Analgesia/Anesthesia in Reptiles

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Abstract: Nowadays, conducting clinical practice means dealing with a wide range of animal species, whose availability on the market is becoming more common and interest among owners is growing, which is why reptile patients may appear more often in the surgery. Due to the completely different nature of these animals, distinguishing them from the world of our most frequent patients, that is mammals, you must have the appropriate expertise to help them in accordance with the accepted international standards. We will often need general anesthesia, not only for surgical patients. Often, we must deal with aggressive and dangerous animals, which means that they require immobilization to ensure the safety of the staff, owners, and the suffering animal. The aim of this study is to familiarize the reader with the methods of conduct and methods of using analgesia and anesthesia in reptiles.

Keywords: Anesthesia, analgesia, drugs dosage, reptiles.

1. SPECIFIC FEATURES OF REPTILES

Reptiles are cold-blooded animals, so the metabolism of applied drugs will depend strictly on the external conditions provided for the creature. The wide range of reptile species living in different climatic zones forces the doctor to explore the conditions they live in [1]. Animals with nocturnal activity are prone to overheating, which means greater oxygen consumption of the tissues. During treatments, such animals should be provided with a lower ambient temperature. The differentiation of anatomical structure and physiology also encourages proper conduct during the anesthesia of these animals [2]. The heart of the reptiles is tripartite, so the oxygenated blood mixes with the non-oxygenated, which affects the efficiency of anesthesia. Lizards and snakes don't have closed rings in the trachea, whereas in turtles they are complete, and the trachea is very short [1]. Many reptiles do not have a diaphragm. They breathe using abdominal, torso, and intercostal muscles. In turn, a tortoise that does not have intercostal muscles uses changes in the visceral system for breathing. Reptilian lung structure is simpler than that of mammals; their flesh is fragile and only the boa and python have two lungs. In reptiles, there is a portal renal circulation, which is the reason for difficult control of the effects of the drugs administered in the back of the body. Muscle relaxation occurs from the front parts of the body, while the return of motor function starts from the back of the body. A characteristic feature is also the manifestation of long periods of apnea, the negative effects of which are mitigated by using positive pressure ventilation. The depth control of anesthesia is a real challenge [3]. The readiness of the animal for the surgery indicates the lack of response to the prick of the needle of the hind limb [1]. The absence of a corneal reflex, which we cannot use in snakes, due to their lack of eyelids, indicates too deep an introduction of the animal into narcosis [4]. An extremely important parameter, that needs to be controlled, is the temperature. Hypothermia promotes all complications. It is necessary to have mats, heating lamps, and hot water bottles. To ensure proper monitoring of the anesthetized reptile, it is necessary to have specialist equipment that allows control of the cardiovascular system, such as a cardio monitor or pencil probe, applied to the eye, allowing the measurement of the heart rate from the ophthalmic artery, which comes with additional costs [5]. Reptile starvation is recommended before endoscopy and laparotomy [6].

2. CHOOSING THE ANESTHETIC

When choosing an anesthetic, the same criteria apply here as in mammals. The drug should provide an appropriate anesthesia for the procedure, ensuring a gentle and possibly quick wake up. It should be easy to apply and have a high therapeutic index [7]. Reptiles have a diverse but relatively high pain threshold; hence, it is not always possible to determine if the drug used is effective. One should bear in mind the type of surgery performed, the size, species, and physiological condition of the animal. Regarding reptiles, guidelines developed by the American Society of

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E-ISSN: 2310-0796/18

Anesthesiologists allow, based on various parameters to influence the success rate of putting the animal into anesthetic state and performing the procedure. Before starting any procedures, a blood test should be performer, with the assessment of the most important parameters i.e. Ht, protein total, glucose [8]. Unfortunately, there are only a few reports on the appropriate dosage of drugs used in reptiles, which is why most have been adapted empirically. It is recommended to use small doses and gradually increase the dose as the effect progresses and selecting those for which there are antagonists, reversing their effect. Wild species and turtles require higher doses of anesthetics [9]. For inhalation anesthetics, isoflurane and sevoflurane are used, and halothane is no longer being used. Reptiles have a physiologically low respiratory rate, so the effectiveness of this anesthesia may be lower. Reptiles can hold their breath for a long period after contact with gas. The use of induction chambers is not recommended, as this increases gas consumption. Therefore, prior anesthesia through injection is recommended, which allows the muscles to relax and thus the intubation of the animal becomes easier.

