

**Case study: chemical containment in parrots (Amazona SP - Lesson, 1830) from de Quinzinho de Barros Zoological Park, municipality of Sorocaba, São Paulo**

**Estudio de caso: contenido químico en loros (Amazona SP - Lesson, 1830) del Parque Zoológico de Quinzinho de Barros, municipio de Sorocaba, São Paulo**

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**ABSTRACT**

The containment and anesthesia of wild animals is extremely important for veterinarians who intend to or already practice in this field. However, before administering anesthesia, it is essential to understand the pharmacology of anesthetics and the biological aspects related to the anatomical, physiological, and behavioral peculiarities of the species to be restrained. The aim of this research was to evaluate parameters such as heart rate (HR), respiratory rate (RR), temperature ( $T^{\circ}$ ), muscle relaxation, reflexes (palpebral, ocular, and pedal), and respiratory pattern in four anesthetic protocols: ketamine 5% at a dose of 30mg/kg combined with xylazine 2%-2mg/kg; ketamine 5% at doses of 15mg/kg and 20mg/kg with diazepam 1% at a dose of 1mg/kg; diazepam 0.5% at a dose of 5mg/kg 15 minutes before isoflurane administration; and the use of isoflurane alone in parrots (*Amazona sp*) kept at the Quinzinho de Barros Municipal Park, Sorocaba, São Paulo. Eleven animals were used: three with the ketamine combined with xylazine protocol, three with ketamine plus diazepam, three with diazepam before isoflurane, and two with the isolated use of isoflurane. The results of this research showed that with the use of ketamine combined with xylazine at this dosage, only superficial sedation was achieved. With the supplementary dose of ketamine and xylazine, the animal reached a moderate anesthetic plane, but respiratory depression occurred. The use of diazepam combined with ketamine 5% at a dose of 15mg/kg is only recommended for minor procedures. Recovery

was slightly less prolonged and with less cardiorespiratory depression compared to the use of ketamine combined with xylazine. Diazepam 0.5%-5mg/kg before isoflurane did not allow for the intubation of the animal; it served to reduce the stress of restraint, requiring a lower concentration of isoflurane for induction. Apnea was observed with the increase of isoflurane concentration, even with the use of diazepam before isoflurane. With the isolated use of isoflurane, the animal reached a moderate to deep anesthetic plane, which would allow for more invasive procedures.

**Keywords:** anesthesia, parrots, ketamine, xylazine, diazepam, isoflurane, *Amazona sp.*

## RESUMEN

La contención y anestesia de animales salvajes es sumamente importante para los veterinarios que pretenden ejercer o ya ejercen en este campo. Sin embargo, antes de administrar la anestesia, es fundamental conocer la farmacología de los anestésicos y los aspectos biológicos relacionados con las peculiaridades anatómicas, fisiológicas y de comportamiento de las especies que se van a contener. El objetivo de esta investigación fue evaluar parámetros como frecuencia cardíaca (FC), frecuencia respiratoria (FR), temperatura (T°), relajación muscular, reflejos (palpebral, ocular y pedal) y patrón respiratorio en cuatro protocolos anestésicos: ketamina 5% a dosis de 30mg/kg combinada con xilacina 2%-2mg/kg; ketamina 5% a dosis de 15mg/kg y 20mg/kg con diazepam 1% a dosis de 1mg/kg; diazepam 0.5% en dosis de 5mg/kg 15 minutos antes de la administración de isoflurano; y el uso de isoflurano solo en loros (*Amazona sp*) mantenidos en el Parque Municipal Quinzinho de Barros, Sorocaba, São Paulo. Se utilizaron 11 animales: tres con el protocolo de ketamina combinada con xilacina, tres con ketamina más diazepam, tres con diazepam antes del isoflurano y dos con el uso aislado de isoflurano. Los resultados de esta investigación mostraron que con el uso de ketamina combinada con xilacina a esta dosis sólo se conseguía una sedación superficial. Con la dosis suplementaria de ketamina y xilacina, el animal alcanzó un plano anestésico moderado, pero se produjo depresión respiratoria. El uso de diazepam combinado con ketamina 5% a una dosis de 15mg/kg sólo se recomienda para procedimientos menores. La recuperación fue ligeramente menos prolongada y con menor depresión cardiorrespiratoria en comparación con el uso de ketamina combinada con xilacina. El diazepam 0,5%-5mg/kg antes del isoflurano no permitió la intubación del animal; sirvió para reducir el estrés de la sujeción, requiriendo una menor concentración de isoflurano para la inducción. Se observó apnea con el aumento de la concentración de isoflurano, incluso con el uso de diazepam antes del isoflurano. Con el uso aislado de isoflurano, el animal alcanzó un plano anestésico de moderado a profundo, lo que permitiría procedimientos más invasivos.

