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Retrospective Study

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Retrospective evaluation of unexpected events during collection of blood donations performed with and without sedation in cats (2010–2013)

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Abstract

Objectives – Describe unexpected events (UEs) that occurred during blood donation in cats with and without sedation.
Design – Retrospective observational study (2010–2013).
Setting – University teaching hospital.
Animals – Client-owned healthy cats enrolled in a blood donation program.
Interventions – None.
Measurements and Main Results – Blood collection for transfusion was performed 115 times from 32 cats. Seventy donation events were in unsedated cats and 45 in sedated cats. For each collection, the anticipated blood volume to be collected, actual blood volume collected, sedation protocol, and any UE in the peridonation period were recorded. There were 6 categories of UEs: movement during donation, donor anxiety, inadequate collected blood volume, jugular vessel related UEs, additional sedation requirement, and cardiorespiratory distress. Fisher's exact test was used to compare the frequency of UEs between sedated and unsedated cats. UEs were recorded in 54 of 115 collections. In the donor population, movement was reported as an UE in 0 cats that donated under sedation and 24/70 (34.3%) cats that donated without sedation ($P < 0.001$). Donor anxiety occurred in 2/45 (4.4%) cats that donated under sedation and 14/70 (20.0%) cats that donated unsedated ($P = 0.014$). Unsedated donation did not increase the likelihood of inadequate donation volume, jugular vessel related UEs, or cardiorespiratory distress. Eight of 45 (17.8%) sedated donations required additional sedation.
Conclusions – Movement during donation and signs of donor anxiety were more frequent in unsedated cats. These were considered minor issues, expected in unsedated cats being gently restrained. Blood collection from unsedated feline donors is a viable alternative to sedated donation.

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Keywords: donor morbidity, feline blood transfusion, feline transfusion, medicine, sedation

Abbreviation

UE unexpected event

Introduction

Current recommendations for collecting feline blood for transfusion describe the use of general anesthesia or heavy sedation of the donor.[1–3] As the practice of feline critical care has advanced, the demand for blood products has increased; however, the availability of feline blood products has remained limited.[3–5] Veterinarians have used client or staff-owned cats or in-house

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colony cats as blood donors, purchased blood products from commercial blood banks, or used hemoglobin-based oxygen-carrying solutions[a] to aid in medical management of cats with severe anemia.[6] The purchase of packed red blood cells can be cost prohibitive, and commercial feline blood banks are not available or feasible in many parts of the world. Moreover, hemoglobin-based oxygen-carrying solutions are no longer commercially available.[7] Therefore, on-demand feline donation is often the preferred option for veterinarians. Sedation with recommended agents, including combinations of ketamine and midazolam or anesthesia with inhalant anesthetics to facilitate blood collection, may lead to hypotension and death.[8–10] Performing feline donations without sedation, as is standard practice for canine donation, may have a number of advantages including decreased donor morbidity and mortality, thereby making the process more appealing to the owners of potential blood donors. There are no previously published assessments of feline blood donation performed without anesthesia or sedation. The objectives of this retrospective study were to describe the unexpected events (UEs) that occurred during blood donation in cats with and without sedation.

Materials and Methods

The institution's blood transfusion log was searched to identify all feline blood donations that occurred between December 1, 2010 and December 31, 2013. Each blood donor record, which details objective data and subjective comments on the ease of the donation, was reviewed for any UE. Donor age and body weight prior to each donation were recorded. The number of previous donations, volume of blood expected to be drawn, actual blood volume collected, any UE encountered, and the sedation protocol, if utilized, were recorded for each donation. Cases were excluded if records were incomplete.

