



Radiographic pelvimetry in 0 to 24 month-old pacas (Agouti paca, Linnaeus, 1766)

[*Pelvimetria radiográfica em pacas de 0 a 24 meses de idade (Agouti paca, Linnaeus, 1766)*]

N.F. Smargiassi, I.C.C. Lippi, R.G.S. Oliveira, M.R.F. Machado,
T.H.C. Sasahara, C.C.C. Santos, F.S. Oliveira*

Universidade Estadual Paulista - Jaboticabal, SP

ABSTRACT

The pelvimetry consists of the metric determination of the pelvis dimensions and its use is directly related to the reproduction. The cartilage closure time of the ossification centers varies according to the bone, some closing already in the uterine life and others remaining present for many years. The objective was to evaluate, radiographically, the pelvic diameters by pelvimetry during the first 24 months of life in pacas, the second largest Brazilian rodent and an animal that has shown big recent scientific interest, aiming the estimated age determination. Twelve pacas were used, which were monthly radiographed up from birth until 24 months old, with the animals anesthetized. The pacas are dolycopelvic animals and with pelvis presenting strong tendency to constant growth along the 12 first months of age, fact that can be useful in the approximated animals' age determination that do not have precise birth date, for example.

Keywords: anatomy, radiology, pelvis, rodent, wild

RESUMO

A pelvimetria consiste na determinação métrica das dimensões pélvicas, e sua utilização está diretamente relacionada à reprodução. O momento de fechamento da cartilagem dos centros de ossificação varia de acordo com o osso, algumas fechando já na vida uterina e outras permanecendo presentes por vários anos. Objetivou-se avaliar, radiograficamente, os diâmetros pélvicos, mediante pelvimetria, durante os 24 primeiros meses de vida de pacas, o segundo maior roedor brasileiro e sobre o qual tem havido grande interesse científico, para a determinação aproximada da idade. Foram utilizadas 12 pacas, as quais foram radiografadas mensalmente a partir do nascimento até 24 meses de idade, com os animais anestesiados. As pacas são animais dolycopélvicos e com pelve apresentando forte tendência ao crescimento constante durante os 12 primeiros meses de vida, o que pode ser útil na determinação aproximada da idade em animais que não possuem data precisa de nascimento, por exemplo.

Palavras-chave: anatomia, radiologia, pelve, roedor, selvagem

INTRODUCTION

The pelvis is the integration element in the transmission and diffusion of forces to the pelvic members. Its ventral portion (cranial face) acts as anchoring and traction point of the abdominal rectus muscle aponeurosis (pubic tendon), and also as protector of the viscera contained in that region. On the other hand, despite of being a rigid structure, in the period close to the parturition and hormonal action, an enlargement occurs in its internal diameter with consequent

loosening pelvic ligaments, sacral dorsal displacement and ilium lateral displacement, besides the pubic symphysis opening (Toniollo and Vicente, 1995).

Obtaining internal and external pelvis diameter measures, by studying the radiographs, is known as radiographic pelvimetry. Through that, it is possible to determine the breed's pelvimetric standard, which will further serve as subsidy for a prophylactic method against possible complications that can occur during the parturition, besides of providing the pelvis

Recebido em 7 de novembro de 2017

Aceito em 3 de outubro de 2018

*Autor para correspondência (*corresponding author*)

E-mail: singaretti@fcav.unesp.br

anatomic and obstetric classification (Bruni and Zimmerl, 1951).

The pelvimetry consists basically in the metric determination of the pelvic dimensions and its use is directly related to the reproduction, as a prophylactic method against the parturition complications caused by deformation, malformation or sequels of affections present in this bone structure. Furthermore, it is a low cost and easy performing diagnostic method, not requiring chemical contention, except in wild animals and those with aggressive behavior (Ferreira, 1991).

The objective was to perform the radiographic pelvimetry during the paca's growth. This animal has generated great recent scientific interest in studies involving teeth radiographic anatomy (Oliveira *et al.*, 2006) and of the axial (Oliveira *et al.*, 2007b) and appendicular skeletons (Oliveira *et al.*, 2007a), a heart topographic anatomy (Ávila *et al.*, 2010), dental eruption for age determination (Oliveira and Canola, 2007), besides the works involving its economic exploration (Almeida *et al.*, 2003). The morphology of the accessory genital glands (Borges *et al.*, 2013), the olfactory bulb organization (Sasahara *et al.*, 2015), the placenta formation process (Bonatelli *et al.*, 2005), the vascular organization and placenta macro, micro and ultra-structural aspects were also described (Miglino *et al.*, 2004).