**Palabras clave:** Anestesia, loros, ketamina, xilacina, diazepam, isoflurano, *Amazona sp.*

## 1 INTRODUCTION

Poultry medicine (excluding domestic birds) has a short history when compared to other areas of veterinary medicine. References to anesthesia and surgery for birds were scarce in the literature until the late 1940s. The first reference to anesthesia in birds was

through information initially contained in the annual conference and later through the journal *Avian Medicine and Surgery* (Altman, 1998).

The chemical containment and anesthesia of wild animals is extremely important for veterinarians who wish to work in this area. However, in Brazil, studies on anesthesia in parrots (*Amazona* sp) are still very scarce. Even with the increase in the number of these birds in Veterinary Clinics, Zoos and Rehabilitation Centers, there are few studies published in scientific journals that report on the best anesthetic to use for each situation, what changes they can cause in the physiological parameters of these animals, what dose of injectable anesthetics is most recommended for each procedure to be carried out, as well as what concentration of inhaled anesthetics is best to use for anesthetic induction and maintenance in these animals. Therefore, there are several aspects that need to be studied in order to avoid problems, or even the death of these animals, due to the inappropriate use of anesthetics.

The lower respiratory system of birds consists of: a larynx, which lacks vocal cords; a trachea; primary bronchi, which branch off into secondary bronchi, tertiary bronchi (or parabronchi) and a series of air sacs (Fowler, 1986; Cruz and Nunes, 2003). The lungs of birds do not have alveoli: gas exchange takes place in the air capillaries located in the lungs. Due to the high diffusion pressure gradient, gas exchange is 10 times greater than in mammals (Cruz and Nunes, 2003; Pablo, 2004). Inspiration and expiration are both active processes, unlike mammals in which only inspiration is active (Ludders, 1992; Cruz and Nunes, 2003).

In most birds, the diaphragm is absent, and when present it is functional (Fowler, 1986; Short, 1987; Cruz and Nunes, 2003).

Birds breathe by the unidirectional flow of air from the air sacs and parabronchial lungs (Sedwick, 2001; Cruz and Nunes, 2003). During inhalation, the air enters the parabronchi, reaching the posterior air sacs (until this moment there is no gas exchange, as the air has not yet passed through the lungs); during exhalation, the air leaves the posterior air sacs, passes through the lungs (where gas exchange occurs), goes to the anterior air sacs and is then eliminated (Ludders and Gleed, 2001b; Cruz and Nunes, 2003). Birds do not have an epiglottis, which makes intubation much easier, because as soon as we open their mouths we can already see the glottis, so there is no need to use flashlights or a laryngoscope (Cruz and Nunes, 2003; Pablo, 2004).

According to Pablo (2004), birds have portal-renal circulation. Venous blood from the legs and lower intestine, which is in the process of returning to the heart, enters the

kidneys via the renal portal system. Thus, according to Cruz and Nunes (2003), substances absorbed by the intestine, excess metabolites, coming from the limbs and hindquarters can reach the renal tubules before passing through the systemic circulation. The same can happen with drugs (anesthetics) that are administered in the posterior portion of the birds, so we can only obtain the partial effect of the drug administered. Due to the portal-renal circulation, some authors recommend avoiding the hind limbs when administering any medication, to avoid the risk of promoting relative overdose in these species.

Birds have an accelerated metabolism, so the doses of drugs used in these species are usually higher than in mammals, and the period of action is also shorter (Steiner and Davis, 1985; Cruz and Nunes, 2003).

According to Bennett, (1992), Skarda, (1995) and Hatt, (2002) hypothermia is a common complication during anesthesia in birds. Bennett, (1992) and Skarda, (1995) add that hypothermia depresses the ventilatory control system and can result in shock, brain damage, electrolyte disturbances, disseminated intravascular coagulation (DIC) and death. The problem is more severe in small birds, where the temperature drops rapidly and the prolonged recovery time caused by injectable anesthetics can exacerbate this problem (Fedde, 1987; Goeltz. et al, 1990). Normal temperature ranges from 40 to 44°C (Steiner and Davis, 1985; Cruz and Nunes, 2003).