3. DRUGS USED IN REPTILE ANESTHESIOLOGY

Analgesics, or painkillers, belong to the basic pharmaceuticals. Despite the fact that we still do not know much about reptile pain, these should be used, especially in premedication and general anesthesia [2].

Ketamine

This is recommended in practice in a set with other drugs. An agent that causes dissociated anesthesia, which means that it selectively inhibits some CNS structures (loss of consciousness) with stimulation of others (catalepsy, eye movements, hallucinations) [5] to act by blocking activation of one type of the channel glutamate excitatory NMDA receptor. It is characterized by slow onset (2–5 minutes), after-effects common during recovery and a wide range of dosages; however, it is best to use minimal doses causing the desired therapeutic effect. Due to the fact that dissociative anesthetics do not cause sufficient myorelaxation of striated muscles and the elimination of visceral pain, it is most often combined with medetomidine for premedication before intubation and anesthesia inhalation. The use of higher doses is associated with prolonged awakening of the reptile patient, which, in extreme cases, can even be 3 days. Then, continuous monitoring of the patient's condition and fluid therapy is necessary. Special precautions should be taken in the case of a liver or kidney disease, as the active substance remains in the body and can significantly affect these organs [7]. There is a report that after using ketamine, snakes can become permanently aggressive [8].

Medetomidine/Dexmedetomidine

Recommended for use in combination with other drugs, because its immobilizing properties are not sufficient. Provides a quick and easy wake up. Its effect can be reversed by a specific antagonist – atipamezole, which works for up to 15 minutes. The combination of the drug is most often used with ketamine or butorphanol. On the market, there is a dexmedetomidine with low concentration that can be safely applied to the smallest of diseased animals [7]. Its depressive effect on CNS results from stimulation of alpha$_2$-adrenergetic receptors, which leads to inhibition and release of norepinephrine (NE) circulation [9]. Sedative effects persist longer than analgesic effects.

Succinylcholine

A drug that causes a depolarizing neuromuscular block. Depending on the dosage, it results in a flaccid or spastic paralysis. The disadvantage of using this drug is that there is no antagonist to reverse its effects. It works from 5 minutes to 1.5 hours, which depends on the rate of metabolism and excretion through the urinary tract [6]. It does not have analgesic properties; therefore, during surgical procedures, it needs to be combined with other drugs. Succinylcholine is a drug widely used in the incapacitation of crocodiles.

Table 1: List of the Most Common Analgesics in Reptiles [Based on: Carpenter, 2005, Mitchell and Tully, 2010]

Substance	Turtles	Lizards	Snakes
Meloxicam (Metacam, Loxicom)	0,2-0,5 mg/kg, *p.o.*	0,2 mg/kg *i.m., i.v.*	0,5 mg/kg *p.o.*
Carprofen (Rimadyl)	2 mg/kg p.o., *i.m.*	1-4 mg/kg, *p.o., i.m., s.c, i.v.*	2-4 mg/kg *i.m., p.o.*
Butorphanol (Torbugesic)	0,5-1 mg/kg b.m., *i.m.*	0,05 mg/kg, *i.m.*	0,5-1 mg/kg *i.m.*
buprenorphine		0,005-0,02 mg/kg, *i.m*; 0,01 mg/kg, *i.m.*; 0,1-1 mg/kg, *i.m.*	

Gallamine

This induces a non-depolarizing neuromuscular block. Through the receptor block for acetylcholine in the motor end plate, it leads to flaccid paralysis. Like succinylcholine, it has no analgesic properties and is widely used in crocodiles, while its effect can be reversed by administering neostigmine methyl sulphate. Among the adverse reactions we can observe accelerated breath and heart rate [10].