In accordance with our institution's blood donor program protocols, cats recruited to be blood donors were aged between 1 and 8 years of age, had normal body condition, were healthy with no previous or ongoing medical illnesses, were living in a household where no animal had undergone international travel, and were current on recommended vaccinations. Donor cats were regularly treated for ecto- and endoparasites using recommended treatments. At admission into the blood donation program, donor cats had blood sampled for assessment of a CBC,[b] serum biochemical analysis,[c] PCR-based assays for *Mycoplasma haemofelis*,[d] *Candidatus Mycoplasma haemominutum*,[d] and *Candidatus Mycoplasma turicensis*,[d] qualitative Feline Leukemia Virus antigen,[e] Feline Immunodeficiency Virus antibody[e] assessment, and blood typing.[f] Prior to recruitment to the feline blood donation program, cats received a behavioral assessment from the Transfusion Medicine Service nurse. For inclusion into the program, the cat must have been deemed to be tolerant of new surroundings and handling, and be accepting of venipuncture without marked manual or any chemical restraint. Once enrolled, donor behavior was monitored closely and donors were retired from the program if they become intolerant of blood donation.

Donations were performed either with or without sedation of the donor cat. Sedation was provided using 1 of 3 protocols.[g] Additional sedation was administered if deemed necessary based on temperament of the cat during preparation for blood donation.[h] Assessment as to whether sedation was required was made prior to each donation event. If the cat required more than gentle restraint during physical examination and blood sampling to verify its fitness to donate, sedation for the donation was administered. Both unsedated and sedated donors had an intravenous catheter placed into a cephalic vein. At a minimum of 45 minutes prior to cephalic catheter placement, lidocaine 2.5%/prilocaine 2.5% cream[i] was applied over the cephalic and jugular veins following clipping of the fur to decrease donor perception of intravenous catheter placement and venipuncture for blood collection, respectively.

The duration of donation was identified as the time from the placement of the cephalic catheter to the administration of intravenous crystalloid fluids after the donation event. Two investigators independently coded all the UEs noted in each blood donor record and grouped each event into 1 of 6 predetermined categories: movement during donation (recorded on the donation record), donor anxiety, inadequate blood volume obtained (based on expected collection volume), jugular vessel related UEs (eg, hematoma formation, local infection, thrombophlebitis), requirement for additional sedation, and cardiovascular or respiratory distress. Donor anxiety was identified in this study as vocalization (eg, hissing, growling, yowling) or swiping. For the purposes of this study, movement was classified as any motion deemed noteworthy by the transfusion nurses, including movement that necessitated either repeat jugular venipuncture or abortion of the collection. If there was any difference in coding between the investigators, the case record was jointly reviewed and an agreement reached. Descriptive data are reported as mean ± SD for normally distributed variables and median (range) for skewed variables. Normality was visually assessed from histograms of plotted data against normal curve. A Fisher's exact test was used to compare the frequency of each UE between the unsedated and sedated donation events using a commercial statistical software program[j] for all statistical analyses.

Table 1: Frequency of unexpected events in 115 feline blood donation events where cats were either sedated or unsedated for the blood collection

Unexpected event	Sedated donor group ($n = 45$)	Unsedated donor group ($n = 70$)
Movement during donation*	0 (0%)	24 (34.3%)
Donor anxiety*	2 (4.4%)	14 (20.0%)
Inadequate blood volume obtained	9 (20.0%)	15 (21.4%)
Jugular vessel related (including hematoma formation)	3 (6.7%)	10 (14.3%)
Additional sedation requirement	8 (17.8%)	n/a
Evidence of cardiovascular or respiratory distress	0 (0%)	3 (4.3%)

*Significant ($P < 0.05$) difference between the sedated and unsedated groups.

Results

Donor characteristics

The median age of the cats that donated blood without sedation was 5 years (range 1.0–8.0). The mean age (±SD) of the donors that required sedation was 4.5 years (±2.1). The mean weight of cats that donated blood without sedation was 5.3 kg (±0.8). The median weight of donors that required sedation was 4.9 kg (range 3.6–6.5).

Comparison of sedated and unsedated donors

One hundred and fifty-eight blood collections were performed during the study period, comprising 89 unsedated and 69 sedated collections. Forty-three donations were excluded due to incomplete data, of which 19 were unsedated and 24 sedated collections, leaving a total of 70 unsedated and 45 sedated collections included in the study.