Physical restraint in birds causes a great deal of stress, with a large release of catecholamines (adrenaline and noradrenaline). These cause the heart rate to increase, reducing flow in the atrium and ventricle, resulting in a decrease in cardiac output and blood pressure. There is an increase in the demand for oxygen in the heart muscle due to its great effort, which can lead the animal to cerebral hypoxia, which can lead to death within a few minutes (Fowler, 1986).

According to Rupley (1999), fasting is recommended before anesthesia to allow the upper gastrointestinal tract to empty. Psittaciformes should be fasted for at least 3 hours (usually 5 to 8 hours), but longer fasts are not recommended.

Induction of anesthesia consists of reaching the anesthetic plane at which laryngo-tracheal reflexes are lost and the patient can be intubated. This induction can be done with a short-acting intravenous anesthetic, or by applying the inhalation anesthetic itself using a mask (Moraes, 1990).

When induction is done with a face mask, the patient must be restrained manually, and the nostrils and mouth or head must be placed in the face mask. Intubation is

recommended if the procedure requires anesthesia for more than 10 minutes. The critically ill bird should be intubated so that breathing can be assisted as necessary. It is a relatively simple procedure, with the glottis located immediately caudal to the tongue.

Birds are intubated in an external position, with the head above the body to avoid regurgitation. If the bird is breathing, the glottis will open rhythmically and the endotracheal tube can be inserted during inspiration (Rupley, 1999). Birds weighing more than 100 grams can be intubated. The cuff should not be inflated so that the intratracheal pressure is not too high (Pablo, 2004). According to Sedgwickb, (2001) and Glead & Ludders (2001) birds have complete tracheal rings, with less circumferential elasticity than mammals.

The patient should be monitored during the induction, maintenance and recovery of any anesthesia, by means of the intensity and depth of respiratory movements, finger pinch reactions, eyelid reflex, cloacal temperature and even by electrocardiogram (Spinosa, Gorniak and Bernardi, 2002).

According to Spinosa, Gorniak and Bernardi (2002), in a light anesthetic plane all the reflexes will be present, but they report that the animal will have no voluntary movements, no response to postural changes or vibration. They report that in the moderate plane of anesthesia there is only loss of the eyelid reflex, with slight foot and corneal reflexes persisting, slow, deep and regular breathing, making this a desirable plane for surgery. In the deep plane, all reflexes are absent and breathing is very slow and regular. Any deeper could lead to depression and respiratory cessation. According to Pablo (2004), the depth of anesthesia should correspond to the degree of pain involved in the procedure.

According to Mandelker (1988), the respiratory rate and type of breathing are the best parameters for monitoring anesthesia. It is important not to allow respiratory depression to occur, as birds are extremely sensitive to respiratory acidosis. Heart rate is also very important, but is not always easily monitored. To verify superficial anesthetic plans, responses to painful stimuli are also good parameters.

In the event of cardiac arrest, good ventilation should be maintained, cardiac massage should be carried out and drugs should be administered to help cardiac function, such as Adrenaline, Atropine or Lidocaine, depending on the case. If apnea occurs, ventilate and administer Doxapran. If respiratory depression occurs, flush the lungs with oxygen and remove the volatile anesthetic if used (Cruz and Nunes, 2003). Iombine has been used in birds of prey and psittaciformes and reverses the effects of xylazine, either

when administered alone or in combination with ketamine (Gleed and Ludders, 2001b). Several authors report that in addition to iombine, tolazoline, atipamezole and piperoxam can be used, which are alpha 2 adrenoceptor antagonists that can be used in cases of overdose or when complications occur after the administration of adequate doses of alpha 2 adrenoceptor agonists (Berthier, Bomsel and Gerbet, 1995; Spinosa, Gorniak and Bernardi, 2003).

The aim of this research is to contribute to the advancement of veterinary medicine literature, as well as the practice of exotic animal anesthesia. The in-depth study of anesthetic techniques in psittacines contributes significantly to various aspects, since exotic species are less studied than companion animals. Therefore, targeted research provides safer and more effective protocols, respecting the physiological particularities of the species, thus reducing complications and providing better recoveries. This has a direct impact on routine practice, since it becomes possible to adopt protocols based on evidence, leading to a substantial improvement in the quality of care provided to this species.