MATERIAL AND METHODS

Twelve male or female pacas were used, kept in captivity in the Wild Animal Sector, Animal Morphology and Physiology Department, School of Agrarian and Veterinarian Sciences, Jaboticabal, São Paulo, Brazil. The research was approved by the University Ethical Committee (process number 011553/13).

The animals were housed in masonry stalls with approximately 15m², with one burrow per stall, sub divided into in three internal communicating divisions, keeping, in each stall, a male and two or three females with individual microchips, markers dorsally injected in the cervical region.

For the animals feeding, rodent feed (1.0% of body weight daily) and seasonal fruits (10% of body weight daily) were used, offered daily in

the afternoon period. Monthly ultrasonography, in B mode, of the adult females, was performed for pregnancy detection, using electronic sectoral bifrequencial transducer of 5.0 and 7.5MHz, as previously described for this species (Oliveira *et al.*, 2003). Pregnant females were put in individual barns for delivering at the pregnancy final third, aiming to facilitate the newborn's handling.

The animals went through radiography in the Radiology Sector of the Veterinary Hospital Governador Laudo Natel of the UNESP Jaboticabal, monthly up from the birth and until 24 months of age, in dorsal decubitus, with the pelvic limbs caudally pulled, in ventrodorsal radiographic incidence. A tubular mesh was used to dress the abdominal region and the pelvic limbs during the radiographic exam (Figure. 1) and tranquilization was performed with meperidine (2.5mg/Kg) and diazepam (0.5mg/Kg) via intramuscular, in the same syringe. For the anesthesia, 10 minutes after sedating, ketamine hydrochloride (20mg/Kg) and xylazine (1.5mg/Kg) were injected, similarly to the technique described for anesthesia in these animals (Oliveira *et al.*, 2003).

For the pelvic development evaluation, all measurements were performed directly over the radiographic film, with support of a millimeter ruler (mm), properly positioned over the viewing boxes, according to the previously described methodology in female dogs (Eneroth and Haugey, 1999), and involved:

- Coxal Diameter (DC): distance between the both iliac tuberosity;
- Transverse Diameter (DT): distance between the iliac bodies in the distal third;
- Acetabular Diameter (DA): distance between the cranial boards of both acetabular cavities (under the arciform line, in the semilunar face height);
- Lateral Ischial Diameter (DIL): distance between the both lateral tuberosity of the ischium;
- Longitudinal Diameter (DL): distance between the lines that delimit the thigh and lateral ischial diameter, thus delimitating the pelvis radiographic longitudinal length (Figure. 2).

Radiographic pelvimetry...



Figure 1. A female 13 months-old paca anesthetized during the radiographic exam. Note the tubular mesh for better positioning of the pelvic limbs, with no need to expose people to the x-rays.

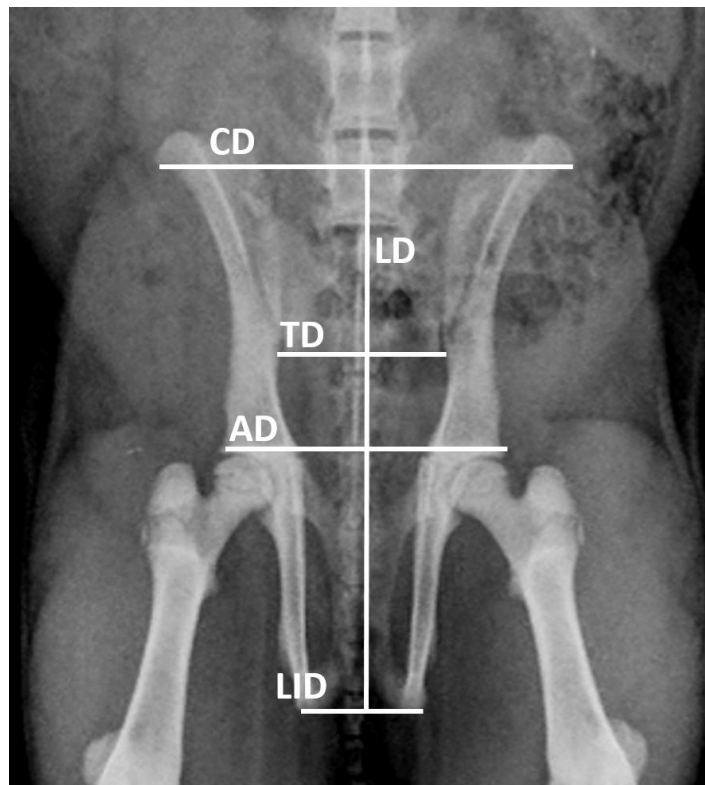


Figure 2. Pelvis radiographic image of adult Agouti paca, in dorsal decubitus, anesthetized, with the measure's location for the pelvimetry. CD: coxal diameter; TD: transverse diameter; AD: acetabular diameter; LID: lateral ischial diameter; LD: longitudinal diameter.

