Use of propofol for anesthesia in cats with primary hepatic lipidosis: 44 cases (1995–2004)

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Objective—To determine morbidity and fatalities in cats with hepatic lipidosis that received propofol to facilitate placement of a feeding tube.

Study Design—Retrospective case series.

Animals—44 cats with presumed primary hepatic lipidosis anesthetized for placement of a feeding tube.

Procedures—Medical records from January 1995 through December 2004 were reviewed to identify cats that matched the inclusion criteria (histologic confirmation of hepatic lipidosis, anesthetized for placement of feeding tube, complete intensive care unit [ICU] records, and recorded outcome). Data extracted included age, body weight, sex, anesthetic drugs, drug dosages, type of feeding tube, duration of anesthesia, number of hours in ICU, administration of blood products, and survival until discharge from ICU.

Results—44 cats (21 females and 23 males) were included in the analysis. Age range was 3 to 15 years (median, 8 years), and body weight ranged from 1.8 to 9.0 kg (4.0 to 19.8 lb), with a median of 4.8 kg (10.6 lb). Twenty-seven cats were administered propofol. There was no significant association between the use of propofol or the dosage of propofol and any risk factor, need for blood products, number of hours in the ICU, or survival. There was no significant difference between cats that received propofol and cats that did not receive propofol with regard to interval until discharge from the ICU.

Conclusions and Clinical Relevance—The use of propofol did not increase morbidity or fatalities in cats with primary hepatic lipidosis. Thus, propofol can be used in these cats for placement of a feeding tube. (*J Am Vet Med Assoc* 2008;232:1841–1843)

Hepatic lipidosis is a common disease associated with inappetence in cats. Successful treatment requires nutritional supplementation, which is typically administered through a feeding tube (eg, gastrotomy tube or esophagostomy tube). Placement of a feeding tube in a cat requires that the cat be anesthetized.

Propofol is a phenol anesthetic that is frequently chosen because it results in a rapid, smooth induction and rapid, smooth recovery from anesthesia. Propofol is metabolized primarily via the liver, but there is also extrahepatic metabolism because metabolism exceeds hepatic blood flow.[1] In cats, pulmonary uptake of propofol is approximately 60% of the injected dose.[2] Hepatic metabolism is through glucuronide conjugation before renal excretion. Propofol is commonly used for human patients with liver disease because of the extrahepatic metabolism and minimal changes in pharmacokinetics in patients with cirrhosis.[3]

Concern has been raised about the use of propofol in cats with hepatic lipidosis. Cats generally have low concentrations of glucuronyl transferase and when coupled with hepatic disease, metabolism may be slowed.[a] Furthermore, the phenol component of propofol can increase oxidative stress for feline RBCs and result in formation of Heinz bodies[4] and hemolytic anemia. It has been recommended[5] that propofol should not be used in cats with hepatic lipidosis.

Abbreviations

ICU	Intensive care unit
PEG	Percutaneous endoscopic gastrostomy

The study reported here was conducted to evaluate the effect of propofol in cats with hepatic lipidosis. We hypothesized that administration of propofol to cats with hepatic lipidosis would increase morbidity (indicated by an increased amount of time in an ICU), increase clinically relevant hemolysis (indicated by an increased need for transfusions with blood products), and increase fatalities (ie, fewer cats surviving until discharge from the ICU).

Materials and Methods

Case selection—Medical records of cats anesthetized for placement of a feeding tube at the Hospital for Animals at Cornell University from January 1995 through December 2004 were assessed. Inclusion criteria included cytologic confirmation by a pathologist of hepatic lipidosis with no other major systemic disease processes (eg, neoplasia or heart failure), anesthetized for placement of a feeding tube without other surgical procedures, complete ICU records, and recorded outcome (eg, discharge from ICU).

Medical records review—Data extracted included age, body weight, sex, administration of propofol (yes or no),

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dosage of propofol administered, type of inhalant anesthetic used, type of feeding tube (esophagostomy tube, PEG tube, or gastrotomy tube), duration of anesthesia, duration of surgery, number of hours in the ICU after placement of feeding tube, administration of blood products (whole blood, plasma, or packed RBCs), and survival (discharge from ICU). Cats were separated into 2 groups on the basis of those that received propofol (propofol group) and those that did not receive propofol (nonpropofol group).

Statistical analysis—Because of skewed data on box-and-whiskers plots, nonparametric analysis was used. Data were reported as median and range. Associations with propofol use were tested by use of the Fisher exact test for dichotomous variables and by use of the Wilcoxon rank sum test for continuous variables. Spearman rank correlation was used to test whether the dosage of propofol was associated with amount of time in the ICU. A Kaplan-Meier survival curve and the log-rank test were used to test whether propofol use affected the interval until discharge from the ICU; data were censored on the basis of cats that died or were euthanatized. All tests were interpreted as 2-sided, with significance defined as values of $P \leq 0.05$. Because of concerns about potential iatrogenically induced morbidity and fatalities (eg, improper placement of a feeding tube), adjustments were not made for multiple comparisons.