Twenty cats had blood donations performed without sedation and 18 cats had blood donations performed under sedation. Of the cats from whom blood was collected without sedation, 6 cats donated once, 4 donated twice, 3 donated 3 times, 3 donated 5 times, 1 cat donated 7 times, 2 donated 8 times, and 1 donated 9 times. Of the cats that donated blood while under sedation, 6 cats donated once, 3 cats donated twice, 4 cats donated 3 times, 4 cats donated 4 times, and 1 cat donated 5 times. There were 6 cats that donated both with and without sedation.

Of the cats that donated blood without sedation, 14 were first-time donors, while 14 cats that required sedation were first-time donors. First-time donors comprised 24.3% of all donations, in whom inadequate blood volume collected ($n = 7$), movement ($n = 6$), and donor anxiety ($n = 6$) were the most common UE. Of the first-time donors, fewer required additional sedation ($n = 3$), developed a jugular vessel related UE ($n = 2$), or had evidence of cardiovascular or respiratory distress ($n = 1$). Eleven first-time donors had no UEs.

Three cats who required sedation for donation were eliminated from the donor program due to the display of signs of anxiety. This did not occur with any cat that had an unsedated donation. Eight cats who had previously allowed unsedated blood donation eventually required sedation for subsequent donations.

The minimum, maximum, and mean volumes of blood collected from sedated donation events were 6.7, 11.8, and 9.7 mL/kg, respectively. The minimum, maximum, and mean volumes of blood collected from the unsedated donation events were 5.6, 12.4, and 9.2 mL/kg, respectively.

A total of 61 donations had no UE reported (61/115, 53.0%), of which 28 (62.2% of all sedated donations and 24.3% of all donations) were from donors that were sedated and 33 (47.1% of unsedated donations and 28.7% of all donations) were from donors that were not sedated.

In the donation events where the cats were sedated for donation, 0/45 had movement reported as an UE, whereas in the donation events where the cats were unsedated for donation, 24/70 (34.3%) cats moved during donation ($P < 0.001$). In the donation events where the cats were sedated, 2/45 (4.4%) had donor anxiety reported as an UE, whereas in the donation events where the cats were unsedated, 14/70 (20.0%) had donor anxiety as a UE ($P = 0.025$). Of the cats that were sedated for donation, 8/45 (17.8%) required additional sedation. There was no difference between the frequency of inadequate volume retrieved ($P = 1.000$), jugular vessel related UEs ($P = 0.244$), cardiovascular/respiratory UEs ($P = 0.279$), and donations with no UEs ($P = 0.129$) when comparing the sedated and unsedated cats (Table 1).

Cardiovascular or respiratory distress was seen in 3 cats in this study population, all of which were cats that donated blood without sedation. One of these cats was noted to have open-mouth breathing following a donation and also had a cardiac gallop rhythm ausculted prior to the subsequent blood donation. This cat went on to perform 2 subsequent donations without a UE observed and was then retired due to age. This cat had no echocardiogram performed at any point. A second cat that had tachypnea following a donation was noted to have an intermittent and rate-dependent heart murmur and gallop rhythm prior to donation (no echocardiogram was performed) and this cat had another 2 subsequent uneventful donations after this UE and was then retired

due to international travel. The third cat had 5 previous blood donations, of which 2 were uneventful and 3 were characterized by donor anxiety prior to an episode where he exhibited collapse, vocalization, panting, and defecation. This cat had a normal echocardiogram performed by a board-certified cardiologist.

Discussion

Feline blood collection has been previously described in sedated or anesthetized cats.[1,2] The procedure by which blood is collected from an unsedated donor is similar to that for a sedated donor; however, there is a greater emphasis placed on donor behavior and temperament when considering donor selection.[11,12] Donors must be tolerant of handling and not fearful of new people or surroundings. These characteristics make an ideal blood donor for unsedated or sedated blood collection; however, to donate blood without sedation, the cat must be able to tolerate gentle restraint for an extended period of time (approximately 10 min).

Recruitment of client-owned cats to participate in a feline blood donor program can be difficult, and the Transfusion Medicine Service at the authors' hospital aims to decrease the risk to the donor and to increase the appeal of the process to potential new feline blood donor owners. Maintenance of the blood donor population via recruitment of owned cats is vital to the blood donor program, as the authors' institutions have no access to commercial feline blood banks.