## 2 MATERIAL AND METHODS

This research was carried out on 10 true parrots (*Amazona aestiva*) and 1 country parrot (*Amazona xantholeuma*), from the Quinzinho de Barros Zoological Park, in the municipality of Sorocaba, state of São Paulo. The birds were subdivided into 4 experimental groups and each group was submitted to a different anesthetic protocol. The individual data for each animal is listed in Table 1 below:

Table 1. Characterization of the animals studied, species, activity, general condition, accommodation and anaesthetic procedures used, at the Quinzinho de Barros Municipal Park, Sorocaba, São Paulo.

N	SPECIES	ACTIVITY	PHYSICAL CONDITIO N	ACCOMMODA TION	WEI GHT (KG)	FASTING TIME (MIN)	ANESTHETICS USED (MG/KG)
1	<i>Amazona aestiva</i>	Active	Good	Large venue	0,350	240	Ketamine 5% (30) Xylazine 2% (2)
2	<i>Amazona aestiva</i>	Active	Good	Large venue	0,390	360	Ketamine 5% (30) Xylazine 2% (2)
3	<i>Amazona aestiva</i>	Active	Good	Large venue	0,495	480	Ketamine 5% (30) Xylazine 2% (2)
4	<i>Amazona aestiva</i>	Active	Good	Large venue	0,370	110	Ketamine 5% (15) Diazepam 1% (1)

5	<i>Amazona aestiva</i>	Active	Good	Large venue	0,355	240	Ketamine 5% (20) Diazepam 1% (1)
6	<i>Amazona aestiva</i>	Active	Good	Large venue	0,395	348	Ketamine 5% (20) Diazepam 1% (1)
7	<i>Amazona aestiva</i>	Aggressive	Good	Large venue	0,355	105	Diazepam 0,5% (5) Isoflurano 2L de O2
8	<i>Amazona aestiva</i>	Active	Good	Large venue	0,365	156	Diazepam 0,5% (5) Isoflurano 2L de O2
9	<i>Amazona aestiva</i>	Active	Good	Large venue	0,440	78	Diazepam 0,5% (5) the animal was not intubated
10	<i>Amazona xantholeuma</i>	Active	Good	Large venue	0,565	70	Isoflurano 2L de O2
11	<i>Amazona aestiva</i>	Active	Good	Large venue	0,420	152	Isoflurano 2L de O2

Source: Prepared by the author (2004).

Before the anesthetic procedures, the birds were physically restrained in a collective enclosure. Passageways were used, in which the animals were captured and placed in cages, which were already weighed and later identified. The animals were weighed inside the cages and their actual weight was calculated. Each animal was restrained using leather gloves, commonly known as “scraping gloves”, to apply the anesthetic. The head and beak were immobilized first, followed by the claws and wingtips. Each injectable drug was dosed into a 1ml syringe and then transferred to a 3ml syringe. The drug was applied intramuscularly to the pectoral region using a hypodermic needle.

Before the anesthetic procedures were carried out, the doses of emergency drugs were calculated: Adrenaline 1mg/ml - 0.1mg/kg; Atropine 10mg/ml - 0.04mg/kg, Doxapram 7mg/kg - 20mg/ml and Iombine 0.3-0.5mg/kg - 3mg/ml.

Four different anesthetic protocols were evaluated:

I. Association of Ketamine (5%) at a dose of 30 mg/kg and Xylazine (2%) at a dose of 2 mg/kg. One animal was given a redose of half the mother dose. Three animals were anaesthetized in this protocol and remained fasted on food and water for 4 to 8 hours.

II. Association of Ketamine (5%) at a dose of 15 to 20mg/kg and Diazepam (1%) at a dose of 1mg/kg. In this group, 3 animals were evaluated and the fasting time varied from 1:50 to 5:50 hours.

III. Diazepam (0.5%) at a dose of 5mg/kg, with a 1ml syringe, 15 minutes before inducing inhalation anesthesia with Isoflurane. A universal vaporizer was used, with a non-rebreathing double “T” baraka system, with an oxygen flow of 2 L/min.

oxygen flow of 2 L/min. After induction with a face mask, intubation was performed with a 2.5 mm orotracheal tube without a cuff. To prevent the parrots from damaging the tube, a cannula made from the distal part of a syringe was used. Induction of anesthesia was considered when the animal showed loss of laryngotracheal reflexes and intubation was possible. Three parrots were submitted to this protocol, with fasting times ranging from 1:42 to 3:17 hours.