Alphaxalone

This is a drug with proven, very good performance. It is characterized by a short duration of effect and can be used alone for short interventions. It has no analgesic effect, hence the need to use it in combination with other drugs. Alphaxalone + alphadolone is a good narcotic. In the case of snakes, when administering i.m. and i.Coe the effect can vary [6].

Butorphanol

The drug is an opioid considered to be 4–7 times as potent an analgesic as morphine. As mentioned earlier, the effect of opioid drugs in reptiles is not known well and not always effective. It is used for premedication in combination with other drugs. It possesses the agonist and antagonist properties of μ-opioid receptors [9].

Diazepam

Due to its powerful myorelaxation properties, it is recommended that it be administered in order to increase this effect, in particular in patients with high muscle strength, such as crocodiles, which may be necessary to be able to perform routine tests in various programmes in zoos [6]. It binds to specific benzodiazepine receptors (BDA), increasing the affinity of GABA to the GABAergic receptor. GABA is a neurotransmitter, that inhibits both pre- and post-synaptic terminals. In the final effect, the inhibitory conductivity in the $GABA_A$-ergic neurons, which inhibit most CNS structures, increases [9].

Propofol

A drug which works quickly and fades quickly. Ideally suited for intubation and continuation of anesthesia, when it is impossible to use inhalation anesthesia. It is effective after intravenous administration, which becomes a problem in the case of snakes, in which this type of administration is not recommended. Its depressive effect on the respiratory center and heart function is offset by the use of forced breathing. In green iguanas, intraosseous administration is a safe alternative [11]. A non-intravenous application is not dangerous, but the effectiveness of the drug is reduced.

Xylazine

As a xylidinethiazine derivative is a potent α_2-adrenergic agonist classified as a sedative and analgesic drug, it has now been replaced by a safer and more effective medetomidine. Recommended only for use in combination with other drugs [5]. Xylazine is often combined with opioids such as butorphanol to enhance sedative and analgesic qualities [12].

Atropine

After its administration, excessive salivation and vomiting are eliminated, but this is not a common problem in reptiles [13, 14].

Isoflurane, Sevoflurane

Isoflurane affects synaptic transmission. The release of excitatory transmitters and the response of postsynaptic receptors are both inhibited. GABA-mediated pre- and post-synaptic inhibitory transmission by this drug is enhanced. Narcosis using anesthetic gases, such as isoflurane or sevoflurane, is the safest, making it the method of choice for reptiles. It allows to general anesthesia to be controlled, without straining the internal organs such as the kidneys or liver, because it is practically not metabolized. Ensures rapid introduction and recovery from narcosis. This method is particularly recommended for weakened animals in poor clinical condition. Due to a reptile's ability to hold its breath, it is recommended to initially provide general anesthesia with the help of injection agents, and then to intubate and continue the anesthesia with the use of inhalants. Sometimes, it is necessary to support breathing. Isoflurane can be irritating to passages [15, 16].

4. LOCAL ANESTHESIA

This is a form of anesthesia that may be sufficient for small surgical procedures. Expected anesthetic effects are obtained using lidocaine or procaine. For anesthesia, a cutting line is used, in combination with other anesthetics and in the entry of the trachea, before inserting the endotracheal tube. The safe dose should not exceed 5mg/kg BW [12].

