Anesthesia in Shelter Medicine

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Shelter medicine presents a unique challenge that is different from veterinary medicine in a hospital setting. The shelter and/or mobile unit environment requires special anesthetic considerations to support high-volume spay-neuter and feral animal programs with high quality of anesthesia/immobilization for surgery and diagnostic procedures. The anesthetic protocols can be tailored to the needs of each specific shelter setting. An ideal shelter anesthesia protocol will have a wide safety margin for animals of all ages. The protocol must also be effective, economical, and easy to use with a small volume for injection, have rapid on- and off-set with a reasonable surgical duration after a single administration, be predictable, and possess perioperative analgesic properties. An anesthesia protocol with a combination of tiletamine-zolazepam and dexmedetomidine in combination with an opioid fits the criteria of the shelter anesthesia protocols. These combinations possess rapid induction of immobilization, unconsciousness, and muscle relaxation with an anesthesia duration of 30 to 45 minutes. Specific and nonspecific reversal agents are also available to facilitate recovery. This article describes the use of these anesthetic protocols as well as monitoring support for these protocols.

Keywords: shelter medicine, anesthesia, immobilization, dexmedetomidine, tiletamine-zolazepam, analgesia, monitoring support, reversal, side effects

In the United States, shelter medicine has grown from interested individual general practitioner participation to a sophisticated specialty practice over the past 5 years. A significant number of shelter medicine service programs have many branches ranging from in-shelter clinics, mobile units, and temporary stationary treatment stations to feral cat programs. Recent development of shelter programs emphasizes high volume with high-quality service. These services require sophisticated and yet practical sedation/immobilization and anesthesia protocols to execute procedures including routine diagnostic procedures as well as spay-neuter and other surgeries.

Unique Shelter Environment and Shelter Animals for Veterinary Care

Many veterinary cases handled easily in a routine veterinary clinic may present challenges in a shelter setting. Shelters strive to provide high-quality veterinary care, including the performance of sophisticated surgical procedures and the management of complex medical cases. In dealing with these animals, shelter veterinarians are not only faced with budgetary constraints, but also with unknown vaccine histories and heartworm status. These facts necessitate a safe and reliable anesthetic protocol. In addition, they may work with individual(s) with minimal medical background for anesthetic administration and handling.

Shelter and feral animals are complex and often require veterinary care including early-age (6 weeks to 3 months) spay-neuter; animals in estrus, pregnant, or with pyometra; various degrees of respiratory tract infection; heavy internal or external parasitic infestation; or clinical or subclinical heartworm conditions.[1] Shelter veterinarians also face animals suffering from cruelty and neglect. These animals do not trust humans and can be aggressive when approached or handled. Other animals may be emaciated and physically weak but need immobilization for close examination. Furthermore, high-volume services often have limited holding facilities for postprocedure recovery of a wide age range of animals in different physical conditions. For all of these reasons, anesthesia protocols should be designed with special considerations.

Shelter Anesthesia Protocol and Related Considerations

Specific recommendations for veterinary shelter medical care related to anesthesia and surgery have been recently published.[1] This special report recommends that animals between 6 and 16 weeks of age be off of feed 2 to 4 hours before surgery but not fasted for more than 4 hours. For animals older than 16 weeks, a 4-hour fast is adequate.[1] Also, routine physical examinations, including a preoperative body tem-

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perature measurement, may not always be possible and are at the discretion of the attending veterinarian based on the animal's anxiety, aggression, and feral behavior. An ideal shelter anesthesia protocol must meet critical criteria aside from safety. For anesthetic drug dosing, an accurate body weight should be obtained, but the best estimated body weight can be used for anesthetic dosage calculation in the event a weight cannot be obtained. Endotracheal intubation may not always be achievable with all the anesthetic procedures; however, endotracheal intubation with oxygen and ventilation should be immediately available and instituted in the event of an emergency.

