mg./kg. IM, SQ or IV

3. Narcotic Antagonists:

Naloxone (Narcan)	0.02 - 0.04 mg./kg. IV, IM

4. Tranquilizers/Sedatives

Phenothiazine derivatives:

Acetylpromazine (Acepromazine)	0.02 - 0.1 mg./kg. IM or SQ; use 1/4 IM dose to give IV

Thiazine Derivative:

Xylazine (Rompun)	0.1 - 0.5 mg./kg. IV; or 0.2 - 1 mg./kg. IM, SQ

Benzodiazepines:

Diazepam (Valium)	0.05 - 0.1 mg./kg. IM, IV
Midazolam (Versed)	0.05 - 0.1 mg./kg. IM or SQ

5. Dissociative Drugs:

Ketamine HCL (Ketaset)	5 mg./kg. IM (for chemical restraint)
	3 mg./kg. IV (for induction of anesthesia)

6. Neuroleptanalgesics:

Innovar-Vet	1.0 ml./9 kg. SQ
Oxymorphone	0.05 - 0.1 mg./kg. IM, SQ
+	
Acepromazine	0.02 - 0.1 mg./kg. IM, SQ
Butorphanol	0.05 - 0.1 mg./kg. IM, SQ
+	
Acepromazine	0.02 - 0.1 mg./kg. IM, SQ

B. *INDUCTION DRUGS*

1. Thiobarbiturates: (for safety reasons we use concentrations of 2.5%, 25 mg./ml.)

Thiamylal Sodium (Biotal, Surital)	10 - 15 mg./kg. IV to effect
Thiopental Sodium (Pentothal)	15 - 20 mg./kg. IV to effect
Methohexital Sodium (Brevane, Brevital)	10 mg./kg. IV (Very short duration of effect, 5 to 10 mins.)

2. Ketamine + Diazepam — 1.0 ml./10 kg. IV (Both drugs can be mixed in a ratio of 1:2, or 1:1)
3. Propofol (Diprivan) — 4 - 8 mg./kg. IV (Very short duration of effect and transiently but profoundly depresses cardiopulmonary function)

C. *ALPHA ANTAGONISTS*

Yohimbine (Yobine)	0.1 mg./kg. IV

Research Briefs

Glucose Tolerance and Insulin Secretion in Spontaneously Hyperthyroid Cats

Drs. Hoenig, Peterson and Ferguson at the University of Georgia concluded from their research that hyperthyroidism in cats may lead to long-lasting alterations of glucose tolerance and insulin secretion which may not be reversed by treatment.

Glucose tolerance and insulin secretion were determined after administration of a glucose load in 11 clinically normal cats and 15 cats with spontaneous hyperthyroidism. In sick hyperthyroid cats, a glucose tolerance test was repeated after treatment with radioactive iodine (I_{131}). All cats had similar baseline glucose concentrations. However, the cats with hyperthyroidism had a significantly decreased glucose clearance, which was worse after treatment. Hyperthyroidism also caused a marked increase in basal and glucose-stimulated insulin secretion, which was not improved with treatment. *(Resource: Res Vet Sci 53:338-341, 1992)*

Acute Necrotizing Pancreatitis and Acute Supprative Pancreatitis in the Cat: A Retrospective Study (1976-1989)

Medical records and histological sections of 40 cats with acute pancreatitis were reviewed by Drs. Hill and Van Winkle of the University of Pennsylvania. Two distinct groups of cats with pancreatitis were established by histologic analysis of tissue: Group 1 (32 cats) had acute pancreatic necrosis (APN); Group 2 (8 cats) had suppurative pancreatitis. Ages of affected cats ranged from 3 weeks to 16 years. The majority consisted of indoor cats of the domestic short-haired breed, but Siamese cats were over-represented relative to the general population. Twenty-two percent of the cats were obese and 57% were underweight. Thirty-eight percent of the cats had acute disease. In the other cats, two stages in the progression of the disease were evident: (1) anorexia, weight loss, and lethargy, followed by (2) acute deterioration, development of shock, and a moribund state, despite fluid therapy.