Table 2: Chemical Restraint/Anesthetic Agents Used in Reptiles [Based on: Carpenter, 2005, Jepson, 2016, Kolle and Hoffmann, 2000]

Agent	Dosage	Species/Comments
Acepromazine	0.05-0.25 mg/kg IM	most species can be used as a preanesthetic with ketamine
	0.1-0.5 mg/kg IM	most species preanesthetic reduce by 50% if used with barbiturates
Alphaxalone (Alfaxan, Jurox)	6-9 mg/kg IV, or 9-15 mg/kg IM	most species good muscle relaxation don't use within 10 days of DMSO treatment
	6-15 mg/kg IM, IV	most species
	9 mg/kg IV	snakes, lizards induction not effective for blotched blue-tongued skinks
	15 mg/kg IM	lizards, chelonians induction, 35-40 min duration, 15-35 min good muscle relaxation variable results
	24 mg/kg ICe	chelonians (red-eared sliders), surgical anesthesia with good relaxation
Atipamezole (Antisedan, Pfizer)	give same volume SC, IV, IP as medetomidine or dexmedetomidine (5 × medetomidine or 10 × dexmedetomidine dose in mg)	most species medetomidine and dexmedetomidine reversal causes severe hypotension in gopher tortoises when given IV
	0.2-0.5 mg/kg IM	chelonians/shell repair 5-10 min before finished
	0.5-0.75 mg/kg IM	chelonians
Atropine	0.01-0.04 mg/kg SC, IM, IV, ICe	most species preanesthetic bradycardia rarely indicated ineffective at this dose in green iguanas
	0.5 mg/kg IM, IV, IT, IO	most species bradycardia, decrease secretions, CPR
Butorphanol	0.4-1 mg/kg SC., IM	most species/analgesia sedation preanesthetic
	0.5-2 mg/kg IM or 0.2-0.5 mg/kg IV, IO	most species/preanesthetic
	1-2 mg/kg IM	snakes/analgesia
	0.05 mg/kg IM q24h x 2-3 days	lizards (iguanas)/analgesia
	1-1.5 mg/kg SC, IM	lizards/administer 30 min prior to isoflurane for smooth, shorter induction
	0.2 mg/kg IM	chelonians/tranquilizer
Butorphanol (B)/ medetomidine (M)	(B) 0.4 mg/kg + (M) 0.08 mg/kg IM	green tree monitor/sedation
Butorphanol (B)/midazolam (M)	(B) 0.4 mg/kg + (M) 2 mg/kg IM	most species/preanesthetic administer 20 min before induction

(Table 2). Continued.

Agent	Dosage	Species/Comments
Chlorpromazine	0.1-0.5 mg/kg IM	most species/preanesthetic not commonly used
	10 mg/kg IM	chelonians/preanesthetic
Dexmedetomidine (Dexdomitor; Pfizer)	-	α2 agonist that has replaced medetomidine
Diazepam	-	muscle relaxation give 20 min prior to anesthesia drug interaction with ivermectin
	0.5 mg/kg IM, IV	all species seizures
	2.5 mg/kg IM, IV	most species seizures
	0.2-0.8 mg/kg IM	snakes use in conjunction with ketamine for anesthesia with muscle relaxation
	0.2-2 mg/kg IM, IV	snakes, lizards
	2.5 mg/kg PO	iguanas/reduce anxiety, which often leads to aggression
	0.2-1 mg/kg IM	chelonians/use in conjunction with ketamine for anesthesia with muscle relaxation
Disoprofol	5-15 mg/kg IV to effect	all species/anesthesia similar characteristics to propofol
Doxapram	5 mg/kg IM, IV q10min prn	most species/respiratory stimulant reduces recovery time reported to partially “reverse” effects of dissociatives
	4-12 mg/kg IM, IV	most species/respiratory stimulant
	20 mg/kg IM, IV, IO	most species/respiratory stimulant
Epinephrine (1:1000)	0.5-1 mg/kg IV, IO, IT	most species cardiac arrest
Etorphine	0.3-0.5 mg/kg IM 0.3-2.75 mg/kg IM (poor relaxation)	crocodilians, chelonians very potent narcotic requires an antagonist
Flumazenil (Romazicon, Hoffman-LaRoche)	-	all species reversal of benzodiazepines, including diazepam and midazolam seldom indicated
	1 mg/20 mg of zolazepam IM, IV	crocodilians, chelonians reversal of zolazepam
Gallamine (Flaxedil, American Cyanamid)	0.4-1.25 mg/kg IM 0.6-4 mg/kg IM 0.7 mg/kg IM 1.2-2 mg/kg IM	crocodiles/results in flaccid paralysis, but no analgesia larger animals require lower dosage reverse with neostigmine use in alligators questionable unsafe in alligators at ≥1 mg/kg, deaths reported in American alligators and false gharials
	0.5-2 mg/kg IM	crocodilians

(Table 2). Continued.