The anesthetic protocol should be tailored to the specific needs of each shelter setting. An ideal anesthesia protocol should meet, at a minimum, the following criteria: 1) have a wide margin of safety; 2) provide rapid induction of reasonable immobilization or unconsciousness, 3) produce excellent muscle relaxation, 4) provide intraoperative and postoperative analgesia, 5) be effective and predictable for animals with a wide variety of ages, medical histories, body sizes, and conformations, 6) provide easy dose calculation and drug preparation for intravenous or intramuscular administration, 7) provide small volume for drug administration, especially for fearful or feral animals, 8) be reversible with minimal side effects, 9) induce a wide range of anesthetic responses ranging from sedation to complete immobilization and a surgical plane of anesthesia, 10) allow rapid and smooth recovery, 11) be economical, 12) minimally use controlled substances, and 13) be commercially available with a long shelf life.

Anesthetic Protocols for Shelter Medicine and Surgery

Although there are many suitable anesthetic protocols used for shelter medicine and surgery, one particular anesthetic combination comes close to meeting all of the requirements of an ideal shelter anesthesia protocol. The combination is a tiletamine-zolazepam–based anesthesia protocol enhanced with dexmedetomidine and an opioid. This tiletamine-zolazepam–based anesthetic combination dates back to earlier development of the tiletamine, zolazepam, ketamine, and xylazine (TKX)[2] protocol that has been used in feral cat programs.[3,4] Over time, 2 drawbacks have been associated with the TKX protocol, including the limited analgesia it provides given the absence of opioids and the fact that it is only suitable for use in cats given the prolonged and erratic recovery associated with dissociative agents in dogs. Furthermore, xylazine-induced hypotension is a concern during the recovery. Modifications to the TKX protocol remove the limitations by replacing xylazine with medetomidine and ketamine with butorphanol. The new protocol is then named Telazol Torbugesic Domitor (TTD; Pfizer Animal Health, New York, NY). The TTD combination is suitable for use in dogs[5] and cats[6] and has largely replaced the TKX combination since its introduction in 2002. In November 2008, Pfizer Animal Health introduced dexmedetomidine to replace medetomidine.[7] This change necessitates a transition from TTD to Telazol-Torbugesic-Dexdomitor (TTDex; Pfizer Animal Health).[7] The transition from TTD to TTDex replaces the medetomidine with the same volume of dexmedetomidine and the suggested doses and volumes for dogs and cats are indicated in this article.

Figure 1. The TTDex combination. (Color version of figure is available online.)

The TTDex combination (Fig 1) provides the following advantages over other anesthetic combinations. Pending on the dosage used (Table 1), the TTDex combination induces various depths of sedation and a surgical plane of anesthesia within 3 to 5 minutes after a single intramuscular injection. The rapid onset of action streamlines operations for high-volume cases without delay. It can be used both in dogs and cats with the same combination and dose rates. Each TTDex combination contributes visceral and somatic analgesia both intraoperatively and postoperatively. Some of the anesthetics in the TTDex combination can be antagonized, if needed, to facilitate recovery. The TTDex combination has a small injection volume to facilitate drug administration. The potency of this drug combination makes it economical. In general, this drug combination provides the efficacy and safety required for procedures performed in shelter animals in various settings.

Preparation of TTDex

The TTDex combination is prepared by reconstituting tiletamine-zolazepam (Telazol) using 2.5 mL of butorphanol (Torbugesic 10 mg/mL) and 2.5 mL of dexmedetomidine (Dexdomitor 0.5 mg/mL) as diluents (Table 1). Each milliliter of the reconstituted TTDex solution contains 100 mg of tiletamine-zolazepam, 5 mg of butorphanol, and 250 μg of dexmedetomidine. Based on clinical experience, the TTDex can be stored at room temperature for up to 3 months after reconstitution.

Table 1. Tiletamine-Zolazepam-Butorphanol-Dexmedetomidine (TTDex) Combination in Dogs and Cats for Premedication, Profound Sedation, and Injectable Anesthesia

TTDex	Desirable purpose (depth of anesthesia)	Intramuscular injection volume for dogs and cats (TTDex)
Telazol powder (tiletamine-zolazepam 500 mg)	Premedication (mild-moderate sedation)	0.01 mL/kg Tiletamine-zolazepam 1 mg/kg Butorphanol 0.05 mg/kg Dexmedetomidine 2.5 μg/kg
2.5 mL (butorphanol, 10 mg/mL)	Chemical restraint (profound sedation)	0.02 mL/kg Tiletamine-zolazepam 2 mg/kg Butorphanol 0.1 mg/kg Dexmedetomidine 5 μg/kg
2.5 mL (dexmedetomidine, 0.5 mg/mL)	Surgical plane of anesthesia	0.03 mL/kg Tiletamine-zolazepam 3 mg/kg Butorphanol 0.15 mg/kg Dexmedetomidine 7.5 μg/kg

