NOTE ***Surgery***

Clinical Usefulness of Propofol as an Anesthetic Induction Agent in Dogs and Cats

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ABSTRACT. Propofol was used as an induction agent of general anesthesia in 77 dogs and 64 cats, all client owned, for a variety of surgeries/treatments or diagnostic procedures. The mean intravenous doses of propofol required to achieve endotracheal intubation in dogs and cats were 6.5 ± 1.4 mg/kg and 10.1 ± 2.8 mg /kg, respectively. Most of the animals could be induced to anesthesia smoothly by the administration of propofol with a high incidence of apnea. Propofol is a clinically valuable anesthetic induction agent in both dogs and cats, however, care must be taken for apnea.

KEY WORDS: anesthesia, induction, propofol.

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Propofol (2,6-di-isopropylphenol) is a non-barbiturate intravenous anesthetic agent that has been used for the induction and maintenance of anesthesia in humans [9, 13, 4]. Like other alkylated phenol compounds, propofol is formulated to be a 1% w/v solution in soybean oil, glycerol, and a purified egg phosphatide emulsion.

Propofol has been reported to produce a rapid and smooth induction of anesthesia without excitement. Propofol is rapidly excreted from the body, approximately 10–20 times faster than thiopentone [3], and this characteristic of propofol may make it an ideal agent for anesthetic induction. However, the adverse effects of propofol, including bradycardia, apnea, hypotension and vascular pain, have been reported in human patients [6, 8]. Recently, the use of propofol for the induction of general anesthesia has been reported in veterinary practice [26], however, the clinical efficacy of propofol, the dose required for smooth and safe anesthetic induction, and its side effects have not yet been fully investigated in dogs and cats.

The purpose of this study was to evaluate the clinical usefulness of a single bolus injection of propofol and its adverse effects in dogs and cats with various diseases. We used 77 dogs and 64 cats, all client owned, in this study. The patients were admitted to the Veterinary Medical Center, the University of Tokyo, and the Veterinary Medical Teaching Hospital, Nippon Veterinary and Animal Science University, from July 1999 to February 2000 for a variety of surgeries or diagnostic procedures. Their age, body weight, gender, and surgeries/treatments are shown in Table 1. Their physical status based on the American Society of Anesthesiology (ASA) [19, 14] before anesthesia is shown in Table 2.

Intravenous catheters were placed in the cephalic veins in all animals before propofol administration. To evaluate propofol as a single induction agent, no premedications that might influence the results of the present study were given before the induction of anesthesia. Propofol (Rapinovet; Takeda Schering-Plough Animal Health K.K, Tokyo, Japan) at a dose of 7.0 mg/kg in dogs or 13.2 mg/kg in cats, was prepared in a syringe before administration. Propofol was slowly administered intravenously in 60 to 90 sec until the laryngeal reflex was depressed. After confirmation of deep depression of the laryngeal reflex, a tracheal tube was intubated using a laryngoscope. Lidocaine spray (Xylocaine spray; Astra Zeneca, Osaka, Japan) was used, if needed, to control the laryngeal reflex. After the evaluation of the anesthetic induction, all the animals were maintained under anesthesia with isoflurane and oxygen. Analgesics were also administered as needed.

All the cases were clinically evaluated for smoothness of induction of anesthesia and endotracheal intubation by the anesthesiologists according to the criteria shown in Table 3. In addition, the induction dose of propofol and its adverse effects during and after induction were recorded.

Table 1. Body weight, gender, and surgeries/treatments in dogs and cats evaluated

	Dogs	Cats
Mean age (range), years	4.8 (0.5~13)	4.5(0.3~13)
Gender	M:41 (Mc:7)	M: 29 (Mc:10)
	F: 36 (Fs:3)	F: 35 (Fs: 9)
Mean body weight (range), kg	19.3 (1.9~47.7)	3.5 (0.5~6.5)
Orthopedic surgery	34	11
Soft tissue surgery	31	42
Dental treatment	1	10
Radiography, Biopsy	4	1
Other	7	0
Total	77	64

M: male, Mc: castrated male, F: female, Fs: spayed female.

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Table 2. Physical status of animals according to the American Society of Anesthesiology standard

	Dogs	Cats
Class I	54	37
Class II	20	22
Class III	2	5
Class IV	1	0
Class V	0	0

Table 3. Evaluation of the condition during the induction of anesthesia and smoothness of endotracheal intubation after propofol administration

	Dogs	Cats
Excellent	64	38
Good	13	25
Fair	0	1
Poor	0	0
Smooth	75	59
Struggle	2	5
Impossible	0	0

[Smoothness of endotracheal intubation after propofol administration]

Excellent Intubate smoothly and with rapid disappearance of laryngeal reflex.

Good Some cough reflex or movement remains when intubating on endotracheal tube, but possible to intubate.

Fair A cough reflex or movement remains when intubating an endotracheal tube, so it was necessary to add more propofol or apply other treatments (lidocaine spray).

Poor Difficult to intubate.

[The condition during induction of anesthesia]

Smooth Smoothly induced to anesthetic condition.

Struggle Struggled against restraint during administration of propofol, but anesthesia induced smoothly without any problems.

Impossible Difficult to induce anesthetic conditions.

The differences in the induction dose of propofol between gender and ASA classification (I and II) were analyzed using an unpaired Student's *t* test. The difference was considered to be statistically significant at $P<0.05$.