Agent	Dosage	Species/Comments
Glycopyrrolate	0.01 mg/kg SC, IM, IV	most species/preanesthetic for excess oral or respiratory mucus rarely indicated generally use only in profound or prolonged bradycardia may be preferable to atropinę does not work at this dose in green iguanas
Haloperidol	0.5-10 mg/kg IM q7-14d	boids/aggression management
Hyaluronidase (Wydase, Wyeth)	25 U/dose SC	crocodilians/combine with premedication, anesthetic, or reversal drugs to accelerate SC absorption
Isoflurane	3-5% induction, 1-3% maintenance	most species inhalation anesthetic of choice in reptiles intubation and intermittent positive pressure ventilation advisable may preanesthetize with low dose propofol, ketamine, etc.
	5% via chamber in 5 L O_2/min	green iguanas/15-35 min loss of righting reflex mean MAC, 1.62%; pH 7.49
Ketamine	-	most species prolonged recovery with higher doses larger reptiles require lower dose safety is questionable in debilitated patients snakes may be permanently aggressive after ketamine anesthesia generally recommend use only as a preanesthetic prior to isoflurane for surgical anesthesia
	10 mg/kg SC, IM q30min	most species/maintenence of anesthesia recovery, 3-4 hr
	20-60 mg/kg IM, or 5-15 mg/kg IV	most species/muscle relaxation improved with midazolam or diazepam
	22-44 mg/kg SC, IM	most species/sedation
	55-88 mg/kg SC, IM	most species/surgical anesthesia induction, 10-30 min recovery, 24-96 hr
	10-20 mg/kg IM	snakes, chelonians/sedation
	20-60 mg/kg SC, IM	snakes/sedation induction, 30 min recovery, 2-48 hr
	60-80 mg/kg IM	snakes/light anesthesia intermittent positive pressure ventilation may be needed at higher doses
	5-10 mg/kg	izards, snakes/decreases the incidence of breath-holding during chamber induction
	20-30 mg/kg IM	iguanas/sedation (i.e., facilitates endotracheal intubation) preanesthetic requires lower dose than other reptiles
	30-50 mg/kg SC, IM	lizards/sedation variable results
	20-60 mg/kg IM	chelonians/sedation induction, 30 min recovery, ≥24 hr potentially dangerous in dehydrated and debilitated tortoises

(Table 2). Continued.