Dose Rate of TTDex for Dogs and Cats

The TTDex combination provides flexibility in several dose ranges from 0.01 to 0.03 mL per kilogram, intramuscularly (IM) (Table 1), such that a veterinarian can decide the dose rate based on the animal's size, age, health status, and surgery type. As with any other anesthetic combinations, the larger the dose of TTDex, the longer the duration of anesthesia and the longer the duration of recovery, if not reversed. Also, the larger the dose, the more profound the cardiorespiratory depression. In principle, pediatric, geriatric, emaciated, and pregnant animals require a smaller dose of TTDex than overall healthy dogs and cats.

Premedication

A combination of TTDex premedication (0.005-0.015 mL/kg, mild to moderate sedation; see dose chart of Table 2) followed by inhalant anesthesia for maintenance provides rapid sedation, smooth induction, and maintenance with a rapid recovery. Premedication with TTDex can reduce the

Table 2. Telazol-Torbugesic-Dexdomitor (TTDex) Sedation/Anesthesia in Dogs and Cats with Body Weight and Drug Mixture Volume. All Dosing Volumes Listed as Intramuscular Dose

Body (lb)	Weight (kg)	Mild Sedation	Moderate Sedation	Profound Sedation	Surgical Anesthesia	Surgical Anesthesia
		0.005 mL/kg	0.01 mL/kg	0.02 mL/kg	0.035 mL/kg	0.04 mL/kg
2-4	1-2	0.005 mL	0.01 mL	0.02 mL	0.035 mL	0.04 mL
4-7	2-3	0.013 mL	0.025 mL	0.05 mL	0.09 mL	0.12 mL
7-9	3-4	0.018 mL	0.035 mL	0.07 mL	0.12 mL	0.15 mL
9-11	4-5	0.023 mL	0.045 mL	0.09 mL	0.16 mL	0.19 mL
11-22	5-10	0.038 mL	0.075 mL	0.15 mL	0.26 mL	0.37 mL
22-29	10-13	0.06 mL	0.12 mL	0.24 mL	0.40 mL	0.48 mL
29-33	13-15	0.07 mL	0.14 mL	0.28 mL	0.49 mL	0.58 mL
33-44	15-20	0.09 mL	0.18 mL	0.36 mL	0.61 mL	0.78 mL
44-55	20-25	0.12 mL	0.23 mL	0.46 mL	0.79 mL	0.98 mL
55-66	25-30	0.14 mL	0.28 mL	0.56 mL	0.96 mL	1.25 mL
66-73	30-33	0.16 mL	0.32 mL	0.64 mL	1.1 mL	1.3 mL
73-81	33-37	0.18 mL	0.35 mL	0.7 mL	1.2 mL	1.45 mL
81-99	37-45	0.21 mL	0.41 mL	0.82 mL	1.44 mL	1.7 mL
99-110	45-50	0.24 mL	0.48 mL	0.96 mL	1.66 mL	1.95 mL
110-121	50-55	0.26 mL	0.53 mL	1.1 mL	1.84 mL	2.2 mL
121-132	55-60	0.29 mL	0.58 mL	1.2 mL	2.0 mL	2.3 mL
132-143	60-65	0.32 mL	0.63 mL	1.3 mL	2.18 mL	2.5 mL
143-154	65-70	0.34 mL	0.68 mL	1.4 mL	2.36 mL	2.7 mL
154-176	70-80	0.38 mL	0.75 mL	1.5 mL	2.63 mL	3.0 mL
>176	>80	0.4 mL	0.8 mL	1.6 mL	2.8 mL	3.2 mL

animal's anxiety, facilitate handling for intravenous drug induction, and provide an anesthetic-sparing effect on both induction and inhalant maintenance. Unlike acepromazine or other anesthetic combinations, the onset of sedation induced by TTDex occurs rapidly (3-5 minutes) after a single intramuscular injection in dogs and cats. Furthermore, all 3 anesthetics in the TTDex combinations provide analgesia before, during, and after the procedures.