RESULTS AND DISCUSSION

Anatomic-radiographic details were already described for the paca's pelvis, which is narrow, elongated and with large and practically parallel ilium, such as the ischium. The pubes meet in the pubic symphysis and between each one of them and the ischium there is a large obturator foramen. The acetabulum, made up of the three pelvis bones, is rounded and deep, what provides good hip joint stability (Oliveira *et al.*, 2007a).

The iliac tuberosity ossification center was the easiest radiographically identified, especially up from the first months of life. The ischial tuberosity ossification center was really hard to visualize in any evaluated age, as well as the radiographic identification of the pubis ossification center was hard, due to the corporal conformation and big pelvic muscular mass of this species, which features robust and compact body (Bentti, 1981, Collet, 1981, Silva, 1994).

The use of the tubular mesh was chosen to dress the abdominal region and the pelvic limbs during the radiographic exam, in such a way that the limbs are as aligned as possible for obtaining a good image, besides avoiding exposure of humans involved in the project to the x-rays.

The pacas are dolico pelvic animals, because they present the pelvis entrance in oval form, laterally flattened (Figure. 3), such as the ruminants, swine and dogs of the breeds German shepherd and German dog (Ferreira, 1991) as well as the neotropical primates (Valle *et al.*, 2006). The pelvis of this species presents a strong tendency to the constant growth in the analyzed diameters. Considering the five evaluated diameters (coxal, transverse, acetabular, lateral ischial, longitudinal) and their respective averages from 0 to 12 months and comparing to the canine pelvis growth, the pacas keep presenting increasing in the coxal, acetabular and longitudinal diameters, different from what occurs in dogs, in which there is a cessation of the acetabular diameter development at the five months old mark. However, the transverse diameter did not increase in values after seven months, similarly to six months in female dogs. The lateral ischial diameter ceased development

at nine months in the pacas (Table 1), unlike the six months in female dogs (Ticer, 1987). This late closure of those diameters demonstrated slow bone development on this wild species when compared to domestic small animals.



Figure 3. Ventrrodorsal radiographic image of 6 months female paca (A), evidencing the pelvis entrance in oval form, laterally flattened, typical of dolico pelvic animal.

Considering the diameters and their averages from 13 to 24 months old in pacas, there was no practically variation, which means, there is development stability of the pelvic bone after one year of age. Small variation of average values may have occurred due to positioning during recumbency of animals and consequently errors on radiographic measurements.

Radiographic pelvimetry...

Table 1. Pelvis radiographic measures (in centimeters) of Agouti paca, from 0 to 24 months animals. CD: coxal diameter; TD: transverse diameter; AD: acetabular diameter; LID: lateral ischial diameter; LD: longitudinal diameter. The measures are grouped within each month (N= 12 animals)

Months	CD	TD	AD	LID	LD
0	4.39	1.83	2.89	1.41	5.89
1	5.58	2.56	3.85	2.05	8.01
2	6.78	2.88	4.71	2.29	9.64
3	7.47	3.18	5.02	2.52	10.43
4	7.55	3.22	5.32	2.47	11.07
5	7.88	3.40	5.28	2.45	11.32
6	8.38	3.58	5.52	2.60	11.60
7	8.85	4.20	5.75	2.65	11.95
8	8.68	3.74	5.53	2.62	12.67
9	9.10	4.11	6.06	3.04	12.40
10	9.23	3.67	5.68	2.62	12.18
11	9.63	4.06	6.04	2.98	12.66
12	10.13	4.02	6.25	2.92	13.42
13	9.95	3.86	6.18	3.05	13.43
14	9.50	3.63	5.93	3.03	12.70
15	9.65	3.88	6.06	3.09	13.03
16	10.15	4.00	6.26	3.26	13.43
17	9.10	3.80	6.00	3.50	13.10
18	9.35	3.80	5.90	3.30	13.10
19	9.70	3.70	5.90	3.20	13.10
20	9.50	3.85	5.95	3.40	13.15
21	10.03	4.04	6.25	3.39	13.44
22	10.46	4.27	6.54	3.43	13.80
23	10.00	3.90	6.00	3.10	13.20
24	10.05	3.85	6.03	3.20	13.20

CONCLUSION

There is strong correlation of the pelvic diameters in pacas until 12 months old, what may be useful in the approximated age determination in animals that do not have precise birth date, for example.

ACKNOWLEDGMENTS

The authors are grateful for the financial support of Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP; 2013/25975-4 and 2015/07073-9).