Agent	Dosage	Species/Comments
	25 mg/kg IM, IV	sea turtles/sedation used at higher doses (50-70 mg/kg) recovery times may be excessively long and unpredictable combination of ketamine and acepromazine gives a more rapid induction and recovery
	38-71 mg/kg ICe	green sea turtles/anesthesia induction, 2-10 min duration, 2-10 min recovery, <30 min
	60-90 mg/kg IM	chelonians/light anesthesia induction, <30 min recovery, hours to days requires higher doses than most other reptiles
	20-40 mg/kg (sedation) to 40-80 mg/kg (anesthesia) SC, IM, ICe	crocodilians/induction, <30-60 min recovery, hours to days; in larger animals, 12-15 mg/kg may permit tracheal intubation not recommended alone in Nile crocodiles
	20-100 mg/kg IM	crocodilians/lower dose for sedation, higher for anesthesia (requires intermittent positive pressure ventilation for hours)
Ketamine (K)/medetomidine (M)	(K) 10 mg/kg /(M) 0.1-0.3 mg/kg IM	most species reverse medetomidine with atipamezole
Ketamine (K)/butorphanol (B)/ medetomidine (M)	(K) 10 mg/kg/(B) 1 mg/kg/(M) 0.15 mg/kg	anesthesia with improved muscle relaxation
Ketamine (K)/propofol (P)	(K) 25-30 mg/kg IM + (P) 7 mg/kg IV	chelonians administer propofol 70-80 min post-ketamine
Lidocaine (0.5-2%)	Local or topical	most species/local analgesia infiltrate to effect (e.g., 0.01 mL 2% lidocaine used for local block for IO catheter placement in iguanas) often used in conjunction with chemical immobilization
Medetomidine	0.1-0.15 mg/kg IM	most species reverse with atipamezole
	0.06-0.15 mg/kg	lizards
	0.15 mg/kg IM	desert tortoises, crocodilians/sedation; incomplete immobilization generally produces bradycardia and bradypnea
	0.04-0.15 mg/kg IM	crocodilians need to reverse
Methohexital (Brevital, Lilly)	-	recovery time of red-sided garter snakes at 21°C (70°F), 125 min; 26°C (79°F), 86 min; 31°C (88°F), 64 min; thinner snakes had longer recovery times; if within 5 wk of parturition, mean recovery time 2x as long as nongravid; time post-feeding had no effect at 1, 3, 10 days
	5-20 mg/kg SC, IV	most species/induction, 5-30 min recovery, 1-5 hr; use at 0.125-0.5% concentration decrease dose 20-30% for young animals avoid use in debilitated animals
	9-10 mg/kg SC, ICe	colubrids/induction, ≥22 min; recovery, 2-5 hr does not produce soft tissue irritation seen with other barbiturates may need to adjust dosage in obese snakes

(Table 2). Continued.

Agent	Dosage	Species/Comments
Metomidate	10 mg/kg IM	snakes profound sedation
Midazolam	-	can be reversed by flumazenil
	2 mg/kg IM	most species/preanesthetic increases the efficacy of ketamine effective in snapping turtles, not in painted turtles
	0.5-2 mg/kg	lizards
	1.5 mg/kg IM	turtles (red-eared sliders)/sedation onset, 5.5 min duration, 82 min recovery, 40 min much individual variability
Naloxone	4 mg/kg IM	green tree monitor/reversal of butorphanol
Neostigmine	0.03-0.25 mg/kg IM 0.063 mg/kg IV 0.07-0.14 mg/kg IM	crocodiles/gallamine reversal may cause emesis and lacrimation fast 24-48 hr before use effects enhanced if combined with 75 mg hyaluronidase per dose when administered SC, IM
Pentobarbital	15-30 mg/kg ICe	snakes/induction, 30-60 min duration, ≥2 hr; prolonged recovery (risk of occasional fatalities) venomous snakes require twice as much as nonvenomous snakes avoid use in lizards
	10-18 mg/kg ICe	chelonians
	7.5-15 mg/kg ICe, or 8 mg/kg IM	crocodilians
Propofol	0.3-0.5 mg/kg/min IV, IO constant rate infusion or 0.5-1 mg/kg IV, IO periodic bolus	most species maintenance anesthesia must provide respiratory and thermal support
	5-10 mg/kg IV, IC	snakes
	3-5 mg/kg IV, IO	lizards (iguanas) intubation and minor diagnostic procedures
	5-10 mg/kg IV, IO	iguanas higher dose is recommended for induction for short duration procedures or intubation
	10 mg/kg IV, IO	lizards, snakes/0.25 mg/kg/min may be given for maintenance
	2 mg/kg IV	giant tortoises
	3-5 mg/kg IV (supravertebral sinus)	chelonians/sedation (i.e., shell repair)
	10 mg/kg IV (supravertebral sinus)	red-eared sliders/40-85 min anesthesia
	12-15 mg/kg IV; 1 mg/kg/min may be given for maintenance	chelonians/lower dosages (5-10 mg/kg IV) may be used 1 mg/kg/min may be given for maintenance
	20 mg/kg IV (supravertebral sinus)	red-eared sliders/60-120 min anesthesia
	10-15 mg/kg IV	rrocodilians/duration, 0.5-1.5 hr maintain on gas anesthetics experimental IM with hyaluronidase

(Table 2). Continued.