Results

Data from 44 cats were included in the analysis. There were 21 females and 23 males. Age ranged from 3 to 15 years (median, 8 years), and body weight ranged from 1.8 to 9.0 kg (4.0 to 19.8 lb), with a median of 4.8 kg (10.6 lb). Twenty-seven cats received propofol for anesthetic induction. Induction agents administered to the other 17 cats included ketamine (n = 2 cats), ketamine plus midazolam (3), ketamine plus diazepam (4), etomidate (1), isoflurane via face mask (5), and sevoflurane via face mask (2).

Anesthesia was maintained by administration of isoflurane in oxygen in 42 cats, whereas anesthesia was maintained by administration of sevoflurane in oxygen in the other 2 cats. Placement of a feeding tube involved esophagostomy tubes in 12 cats (8 in the propofol group and 4 in the nonpropofol group), PEG tubes in 23 cats (16 in the propofol group and 7 in the nonpropofol group), and gastrotomy tubes in 9 cats (3 in the propofol group and 6 in the nonpropofol group).

Groups did not differ with regard to age or body weight (**Table 1**). Similarly, groups did not differ with regard to survival (**Table 2**). Dosage of propofol in cats that received blood products ranged from 4.0 to 7.0 mg/kg (1.8 to 3.2 mg/lb), with a median of 4.5 mg/kg (2.0 mg/lb), which did not differ significantly ($P = 0.96$) from the dosage for cats that did not receive blood products (range, 2.2 to 28.8 mg/kg [1.0 to 13.1 mg/lb]; median, 5.0 mg/kg [2.3 mg/lb]). Number of hours in the ICU also was not significantly ($P = 0.24$) correlated with the dosage of propofol (Spearman rank correlation, $r = –0.24$; n = 26 cats). Cats that survived received dosages of propofol that were significantly ($P = 0.012$) higher, compared with dosages for nonsurvivors. Dosages for the 24 survivors in the propofol group ranged from 2.2 to 28.8 mg/kg (median, 5.0 mg/kg; first quartile, 4.0 mg/kg), whereas the dosage for each of the 2 nonsurvivors in the propofol group was 2.5 and 3.1 mg/kg (1.1 and 1.4 mg/lb), respectively.

Although there was no significant association between use of propofol and survival, there was a significant ($P = 0.034$) association between number of hours in the ICU and survival (median, 117 hours for survivors and 48 hours for nonsurvivors). Number of hours until discharge from the ICU did not differ significantly ($P = 0.94$; log-rank test in the survival analysis) between the propofol and nonpropofol groups.

Seven of 44 (16%) cats did not survive until discharge from the ICU. Five cats (1 in the propofol group and 4 in the nonpropofol group) died of natural causes. Two cats (1 in each group) were euthanatized.

Table 2—Frequency of use of propofol or other anesthetic drugs (nonpropofol) in 44 cats with hepatic lipidosis anesthetized for placement of a feeding tube.

Variable	Category	Propofol	Nonpropofol	*P* value*
Sex	Male	13	10	0.55
	Female	14	7	—
Inhalant	Isoflurane	26	14	0.06
	Sevoflurane	0	3	—
Tube	Other than gastrotomy	24	11	0.07
	Gastrotomy	3	6	—
Blood†	No	24	15	1.00
	Yes	3	2	—
Plasma	No	26	15	0.55
	Yes	1	2	—
Survived	No	2	5	0.09
	Yes	25	12	—

†Includes whole blood, plasma, and packed RBCs.
— = Not applicable.
See Table 1 for remainder of key.

Table 1—Median (range) values for 44 cats with hepatic lipidosis anesthetized by use of propofol or other anesthetic drugs (nonpropofol) for placement of a feeding tube.

	Propofol		Nonpropofol		
Variable	No. of cats	Median (range)	No. of cats	Median (range)	*P* value*
Age (y)	25	9 (3–13)	16	5 (3–15)	0.12
Body weight (kg)†	27	4.9 (1.8–9.0)	17	4.2 (2.4–6.8)	0.48
Duration of anesthesia (min)	27	85 (30–215)	17	120 (30–215)	0.08
Duration in ICU (h)	27	117 (0–454)	17	100 (8–298)	0.55

*Values were considered significant at $P < 0.05$. †To convert kilograms to pounds, multiply value by 2.2.