IV. Isoflurane only, with an oxygen flow of 2L/min, induction with a face mask, for subsequent intubation, using the same device described above. Two parrots were assessed in this group, with fasting times ranging from 1:10 to 2:32 hours. The parameters measured and the equipment used to monitor the birds were: the Doppler, to assess cardiovascular function and blood flow; a stethoscope, to check the rhythm and heart rate (HR), when this was not possible with the Doppler; a thermometer, to assess temperature; and hemostatic forceps, to assess the foot reflex. Eyelid and corneal reflexes, muscle relaxation (MR), decubitus, respiratory pattern and respiratory rate (RR) were also observed through inspection and palpation. The patient was monitored during induction, maintenance and recovery from anesthesia.

After anesthetic monitoring was complete, the animals were wrapped in newspaper, placed in paper-lined cages and taken to a quiet, warm environment. Recovery time was considered to be the time elapsed between the application of the drugs and the parrots' complete recovery of consciousness and equilibrium.

### **3 RESULTS**

The results obtained are listed in Table 2 below:

Table 2. Characterization of the individual, species, anesthetics used and parameters assessed during monitoring. Source: Prepared by the author (2004).

N	SPECIES	ANESTHETIC % (MG/KG)	HR (BPM)	T°C	REFLECTS/ MIN	RM/MIN	DECUBITUS /MIN	RESPIRATORY FREQUENCY			RECOVERY (MIN)
								MIN	FR	BREATHING PATTERN/ MIN.	
1	<i>Amazona aestiva</i>	Ketamine 5% (30 Xylazine 2% (2))	-	-	All +	Bad /15	No	30	108 168	Superficial, fast and regularly	-
		Redose: ½ dose 35 min after the first dose	92-72	>42 - 41,5	Eyelid ↓	Good/45	Ventral /4	45	41 24	deep, slow and regularly	143
2	<i>Amazona aestiva</i>	Ketamine 5% (30) Xylazine 2% (2)	100-160	>42	All +	Moderate / 7	No	35	75 40	Superficial, fast and regularly / 49	172
3	<i>Amazona aestiva</i>	Ketamine 5% (30) Xylazine 2% (2)	108-136	39.1- 41	All +	Moderate / 4	No	50	60 40	Superficial, fast and regularly / 4	154
4	<i>Amazona aestiva</i>	Ketamine 5% (15) Diazepam 1% (1)	96-120	41.7- > 42	All +	Bad / 25	No	45	60 36	Superficial, fast and regularly / 5	130
5	<i>Amazona aestiva</i>	Ketamine 5% (15) Diazepam 1% (1)	112-200	40,7- 40,5	Eyelid -/ 10	Good / 10	Ventral/ 5	60	32 18	Deep, slow and regularly / 45	110
6	<i>Amazona aestiva</i>	Ketamine 5% (15) Diazepam 1% (1)	114-152	41,4- >42	Eyelid -/ 7 All +/ 23	Moderate / 7	Back / 7	46	40 16	Deep, slow and regularly / 13	92
7	<i>Amazona aestiva</i>	Diazepam 0,5% (5) Isoflurano (2L de O2)	184-152	40,2- 41	All +/1 All -/21	Excellent / 22	Ventral/ 16	16	40 60	Deep, slow and regularly / 22/ 7*	255
8	<i>Amazona aestiva</i>	Diazepam 0,5% (5) Isoflurano (2L de O2)	176-140	40,9- 41,4	All +/1 All -/22	Excellent / 21	Ventral/19	15	18 68	Deep, slow and regularly / 21/ 6*	156
9	<i>Amazona aestiva</i>	Diazepam 0,5% Não foi possível intubar	-	-	All +/10	Bad/ 15	No	77	36 20	superficial, fast and regularly / 15	117
10	<i>Amazona Xanthoni</i>	Isoflurano(2L de O2)	196-144	>42	Eyelid -/ 1 All - /20	Moderate / 2 Excellent / 13	Ventral/ 8	34	136- 28	Superficial, fast and regularly / 20	34
11	<i>Amazona aestiva</i>	Isoflurano (2L de O2)	100-140	>42	Eyelid - / 8 All - / 28	Moderate / 8 Excellent / 28	Ventral/ 8	19	24- 20	Deep, slow and regularly / 14	18

\*Time elapsed from the start of Isoflurane administration.

### 3.1 1st PROTOCOL: KETAMINE 5% - 30 MG/KG AND XYLAZINE 2% - 2MG/KG

With the application of this anesthetic protocol, the parrots remained with poor to moderate MRI, did not fall into decubitus, all reflexes were present (palpebral, corneal and foot), the breathing pattern was superficial, rapid and regular, with the presence of

voluntary movements. Recovery time was around 143 to 172 minutes. In one of the individuals, after 35 minutes from the first application of the combination,  $\frac{1}{2}$  of the mother dose of Ketamine and Xylazine was administered to assess the effects of the re-dose. The animal fell into a prone position 4 minutes after the top-up dose, showed a decreased eyelid reflex and moderate foot reflex at 13 minutes and its RR had decreased to 24 movements per minute at 32 minutes.