Agent	Dosage	Species/Comments
Rocuronium (Zemuron, Organon)	0.25-0.5 mg/kg IM	box turtles/neuromuscular blocking agent no analgesia for intubation only and small, non-painful procedures
Sevoflurane	To effect	most species/anesthesia rapid induction and recovery when intubated
Succinylcholine	0,4-2 mg/kg IM	no analgesia narrow margin of safety crocidilians
Thiopental	19-31 mg/kg IV	green sea turtles/anesthesia induction, 5-10 min recovery, <6 hr erratic anesthesia
Tiletamine/zolazepam (Telazol, Fort Dodge)	-	sedation, anesthesia severe respiratory depression possible (may need to ventilate) variable results; may have prolonged recovery use lower end of dose range in heavier species good for muscle relaxation prior to intubation other anesthetic agents may be preferable
	4-5 mg/kg SC, IM	most species/sedation induction, 9-15 min recovery, 1-12 hr non-invasive procedures
	5-10 mg/kg IM	most species
	3 mg/kg IM	snakes/facilitates handling and intubation of large snakes induction, 30-45 min prolongs recovery
	3-5 mg/kg IM	snakes, lizards/sedation
	10-30 mg/kg to 20-40 mg/kg IM	snakes, lizards/induction, 8-20 min recovery, 2-10 hr variable results longer sedation and recovery times at 22°C (72°F) than at 30°C (86°F) good sedation in boa constrictors at 25 mg/kg IM generally need to supplement with inhalation agents for surgical anesthesia some snakes died at 55 mg/kg
	3.5-14 mg/kg IM (generally 4-8 mg/kg)	chelonians/sedation induction, 8-20 min does not produce satisfactory anesthesia even at 88 mg/kg
	5-10 mg/kg IM, IV	large tortoises/facilitates intubation if light, mask with isoflurane rather than redosing
	1-2 mg/kg IM	crocodilians/recovery takes several hours
	2-10 mg/kg IM	large crocodilians/may permit intubation
	5-10 mg/kg (sedation) to 10-40 mg/kg (anesthesia) SC, IM, ICe	crocodilians
	15 mg/kg IM	alligators/induction, >20 min adequate for minor procedures

(Table 2). Continued.

Agent	Dosage	Species/Comments
Xylazine	0.1-1.25 mg/kg IM, IV	most species preanesthetic for ketamine potentially reversible with yohimbine atipamezole better reversal than yohimbine
	0.1-1 mg/kg IM	crocodilians
	1-2 mg/kg IM	nile crocodiles
Yohimbine (Yobine, Lloyd)	-	xylazine reversal rarely indicated

5. SUMMARY

Summarized, in order to obtain the possibility of safe general anesthesia in reptiles, initial injectable anesthetics should be used, which will ensure appropriate myorelaxation and calming, which will allow the patient to intubate and then continue anesthesia with inhalation anesthetic. If it is not possible to use such a procedure, the agent of choice is propofol. The problem, in this case, appears in snakes, in which, because intravenous administration is limited, propofol will not always work. It is extremely important to monitor the patient with specialist equipment. Despite the limited number of scientific reports on the perception of pain in reptiles, it is recommended that painkillers be used during all surgical procedures. An important role is also played by the education of veterinarians in this exciting field of veterinary medicine, through participation in numerous workshops, conferences, and access to specialist literature.

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Received on 13-09-2018 Accepted on 11-10-2018 Published on 01-11-2018

DOI: http://dx.doi.org/10.12970/2310-0796.2018.06.09