The premedication dose of TTDex for dogs and cats is 0.01 mL/kg IM. This premedication is compatible with intravenous induction agents such as propofol, additional Telazol, or ketamine-diazepam induction for endotracheal intubation. The TTDex has significant sparing effects on the intravenous induction anesthetic agents as well as isoflurane and sevoflurane maintenance. The listed TTDex premedication dose of 0.01 mL/kg is a suggestive dose. Some practitioners prefer heavier sedation, for which the dose can then be increased to 0.015 or 0.0175 mL/kg. In contrast, the degree of sedation is reduced with lower doses (between 0.005 and 0.0075 mL/kg IM).

Chemical Restraint

For apprehensive animals in which there is a concern for fear of biting potential, profound sedation is appropriate before a procedure is performed to protect both the animal and the handler. For mild to moderately painful diagnostic or surgical procedures, a dose of 0.02 to 0.025 mL/kg IM can be used (or see dose chart of Table 2 for profound sedation). Examples of this include cat castration, a laceration repair, radiography, simple dental procedure, or deep ear cleaning. A lower dose, while maintaining the appropriate level of anesthesia, provides a shorter recovery time. As with any other anesthetics, there are individual variations in response to the TTDex combination. If an animal appears too light with this dose of TTDex, supplement with an isoflurane (1%) face mask for a short period of time to complete the surgery. For example, because cat castrations are short procedures, some shelter practitioners prefer to administer this dose of TTDex to immobilize the cat and then supplement with isoflurane if the cat is too light. Once the procedure is complete, the cat is reversed with atipamezole to shorten the recovery. Reversal of TTDex is discussed later in this article.

Injectable Anesthetic

To use the TTDex as injectable anesthesia for surgery, such as ovariohysterectomy, a dose of 0.03 mL/kg IM is recommended. This provides a surgical plane of anesthesia for 30 to 40 minutes. If a longer (up to 50 minutes) procedure is performed, then a dose of 0.04 mL/kg should be used (or see the dose chart of Table 2 for surgical anesthesia). At these doses, dogs and cats assume laterally recumbency 3 to 5 minutes after intramuscular injection and can be intubated and maintained on 100% oxygen without inhalant anesthetic. If the anesthesia must be extended, isoflurane or sevoflurane may be used as a supplement. However, at this dose rate, the inhalant is not usually necessary. The key point to remember when using this dose of TTDex is that the effect occurs very quickly after a single intramuscular injection. The animal very quickly assumes lateral recumbency and is ready for prepping and surgical stimulation; therefore, to take advantage of the entire surgical duration induced by TTDex, everything should be in place and ready to start before administration.

In addition, the wide safety margin of TTDex allows an estimated body weight with a dose at 0.15 mL per 10 lb IM for those cases in which the body weight cannot be obtained for whatever reason. This dose rapidly immobilizes for both dogs and cats for surgery. The anesthesia can be further titrated depending on the procedures performed.

Options for Administration of TTDex

TTDex can be administered in an intravenous injection instead of IM. For intravenous administration, halve the recommended intramuscular doses for both dogs and cats. The onset is immediate and the duration of effect is approximately two thirds the length of intramuscular administration.

There are several opioids that can be used in place of butorphanol for reconstitution of the Telazol in the TTDex combination. For example, hydromorphone (2 mg/mL), morphine (15 mg/mL), nalbuphine (20 mg/mL), and buprenorphine (0.3 mg/mL) can all replace butorphanol using the identical volume (2.5 mL) in the TTDex combination. Butorphanol induces less respiratory depression and bradycardia than other opioids, which is why it is preferred in the TTDex combination.

Options for Postoperative Analgesia

After an invasive procedure in TTDex-anesthetized dogs, the postoperative analgesia can be managed in a variety of ways. One is to provide a second dose of opioid. This can be either using the same type of opioid included in the TTDex or using buprenorphine to take advantage of a longer duration of action than other types of opioids. The dose of the opioid depends on the invasiveness of the surgery; it can be a full or smaller dose. For example, additional butorphanol (0.2 mg/kg), hydromorphone (0.05 mg/kg), morphine (0.25 mg/kg), nalbuphine (0.4 mg/kg), or buprenorphine (15 μg/kg) extends the analgesia when administered IM at the end of the surgery. Additionally, a nonsteroidal antiinflammatory drug, such as carprofen (4 mg/kg, subcutaneously) or meloxicam (0.2 mg/kg, subcutaneously), administered either before or soon after surgery, provides additional analgesia and antiinflammatory action.