### 3.2 2nd PROTOCOL: KETAMINE 5% - 15 TO 20MG/KG AND DIAZEPAM 1% - 1 MG/KG

At a dosage of 15mg/kg of Ketamine and Diazepam 1 mg/kg, it was observed that the animal remained with all reflexes present, RM was poor and it did not fall into decubitus. The respiratory pattern was superficial, rapid and regular. The measured RR ranged from 60-36 respiratory movements per minute over 45 minutes, and the HR ranged from 96-120bpm. Recovery time was 110 minutes. At a dose of 20mg/kg Ketamine and 1 mg/kg Diazepam, it was observed that the animals lost their palpebral and corneal reflexes and showed good to moderate muscle relaxation 5 - 10 minutes after the anesthetics were applied. The breathing pattern was deep, slow and regular. RR ranged from 16-36 respiratory movements per minute and HR from 112-200 bpm. Recovery time ranged from 92 to 110 minutes.

### 3.3 3rd PROTOCOL: DIAZEPAM 0.5% - 5MG/KG AND ISOFLURANE

It was observed that muscle relaxation was excellent, the animals lost all reflexes 7 - 8 minutes after the administration of Isoflurane, the breathing pattern was deep, slow and regular 7 minutes after the administration of Isoflurane. The animals were able to reach a moderate to deep anesthetic plane. HR ranged from normal to increased. It was observed that after increasing the concentration of Isoflurane administered to one of the animals in this protocol, it went into apnea, so the administration of the anesthetic was interrupted and ventilation was performed. After 6 minutes of this apnea, the animal had RR= 72 respiratory movements per minute. Recovery for these animals ranged from 152 to 255 minutes. Intubation was not possible in the third animal. The animal had a fracture of its lower part of the beak and obstruction of the trachea. The impossibility of performing intubation made it impossible to assess the parameters in this animal.

### 3.4 4th PROTOCOL: ISOFLURANE

After 18 minutes from the start of Isoflurane administration, there was no eyelid reflex and moderate MR. After 14 - 20 minutes, the birds showed a deep, slow and regular breathing pattern. At around 20 - 28 minutes, all reflexes were absent. The lowest heart rate observed in these animals was 100 bpm and the lowest respiratory rate was 20. Recovery time was 34 -18 minutes. These animals were able to reach a moderate to deep level of anesthesia, which would allow for more invasive procedures, with very rapid recovery after the anesthetic was stopped.

Below are figures illustrating the stages of the anesthesia process in parrots (Amazona sp):

Figure 1. Anesthesia process and monitoring, cardiorespiratory monitoring (A), cardiac monitoring using Doppler (B) and intubated, receiving inhalation anesthesia (C). Source: Prepared by the author (2004).