Sedation or anesthesia carries a risk of adverse effects including hypotension, hypoxemia, decreased renal perfusion, and death.[1,2] These consequences make the use of anesthetic agents for chemical restraint during blood donation less appealing. Pharmaceutical agents used for chemical restraint of cats in this transfusion program have been described previously.[3] Several veterinary studies have described the effects of sedation on feline blood donors. Killos et al found that 84% of blood donor cats anesthetized with sevofluorane and 42% of donor cats anesthetized with a combination of ketamine, midazolam, and butorphanol developed hypotension that required treatment with intravenous fluid therapy.[8] In this report, cats that received injectable sedation also developed hyperthermia and showed a slower return to normal behavior than those anesthetized with sevoflurane.[8] Iazbik et al studied feline blood donors anesthetized with sevoflurane and found that their heart rate and blood pressure decreased significantly following blood donation, but did not report any adverse effects of this sedation.[9] A final report described the use of a proprietary combination of tiletamine and zolazepam for sedation of feline blood donors and found that rectal temperature significantly decreased and blood pressure significantly increased following donation, but there were no instances of pallor or collapse after recovery from sedation.[13] Although the cardiovascular effects seen in these studies appear minor, they are present, as are the risk of adverse effects (some of which may not have been detected in these studies) resulting in death.

Although both Killos et al and Iazbik et al discuss the effects of feline donation under sedation or anesthesia on blood pressure, heart rate, packed cell volume, and mucous membrane pallor, they do not discuss other potential adverse events such as jugular vessel hematoma.[8,9] In human medicine, adverse events occur in approximately 4–36% of blood donations.[14,15] Environmental factors are documented to play a major role in the frequency of human donor adverse events, with an increase in events when blood donation occurs in crowded conditions, under conditions of increased environmental temperatures, and in conditions with high levels of noise and extended wait times prior to donation. The most common adverse events in people include weakness, sweating, and pallor.[14] One cat in this study collapsed following donation, but otherwise these adverse events described in people were not observed in the current study of feline blood donors. Although weakness should have been noted, cats do not sweat and pallor may not have been noted on the record as a UE. Although infrequent, cardiovascular UEs in human blood donors include hypertension, hypotension, bradycardia, and dizziness. These are presumed to be the result of a vasovagal reaction rather than true cardiovascular compromise.[14]

Venipuncture-related adverse events (eg, hematoma, nerve injury, local infection, and thrombophlebitis) are common in human blood donors with a phlebotomy-related reaction rate of 9–36%, with a higher incidence in autologous donors due to underlying medical conditions.[14,15] A similar incidence of vessel-related adverse events was seen in this study (11% of cats), with the level not being significantly different between unsedated ($n = 10$, 14.3%) and sedated donors ($n = 3$, 6.7%).

Cardiovascular or respiratory distress was not more frequent in cats that donated without sedation when compared to cats that received sedation. No cats that donated blood while sedated had a cardiovascular or respiratory UE. Three cats that donated without sedation developed a cardiovascular or respiratory UE. In each case, a physical examination was performed by a veterinarian within minutes of the UE and all of the cats were found to be normotensive. The respiratory abnormalities included tachypnea and panting, and the collapse was presumed to be cardiovascular in origin. The cause of the UE is difficult to assess in a retrospective study; however, we surmise that the respiratory UEs were stress related, and vasovagal syncope may have caused the other cat to collapse.[15] In retrospect, consideration should have

been made to retire all 3 cats from the program after these events. In a 1999 study of adverse events in human blood donors, first-time donors were 5 times more likely to have a vasovagal reaction involving syncope than repeat donors.[16] First-time donors in this study were not more likely to have an UE than veteran donors.