Reversal of TTDex

All but one component in the TTDex can be effectively reversed with a specific antagonist. Dexmedetomidine is reversed with atipamezole. Butorphanol is antagonized with

naloxone or naltrexone. The zolazepam of the Telazol is antagonized with flumazenil (Romazicon; Roche, Nutley, NJ, USA). The only component that does not have a specific antagonist is tiletamine. However, studies have shown that doxapram (Respiram; Modern Veterinary Therapeutics, LLC, Miami, FL), administered at a dose of 5.5 mg/kg intravenously, can antagonize tiletamine-zolazepam–anesthetized animals by increasing respiratory rates and shortening arousal time.[8] In general, atipamezole is the most commonly used reversal agent for the TTDex combination to antagonize dexmedetomidine when the procedure is complete. The atipamezole volume used for reversal is half the volume of the TTDex used. Intramuscular administration of atipamezole is recommended to minimize sudden arousal.

Premature reversal of TTDex-anesthetized dogs with atipamezole leaves the tiletamine dominant and results in a typical dissociative recovery characterized by head shaking, salivation, muscle rigidity, paddling, or vocalization. Therefore, in TTDex-anesthetized dogs, it is not recommended to administer atipamezole until at least 50 minutes has elapsed since administration of the TTDex. This ensures that the tiletamine has been metabolized to a level that will not cause a dissociative type of rough recovery. If the dog was treated with a TTDex dose of 0.02 mL/kg or less, the atipamezole reversal can be administered earlier without a rough recovery. In contrast to the TTDex-anesthetized dogs, TTDex-anesthetized cats can receive atipamezole at any time. This antagonizes the dexmedetomidine and shortens the arousal time, which allows the cats to be self supported with less attendance during the recovery.

Side Effects of TTDex

As with any other anesthetic combination, TTDex has anesthetic side effects. As mentioned previously, because the TTDex combination takes effect so quickly, animals should be in the surgical preparation area with monitoring instituted soon after administration of the TTDex. Some dogs or cats develop hypoxia soon after administration of TTDex. This hypoxia is also observed in studies evaluating TTD in dogs[5] and cats.[6] The hypoxia usually occurs within the first 5 to 8 minutes after administration of a surgical dose of TTDex. The hypoxia is oxygen responsive, so it is resolved by providing 100% oxygen insufflation via face mask or flow by. The hypoxic response usually subsides with the start of surgical stimulation.

An apneustic breathing pattern (inspiratory breath holding followed by a few rapid breaths) may be observed in dogs and cats receiving TTDex. No treatment is required. In addition, apnea may occur occasionally. Intubation followed with positive ventilation using either an anesthetic breathing circuit with an anesthesia machine or an Ambu bag resolves the issue. The apnea usually subsides once the surgical stimulation starts. Some dogs may develop bradycardia after TTDex administration. This bradycardic response results from vasoconstriction induced by dexmedetomidine and usually does not require treatment. Cats receiving TTDex are unlikely to have a bradycardic response.

Unlike other anesthetic combinations, TTDex usually induces hypertension and not hypotension. This hypertensive stage should not be interpreted as a lack of analgesia or a response to surgical stimulation. No treatment is necessary for such hypertension.

There is no vomiting response when high doses of TTDex are used in dogs and cats. This is likely due to the rapid onset of anesthesia, which reduces activation of the vomiting center. However, some animals may vomit when receiving smaller doses of TTDex. This is not long lasting and is not considered a clinical concern.

Pain on intramuscular injection of TTDex may be noticed in dogs and cats. This is likely due to the low pH associated with the drug mixture. However, the small amount required for injection likely minimizes the pain. Attempting to change the volume or adjust the pH of the TTDex mixture to minimize the injection pain is not warranted.

Monitoring TTDex Anesthesia

In the complex shelter environment, anesthesia monitoring is vital. Basic monitoring is achieved by palpating animal's lingual, radial, femoral, or metatarsal arterial pulse rate and rhythms; observing mucous membrane colors; and monitoring respiratory rate, depth, and patterns. Assessing jaw tone, eye position, and general muscle tone are helpful in assessing the animal's anesthetic depth.