Discussion

In the study reported here, we did not obtain any evidence that the use of propofol increased morbidity or fatalities in cats with hepatic lipidosis. Propofol is a commonly used anesthetic because of its favorable pharmacodynamic and pharmacokinetic characteristics. Although propofol typically is metabolized via glucuronide conjugation in the liver, there is also important extrahepatic metabolism because clearance exceeds hepatic blood flow.[1] For example, in humans with cirrhosis and in pigs whose livers were removed during transplantation surgeries, the pharmacokinetics of propofol are virtually unchanged.[3,6] In cats and sheep, pulmonary uptake contributes substantially to propofol clearance,[2,7] and renal clearance is evident in humans.[7]

Hepatic lipidosis is a common syndrome associated with poor nutrition. It is a condition in which large vacuoles of lipid accumulate in hepatocytes; however, the condition is reversible. In cats, hepatic lipidosis typically is associated with inappetence and can be primary or secondary to other disease processes that lead to inappetence.[5] Treatment of animals with hepatic lipidosis centers on reinstitution of nutritional components, which is usually accomplished via a feeding tube. Considering the pharmacokinetic characteristics of propofol (particularly in patients with liver disease or dysfunction), propofol is commonly chosen as the induction agent for cats with hepatic liposis that are anesthetized for placement of a feeding tube.

Concern has been raised about the administration of propofol to cats with hepatic lipidosis. This concern is based on the fact that cats have low concentrations of glucuronyl transferase and thus the clearance of propofol could be slowed. Additionally, propofol increases oxidative stress for feline RBCs and therefore can cause formation of Heinz bodies when administered repeatedly via constant rate infusion for several consecutive days.[6] Although repeated short-duration anesthesia is not associated with adverse hematologic changes in cats that do not have hepatic disease,[8] some clinicians have argued that cats with hepatic disease are at greater risk of hemolytic consequences.[a] Because the study reported here was a retrospective case series, it was not possible to evaluate hemolysis on the basis of changes in the PCV. In many of the cats, PCV was not routinely determined and fluid administration was not standardized. An estimation of clinical hemolysis was indirectly assessed by evaluating the need for blood products and the number of hours spent in the ICU. Our assumption was that cats that had clinically relevant hemolysis would require more blood products and spend more time in the ICU. However, the propofol group did not require additional blood products and did not spend additional time in the ICU, compared with results for the nonpropofol group. However, it is possible that some cats that would have benefited from administration of a blood product did not receive it because of clinician choice or owner reluctance.

Similarly, records analysis did not allow us to assess generalized morbidity. Generalized morbidity was indirectly assessed by analysis of the number of hours spent in the ICU. A limitation of this assessment is that the number of hours spent in the ICU could have been affected by variables other than morbidity. Those variables could have included the time of day that a cat was admitted or the particular clinician who had primary responsibility for the care of each cat. However, there was no difference in the number of hours spent in the ICU for cats in the propofol or nonpropofol groups, and it is difficult to imagine that the time of day a cat was admitted to the ICU or the clinician with primary responsibility for care would have been associated with the decision to use propofol.

Survival was a more direct assessment. Of the 44 cats included in the study, only 7 died (2/27 in the propofol group and 5/17 in the nonpropofol group). Although there was not a significant difference between groups and relatively few cats died, the risk of death was negatively associated with the use of propofol (ie, the risk of death was lower for cats that were administered propofol). Three types of feeding tubes were used (esophagostomy tubes, gastrotomy tubes via surgery, and PEG tubes). We believed it was possible that the increased invasiveness of a surgical approach could have contributed to increases in morbidity and fatalities; however, there was no significant difference in duration of anesthesia between cats in which a gastrotomy tube was placed and the other cats, and type of tube was not associated with propofol administration.

Selection of cats for inclusion required that they did not have concurrent disease. This would have biased the selection for cats that had primary rather than secondary hepatic lipidosis. It is possible that these cats were not as systemically ill as other cats with secondary hepatic lipidosis; morbidity and survival may differ in cats with systemic illness. Similarly, the impression that cats with hepatic lipidosis do worse after receiving propofol[a] may have more to do with the severity of illness in the cats with hepatic lipidosis referred to veterinary medical teaching hospitals. It is likely that cats with mild or moderate hepatic lipidosis are being treated in general or secondary practices and that only the cats with the most severe hepatic lipidosis are referred to tertiary care facilities, such as veterinary teaching hospitals.

Data were collected from medical records of cats treated during a 9-year period. It is possible that the standard of care changed during that time period; however, it was beyond the scope of this study to assess such changes. We conclude that the use of propofol to induce anesthesia in cats with primary hepatic lipidosis for the purpose of placing a feeding tube does not increase morbidity or fatalities.

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