REFERENCES

- ALMEIDA, M.M.; CARVALHO, M.A.M.; CAVALCANTE FILHO, M.F.; MIGLINO, M.A.; MENEZES, D.J.A. Estudo morfológico e morfométrico do ovário de cutias. *Braz. J. Vet. Res. Anim. Sci.*, v.40, p.55-62, 2003.
- ÁVILA, B.H.P.; MACHADO, M.R.F.; OLIVEIRA, F.S. Descrição anátomo-topográfica do coração da paca (*Agouti paca*). *Acta Sci. Vet.*, v.38, p.191-195, 2010.
- BENTTI, S.B. Roedores da América tropical. *Natura.*, v.70, p.40-44, 1981.

- BONATELLI, M.; CARTER, A.M.; MACHADO, M.R.F. et al. Placentation in the paca (Agouti paca L). *Reprod. Biol. Endocrinol.*, v.28, p.3-9, 2005.
- BORGES, E.M.; BRANCO, E.; LIMA, A.R. et al. *Morfologia e topografia dos órgãos genitais masculinos externos da paca (Cuniculus paca Linnaeus, 1766)*. *Biotemas*, v.26, p.209-220, 2013.
- BRUNI, A.C.; ZIMMERL, U. *Anatomia degli animali domestici*. 2.ed. v.1 Milano: Casa Editrice Dottor Francesco Valardi, 1951. v.1, 736p.
- COLLET, S.F. Population characteristics of agouti paca (rodentia) in colombia. *Biol. Series*, v.5, p.601, 1981.
- ENEROTH, S.W.P.; HAUGEY, K.G. Radiographic pelvimetry for assessment of dystocia in bitches: a clinical study in two terrier breeds. *J. Small Anim. Pract.*, v.40, p.257-264, 1999.
- FERREIRA, N. *Tópicos de anatomia topográfica veterinária*. São Paulo: Manole. 1991. p.66-73.
- MIGLINO, M.A.; CARTER, A.M.; AMBROSIO, C.E. et al. Vascular organization of the hystricomorph placenta: a comparative study in the agouti, capybara, guinea pig, paca and rock cavy. *Placenta*, v.25, p.438-448, 2004.
- OLIVEIRA, F.S.; CANOLA, J.C. Erupção dental em pacas (Agouti paca) criadas em cativeiro. *Arq. Bras. Med. Vet. Zootec.*, v.59, p.390-394, 2007.
- OLIVEIRA, F.S.; CANOLA, J.C.; MACHADO, M.R.F.; CAMARGO, M.H.B. Descrição anátomo-radiográfica do esqueleto apendicular da paca (Agouti paca Linnaeus, 1766). *Acta Sci. Vet.*, v.35, p.83-87, 2007a.
- OLIVEIRA, F.S.; CANOLA, J.C.; MACHADO, M.R.F.; CAMARGO, M.H.B. Descrição anátomo-radiográfica do esqueleto axial da paca (Agouti paca, Linnaeus, 1766). *Acta Sci. Vet.*, v.34, p.331-334, 2007b.
- OLIVEIRA, F.S.; CANOLA, J.C.; OLIVEIRA, P.T.; PÉCOR, J.D.; CAPELLI, A. Anatomoradiographic description of the teeth of pacas bred in captivity. *Anat. Histol. Embryol.*, v.35, p.316-318, 2006.
- OLIVEIRA, F.S.; TONIOLLO, G.H.; MACHADO, M.R.F.; PAURA, D. Hemi-ovariossalpingohisterectomia em pacas prenhes e posterior ocorrência de prenhez (Agouti paca, Linnaeus, 1766). *Cienc. Rural*, v.33, p.547-551, 2003.
- SASAHARA, T.H.C.; LEAL, L.M.; SPILLANTINI, M.G.; MACHO, M.R.F. Organisation and tyrosine hydroxylase and calretinin immunoreactivity in the main olfactory bulb of paca (Cuniculus paca): a large caviomorph rodent. *Neurochem. Res.*, v.40, p.740-746, 2015.
- SILVA, F. *Ordem rodentia: mamíferos silvestres do Rio Grande do Sul*. Porto Alegre: Fundação Zoobotânica do Rio Grande do Sul, 1994. 245p.
- TICER, J.W. *Técnicas radiológicas na prática veterinária*. 2.ed. São Paulo: Roca, 1987. p.116.
- TONIOLLO, G.H.; VICENTE, W.R.R. Pelviologia e pelvimetria nas espécies domésticas e aspectos anatomicos da pelve em obstetrician. In: TONIOLLO, G.H.;
- VALLE, C.M.R.; VALLE, R.D.R.; MONTEIRO, F.O.B.; BOMBONATO, P.P. Pelvimetria em macacos-da-noite (Aotus azaral infulatus – KUHL, 1820). *Braz. J. Vet. Res. Anim. Sci.*, v.43, p.370-378, 2006.