Several recently developed portable monitors are capable of measuring blood pressure, hemoglobin saturation for oxygen, respiratory rate, end-tidal CO_2, and electrocardiogram. Some of these units are reasonably priced and yet produce consistent and reliable data. Blood pressure in small dogs and cats, regardless of the vasoconstriction stage, is now measured accurately and with minimal difficulty using some of these portable blood pressure monitors. Pulse oximetery, measured on the tongue of the animal as soon as they are anesthetized, allows early detection of hypoxia.

Body temperature should also be carefully monitored both during and after surgery. Hypothermia prolongs the duration of recovery, especially when using an injectable anesthetic because it slows drug metabolism. Provide an exogenous heat source during surgery. It is also helpful to use towels or bubble wrap to reduce body heat loss during recovery.

TTDex and Controlled Substance Recordkeeping

Controlled substances require detailed recordkeeping, even in the shelter environment. Because both tiletamine-zolazepam and butorphanol are controlled substances, accurate and daily recordkeeping is an important part of using TTDex. In the TTDex combination, butorphanol (2.5 mL) and dexmedetomidine (2.5 mL) are used as diluents for Telazol powder. Therefore, the controlled substance record should capture 1.0 mL of Telazol and 0.5 mL of butorphanol for each milliliter of TTDex reconstituted. Each milliliter of

TTDex also contains 0.5 mL of dexmedetomidine, but because dexmedetomidine is not a controlled substance, it does not need to be tracked. An easy way track the use of TTDex is to record the amount used in milliliters for each animal. This amount represents the Telazol volume, and half of this volume is butorphanol volume. For example, if a dog receives 0.5 mL TTDex, record 0.5 mL of Telazol and 0.25 mL of butorphanol in the respective controlled substance logs.

Conclusion

In conclusion, TTDex is a safe anesthetic combination that can be used at the same dose rate in both dogs and cats. This simplifies operation of the shelter environment. The TTDex combination is very close to the ideal shelter anesthetic protocol. It is safe and economical and provides flexibility for use as a premedication in conjunction with an inhalant for maintenance, or it can be used as a total injectable anesthetic combination to accomplish high-volume surgeries and immobilizations. In addition, antagonizing the TTDex combination shortens anesthesia recovery.

References

1. Looney AL, Bohling MW, Bushby PA, et al. The Association of Shelter Veterinarians veterinary medical care guidelines for spay-neuter programs; Association of Shelter Veterinarians' Spay and Neuter Task Force. J Am Vet Med Assoc 233:74-86, 2008
2. Ko JCH, Thurmon JC, Benson GJ, et al. An alternative drug combination for use in declawing and castrating cats. Vet Med 88:1061-1065, 1993
3. Cistola AM, Golder FJ, Centonze LA, et al. Anesthetic and physiologic effects of tiletamine, zolazepam, ketamine, and xylazine combination (TKX) in feral cats undergoing surgical sterilization. J Feline Med Surg 6:297-303, 2004
4. Williams LS, Levy JK, Robertson SA, et al. Use of the anesthetic combination of tiletamine, zolazepam, ketamine, and xylazine for neutering feral cats. J Am Vet Med Assoc 220:1491-1495, 2002
5. Ko JC, Payton M, Weil AB, et al. Comparison of anesthetic and cardiorespiratory effects of tiletamine-zolazepam-butorphanol and tiletamine-zolazepam-butorphanol-medetomidine in dogs. Vet Ther 8:113-126, 2007
6. Ko JC, Abbo LA, Weil AB, et al. A comparison of anesthetic and cardiorespiratory effects of tiletamine-zolazepam-butorphanol and tiletamine-zolazepam-butorphanol-medetomidine in cats. Vet Ther 8:164-176, 2007
7. Ko JC, Knesl O, Weil AB, et al. FAQs—Analgesia, sedation, and anesthesia: making the switch from medetomidine to dexmedetomidine. Compend Contin Educ Vets 31:1-24, 2009
8. Hatch RC, Clark JD, Jernigan AD, et al. Searching for a safe, effective antagonist to Telazol overdose. Vet Med 82:112-116, 1988