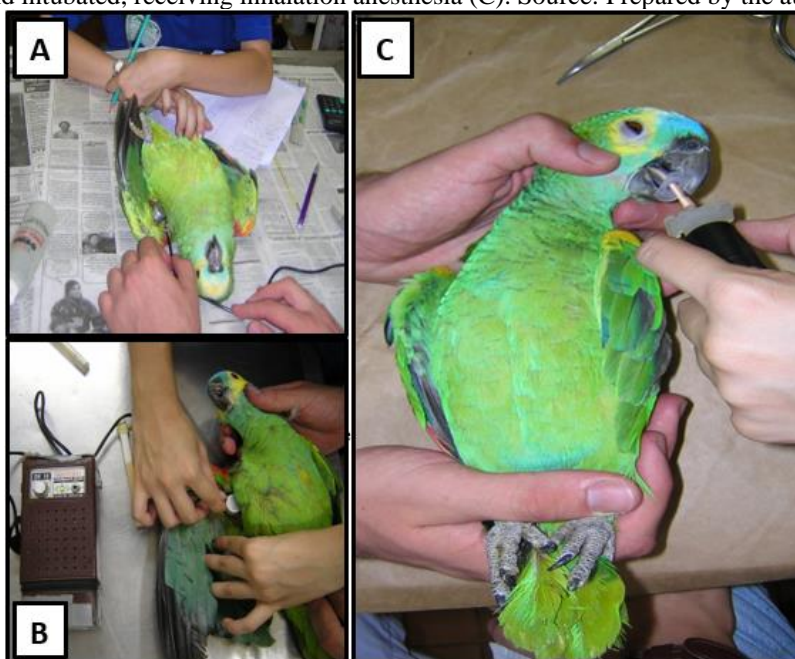
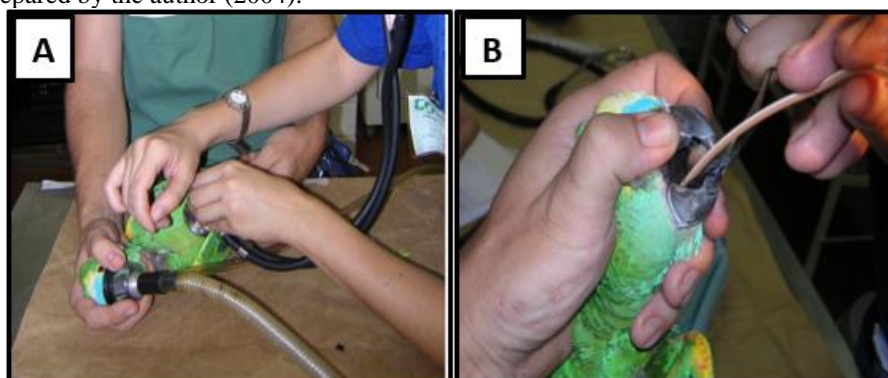


Figure 2. Animal receiving inhalation anesthesia in the mask, for subsequent intubation and cardiac monitoring with a stethoscope (A), Animal being intubated, with an orotracheal tube, without a cuff (B). Source: Prepared by the author (2004).



#### 4 CONCLUSION

Anesthesia in parrots can be a major challenge in veterinary medicine for exotic animals, since their respiratory anatomy makes ventilation and oxygenation more complex. Their physiological response to stress can make anesthetic management difficult, requiring constant monitoring. The correct choice of anesthetic agents is fundamental, given the differences in metabolization between species. Therefore, a deeper understanding of the physiological and behavioral particularities of parrots, together with strict protocols, is essential to guarantee the safety and efficacy of anesthesia in these animals.

In the present study, it was observed that the combination of ketamine (30mg/kg) and xylazine (2mg/kg) as well as the combination of ketamine (20mg/kg) and diazepam (1mg/kg) allows diagnostic procedures, such as physical examination, and other non-invasive procedures to be carried out. It is not indicated for more invasive procedures. When we used diazepam before isoflurane, the animal reached a moderate anesthetic plane and muscle relaxation was more evident than when we used isoflurane alone.

However, despite the fact that induction was faster and more evident with the use of diazepam, recovery from anesthesia, when comparing the two techniques, was faster when isoflurane alone was used. Therefore, the use of diazepam as an MPA should be considered for those birds more susceptible to the stress of physical restraint. For invasive procedures, isoflurane proved to be the drug of choice, as it allows better control of anesthesia time, without accumulative effects, an adequate anesthetic plan, good muscle relaxation and rapid recovery. Side effects such as respiratory depression and bradycardia seem to be associated with the plasma concentration of isoflurane, regardless of the effects of diazepam as an MPA.

In summary, research into anaesthesia in parrots plays a crucial role in the advancement of exotic veterinary medicine. The implementation of protocols adapted to the physiological characteristics of parrots (*Amazona* sp) not only optimizes anaesthetic results, but is also vital for promoting animal welfare during and after procedures. Furthermore, the continuous integration of new scientific knowledge and the constant updating of protocols is imperative for the improvement of veterinary practices aimed at exotic birds. Research in this field contributes significantly to the formation of evidence-based guidelines, which strengthen the ability of veterinary professionals to manage parrots with precision and care, minimizing risks and improving the quality of life of these animals. This study showed that the choice of anesthetic protocol used will vary

according to its purpose, as well as the patient's temperament, since for less invasive procedures patients benefited from protocols with an association of ketamine and diazepam as well as ketamine with xylazine. Patients undergoing more invasive procedures benefited from the use of isoflurane, with or without diazepam, with faster induction when combined. However, the small sample size, as well as the heterogeneity of the sample and the equipment used, may have influenced the results, so a study with larger and more homogeneous groups is recommended.