Most of the animals were smoothly induced to anesthesia without undesired events. The mean dose of propofol needed for endotracheal intubation was 6.5 ± 1.4 mg/kg in dogs and 10.1 ± 2.8 mg/kg in cats. The average dosages needed for dogs were similar and for cats were higher than those reported previously [23]. There was no significant difference in the dose of propofol between gender or among ASA classifications (ASA I, II). Patients classified as ASA III and IV were not included in the statistical analysis due to small number of patients. These patients were induced with similar dose of propofol (ASAIII; 2 dogs-6.2 mg/kg, 6.7 mg/kg, 5 cats- mean 7.2 mg/kg, ASAIV; 1 dog-6.0 mg/kg). As for the induction manner, 64 dogs (83.1%) were evaluated as "Excellent" and 13 dogs (16.9%) were evaluated as "Good" by the anesthetist. In cats, 38 cases (59.4%) were evaluated as "Excellent" and 25 cases (39.1%) were evaluated as "Good" (Table 3). One cat (1.6%) was evaluated as "Fair" because the laryngeal reflex had not completely disappeared following the administration of 13.2 mg/kg of propofol and local anesthetic spray. The cat was induced to anesthesia with 5.0% isoflurane by face mask without any adverse events. Two dogs and five cats struggled against restraint during the administration of propofol. However, they were induced to anesthesia smoothly without apparent problems.

Table 4. Adverse effects caused by the administration of propofol

	Dog	Cat
Apnea	67 (87.0%)	40 (62.5%)
Bradycardia	18 (23.4%)	4 (6.25%)
Hypotension	2 (2.6%)	1 (1.6%)
Arrhythmia	0 (0%)	1 (1.6%)
Tachycardia	0 (0%)	1 (1.6%)
Vascular pain	0 (0%)	1 (1.6%)
Seizure	1 (1.3%)	0 (0%)
Natatorial movement	0 (0%)	1 (1.6%)
Vomit	1 (1.3%)	0 (0%)

The adverse effects during and immediately after induction are shown in Table 4. Apnea was recorded in 67 of 77 dogs (87.0%) and 40 of 64 cats (62.5%) during or immediately after administration of propofol. In these cases, assisted or controlled ventilation with 100% oxygen was initiated soon after endotracheal intubation, and no other anesthesia - related adverse events were observed. Respiratory depression and apnea have been reported as the most common adverse effect associated with the administration of propofol in humans, dogs and cats [22, 25]. Propofol decreases tidal volume and respiratory rate by the depression both of respiratory center and the response to arterial carbon dioxide tension [10]. The duration and severity of respiratory depression depends on the dose and speed of administration [15, 23]. It has been known that high doses of anesthetics are needed when sedatives, tranquilizers, and analgesics are not premedicated [26]. In this study, we did not use any premedications, therefore, a relatively high dose of propofol was required to achieve endotracheal intubation. It may cause a high incidence of apnea. As apnea during and immediately after the induction of anesthesia was easily treated by assisted or controlled ventilation and did not cause respiratory problems during the maintenance of anesthesia with isoflurane, it should not be a serious problem in clinical cases. However, care must always be taken for apnea, and preparation for endotracheal intubation and the presence of an anesthesia machine are strongly recommended whenever propofol is administered.

Mild bradycardia was observed in 18 dogs (23.4%) and 4 cats (6.3%), among which two dogs (2.6%) showed mild hypotension as well. The heart rate (HR) and arterial blood pressure (BP) were monitored by a multifunction monitor

(COLIN BP-508, Nihon Colin Co., Tokyo, Japan). Bradycardia was recorded immediately after the administration of propofol or during surgeries/treatments. However, it was reversed by the administration of atropine sulfate (0.025–0.05 mg/kg,s.c., i.m., or i.v.) in all dogs and cats without any other complications. Although hypotension, arrhythmia (first degree atrioventricular heart block), and tachycardia were observed in one cat (1.6%), and tachycardia was observed in another cat after the administration of propofol, the symptoms in each case disappeared without any specific treatments. Propofol administration induces fewer changes in cardiovascular function than do barbiturates in humans, dogs and cats [11, 17, 20]. Several reports have shown that cardiovascular depressions such as hypotension appear due to mild myocardial depression and peripheral vascular dilation [12, 21]. In this study, the cardiovascular changes observed immediately after administration of propofol returned to normal without any treatments in most cases except for the administration of atropine. Therefore, cardiovascular changes induced by propofol would be clinically mild dogs and cats.

Pain that seemed to be induced by vascular stimulation of propofol was observed in one cat which withdrew its forelimb during the administration of propofol, but it disappeared soon after that and did not cause any problems. The most frequent side effect of propofol in humans is pain at the injection site and several techniques have been reported to reduce or avoid this problem [6, 16, 18]. On the other hand, perception of pain during intravenous injections of propofol are rare in small animals [23]. In fact, only one cat showed temporary vascular pain in this study. Vascular pain during propofol administration would be a rare problem in veterinary practice.

Natatorial movement was observed in one cat during the anesthetic recovery phase after extubation; however, it disappeared within a few minutes after the cat awakened. Several human case reports have shown that excitation and spontaneous movements (myoclonus), including opisthotonos, muscle flexion, twitching, jerking, extension movements and generalized grand mal seizures, occurred during or after propofol administration [24, 27]. In humans, propofol seems to be both anti - and proconvulsant at the same time and by different routes [3, 5, 7, 24]. Although care should be taken, clinical problems caused by these effects will be very rare.

Vomiting was observed in one dog immediately after the extubation. There have been some reports showing that propofol anesthesia has fewer incidences of postoperative nausea and vomiting than other anesthetic agents in human patients [1]. Another study reported that propofol significantly prevented nausea and vomiting caused in human patients receiving chemotherapy [2]. Therefore, the vomiting observed in this case may not have been related to propofol administration.

In conclusion, most of the animals could be induced to anesthesia smoothly and safely by the administration of propofol. However, a high incidence of apnea was recorded in this study. If intubation and other instruments for artificial ventilation are adequately prepared, propofol can be a clinically valuable anesthetic induction agent both dogs and cats.

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