In the current study, movement during donation and signs of donor anxiety occurred more frequently in cats that were not sedated for blood donation. Movement during donation was the most frequent UE, occurring in a third of the unsedated donor cats. Minimization of this UE can be achieved with appropriate donor selection; however, with skilled phlebotomists and handlers, the effect of minor donor movement on a successful donation is minimal. Donor anxiety was reported in one fifth of unsedated feline donors. This behavior should be noted, as it may determine the viability of a donor for future donations. Two cats who were sedated for blood donation did display signs of anxiety, characterized by growling and hissing during handling, and aggressive behavior following donation. Both cats were retired from the donor program. Of the 14 donation events in the unsedated group where the cats were noted to have donor anxiety, 6 were vocal alone (eg, hissing, growling), 3 were noted as subjectively appearing anxious or scared, 2 resisted handling, and 1 exhibited marked aggression. Donor anxiety often leads to exclusion from future unsedated blood collection or a progression to full sedation during the donation.[11,12]

The results of this study suggest that the impact of both movement and donor anxiety on donation success is not marked, as there was no significant difference between sedated and unsedated donations in the incidence of vessel-related complications or collection of inadequate blood donation volume. The movement and signs of donor anxiety were considered minor issues, to be expected in unsedated cats being gently restrained.

There were several limitations to this study. Primarily, this study relied on accurate, complete, and consistent recording of blood collection characteristics by staff at the time of donations. The majority of the donations were performed by 3 transfusion medicine nurses, leading to consistency in the recording of events. The relevance of the notation of movement as a UE is difficult to gauge. It is possible that recording of movement in the records was zealous, as unsedated blood donation was a new protocol, and monitoring of this protocol was used to determine the feasibility of unsedated blood donations. Measurements of heart rate, respiratory rate, and blood pressure were not regularly recorded following donation, in an effort to minimize handling of the patient to reduce donor anxiety, and were only performed when a patient showed clinical signs that indicated a cause for concern. Therefore, there may have been a higher incidence of cardiovascular and respiratory UEs than was recorded.

Additionally, the population of the study was not uniform, as many cats had performed a number of donations prior to inclusion in this study population. In people, up to 50% of the donor population is reported to be repeated donors as compared to reports of 35% in dogs who are used for blood donation.[6] A blood donor may become more or less compliant with repeated donations.

This study describes the UEs associated with unsedated feline blood collection. The appeal of unsedated blood collection is high due to increasing demand for feline blood products and the need to convince cat owners to enroll their cat into a transfusion program. Although the rate of movement and donor anxiety UEs were significantly higher in the unsedated feline donors, the effect of this on donation success was minimal, and in the majority of cases they were not severe enough to prevent subsequent unsedated blood donations. Because the occurrence of donor anxiety was minimal and there were no UE associated with damage to blood vessels or blood volume collected, unsedated blood donation is a viable alternative to blood collection from sedated or anesthetized cats.

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Footnotes

[a] Oxyglobin, OPK Biotech LLC, Cambridge, MA.
[b] Complete blood count; Advia 2120i, Siemens Healthcare Diagnostics Ltd, Camberley, Surrey, UK.
[c] Serum biochemical analysis; IL600, Instrumentation Laboratory, Birchwood, Warrington, Cheshire, UK.
[d] *Mycoplasma haemofelis*, *Candidatus Mycoplasma haemominutum*, and *Candidatus Mycoplasma turicensis* polymerase chain reaction assays, Langford, Bristol, UK.
[e] Feline leukemia virus (FeLV) antigen and feline immunodeficiency virus (FIV) antibody assays, Westernblot ELISA, MegaCor Diagnostik, Hoerbranz, Austria.
[f] Feline blood typing, Quicktest A+B, Alvedia via Pet Blood Bank Services Ltd, Loughborough, Leicestershire, UK.
[g] Protocol 1, Midazolam 0.2 mg/kg and ketamine 3 mg/kg IV; Protocol 2, midazolam 0.25 mg/kg and ketamine 5 mg/kg IM; Protocol 3, midazolam 0.2 mg/kg, ketamine 3 mg/kg, and butorphanol 0.2 mg/kg IV.
[h] Midazolam 0.2 mg/kg IV or butorphanol 0.2 mg/kg IV.
[i] Emla Cream 5%, APP Pharmaceuticals, Lake Zurich, IL.
[j] Statistical Package for the Social Sciences (SPSS), IBM Corporation, Armonk, NY.

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