## REFERENCES

- ALTMAN, B.R. Twenty years of progress in avian anesthesia and surgery. *Journal of the American Veterinary Medical Association*, vol.212, p.1233-1235, 1998.
- BENNETT, R. Current methods in avian anesthesia. In: *ACVS VETERINARY SYMPOSIUM, 1992*. Miami. Proceedings... Miami: American College of Veterinary Surgeons, 1992, p.619-624.
- BERTHIER, L.J; BOMSEL, C.M; GERBET, S. Anesthesia of wild animals: Association of medetomidine- ketamine and atipamezole. *The Veterinary Hour*. ,v. 27, p.30, 1995.
- FEDDE, M.R. Drugs used for avian anesthesia: a review. *Poultry science*, v.57, p.1376-1399, 1987.
- FOWLER. M.E. Inhalation Anesthesia for Captive Wild Mammals, Bikes, and Reptiles. In: \_\_\_\_\_. *Zoo and Wild Animal Medicine*. Philadelphia: W.B. SAUNDERS, 1986. chap. 7, p. 52 - 54.
- GLEED. R.D; LUDDERS.J.W. (Ed). Inhaled anesthesia for birds. *Recent Advances in Veterinary Anesthesia and Analgesia: Companion Animals, 2001a*. Available at: <<http://www.Ivis.org.htm>>. Accessed on: Aug. 24, 2004
- GLEED. R.D; LUDDERS.J.W. Injectable anesthesia and analgesia of Birds, *Recent Advances in Veterinary Anesthesia and Analgesia: Companion Animals 2001b*. Available at: < <http://www.Ivis.org.htm>>. Accessed on: September 10, 2004
- GREENE, S. Poultry Anesthesia. In: PABLO. S.L. *Secrets in Veterinary Anesthesia and Pain Management*. Porto Alegre: ARTMED, 2004. p. 341 - 360.
- GOELZ, M.F; HAHN, A.W; KELLEY, S.T. Effectes of halothane and isoflurane on mean arterial blood pressure, heart rate, and respiratory rate in adult pekin ducks. *American Journal of Veterinary Research*, v.51, p.458-460, 1990.
- HATT, J.M. Anesthesia and analgesia of pet birds. *Schweizer Archiv Fuer Tieheilkunde; German*, v.144, p.606-613, 2002.
- LINK, K.A; GLEED, R.D. Anesthesia of birds and wild animals. In: SHORT, C.E. *Principles and Practice of veterinary Anesthesia*. Baltimore: Williams & Wilkins, 1987.p.327-329.
- LUDDERS, J.W. Minimum anesthetic concentration and cardiopulmonary dose-response of halothane in ducks. *Veterinary Surgery*, v.21, p.319-324, 1992.
- MANDELKER, L. Avian anesthesia, part 2: Injectable agents. *Companion Animal Practice anesthetics/ Avian Medicine*, v.2, p.21-23, 1988.
- MASSONE, F. Physical Restraint and Anesthesia in Wild Animals. In: \_\_\_\_ CRUZ, L.M; NUNES, V.L.A. *Anestesiologia Veterinária: Farmacologia e técnicas*, 4. ed. Rio de Janeiro: Guanabara Koogan, 2003, p. 1 - 7.
- MORAES, F.C.Y. The use of xylazine, ketamine, midazolam and isoflurane in the amputation of a wing. *Clinica veterinária; Jaboticabal*. V. 4, p. 9-10, 1990.

PADDLEFORD, R.R. Anesthesia in small and medium-sized exotic mammals, birds and reptiles. In: SEDGWICK, J. C. Manual de Anestesia em pequenos animais. 2 ed. São Paulo: Roca, 2001. p. 367 - 373.

RUPLEY, A.E. Surgery. In: \_\_\_\_\_. Manual de Clínica Aviária. São Paulo: Roca, 1999. chap. 14, p. 461-457

SKARDA, R.T; et.al. Avian anesthesia. In: \_\_\_\_\_. Handbook of Veterinary Anesthesia, 2. ed. St. Louis: Mosby, 1995. p. 371.

SPINOSA, H.S; GORNIK, S.L; BERNARDI, M.M. Tranquilizers, Centrally Acting Muscle Relaxants and Antidepressants. In: \_\_\_\_\_. Pharmacology Applied to Veterinary Anesthesia. Rio de Janeiro: Guanabara KOOGAN, 2003. chap. 14, p. 150 - 153.

STEINER, C.V; DAVIS, R.B. Respiración de Las Aves. In: \_\_\_\_\_. Pathology of caged birds / selected topics. España: Acribia, 1985. p. 230 - 232.