The most common clinical signs were severe lethargy (100%), reduced appetite (97%), dehydration (92%), and hypothermia (68%). The initial hemogram occasionally showed a neutrophilia (30%) and anemia (26%), but packed cell volume (PCV) decreased markedly to the extent that 55% of cats were anemic terminally. Serum biochemical abnormalities included increased activities of ALT (68%) and ALP (50%), and increased concentrations of bilirubin (64%) and cholesterol (64%). Cats with APN were hyperglycemic (64%), glycosuric (60%) and ketonuric (20%), whereas cats with suppurative pancreatitis tended to be hypoglycemic (75%). Renal failure and electrolyte abnormalities were mild or infrequent except for hypokalemia (56%). This study characterizes a severe necrotizing pancreatitis in the cat similar to that reported in other species, and a histologically distinct suppurative pancreatitis. *(Resource: J Vet Int Med 7:25-33, 1993)*

Feline Infectious Peritonitis: A Review of Clinicopathological Changes in 65 Cases and a Critical Assessment of Their Diagnostic Value

In 65 natural cases of feline infectious peritonitis (FIP) the common clinicopathological changes included lymphopenia (77%), neutrophilia (45%), anemia (37%), hyperproteinemia (39%) and hyperglobulinemia (39%). There was no difference in the frequency of these abnormalities between the

38 cases of effusive disease and the 27 cases of noneffusive disease. The most consistent changes shown by serum protein electrophoresis were increases in alpha2- and gamma-globulins. The protein content of the effusions ranged from 39 to 98 g/liter with the globulins comprising 50-82%. Coronavirus serology showed a wide variation in antibody titers (0 to 2560) with 320 the modal titer.

The diagnostic value of this information was evaluated by comparing it with data from 65 cats in which FIP was considered as a differential diagnosis, but another disease was diagnosed. None of the laboratory tests, including coronavirus serology, had good sensitivity and specificity for the diagnosis of the disease. The presence of multiple abnormalities compatible with the disease increased the specificity, but decreased the sensitivity of the diagnosis. *(Resource: Vet Rec 129:209-212, 1991)* ■

Request for Sera to Test New FIP Diagnostic Test

The Diagnostic Laboratory and the Cornell Feline Health Center have been working on a new diagnostic test that will determine if a cat has been exposed to the pathogenic form of feline infectious peritonitis virus (FIPV-II group), the less pathogenic form of FIPV (FIPV-I group), the feline enteric coronaviruses (FECV), or a combination of these viruses. The test under development is an ELISA that relies on three monoclonal antibodies, each having specificity for one or more of the above mentioned groups of coronaviruses. The monoclonals compete with feline serum antibodies for coronaviral antigenic sites that are specific for the monoclonals. Results of feasibility studies for this competitive ELISA test, using sera from cats that were infected experimentally with the above-mentioned viruses, are encouraging.

To validate the test, we must evaluate sera from cats in natural settings that have broken with FIP that is confirmed by histopathology. You can become actively involved in validating the test by drawing blood from cats suffering from presumed FIP, save the serum, and when the cat is confirmed to have FIP by histopathology, send us the serum so we can use it to evaluate our new diagnostic test. We will need about 200 sera samples. Submitted serum will be run on both our old coronaviral antibody test and the new competitive test.

Participating veterinarains will receive the test results free of charge and a preprint of the paper resulting from the study. The paper will summarize the data and indicate if the test will be useful for determining the FIP status of cats.

If you have questions about the study call Dr. Richard Jacobson at (607)253-3677. Please send serum samples to:

Dr. Richard Jacobson, Director
Automated Serology Laboratory, DL
College of Veterinary Medicine
Ithaca, NY 14853

Rx for Continuing Education— Attend the Feline Practitioners Seminar

The Office of Continuing Education, the Cornell Feline Health Center and the American Association of Feline Practitioners invite you to attend the Fifth Annual Feline Practitioners Seminar from August 6 to August 9, 1993. This seminar will help feline practitioners expand their skills and the services offered to their clients. Topics and speakers are scheduled as follows:

Friday, August 6—Liver Diseases, Dr. Sharon Center; Optional: Computer Laboratory for Practice Management

Saturday, August 7—FIP Update, Dr. Fred Scott; Feline and Human Allergies, Dr. David Rosen; Feline Pediatrics, Dr. Betsy Arnold; Glucotrol and What to Do About Insulin, Dr. Thomas Elston; and Surgery, Dr. Kathy Linn

Sunday, August 8—Feline Hematology, Dr. Marjory Brooks; and Oncology, Dr. Ann Hohenhaus

Monday, August 9—FeLV and FIV Update, Dr. Margaret Barr; Oncology, Dr. Ann Hohenhaus; and Radiology, Dr. Amy Yeager

Registration forms and additional information on the seminar are available by contacting Linda Alfreds, Office of Continuing Education, College of Veterinary Medicine, Ithaca, NY 14853, or by calling (607) 253-3200.

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