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# CORRECTION OF UROGENITAL ANOMALIES IN A DOG WITH FINDINGS SUGGESTING CHIMERISM: CASE REPORT

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**Abstract:** Chimerism is a condition in which an individual is composed of two or more genetically different populations of cells. In dogs, although rare, this condition can manifest as genital anomalies, fertility problems and hormonal disorders. In this context, the objective of the present study was to report the surgical intervention in a male dog that was born with limbs and sexual organs with duplication and aplasia in anomalous tissues. Postoperative recovery was satisfactory during the 4-month follow-up.

## INTRODUCTION

The term chimerism is used to designate a rare event in which an individual has more than one type of DNA. This genetic anomaly can occur in animals and humans and can result in different degrees of genetic and phenotypic mosaic. Its causes are varied and include the fusion of two or more embryos at early stages of development, the exchange of cells between identical twins, the incorporation of fetal cells by the mother or caused by bone marrow transplantation or blood transfusions (SILVA et al., 2021).

It is known that the majority of chimeras are asymptomatic, however, some may predispose to the development of physical abnormalities, autoimmune diseases and other related conditions (SILVA et al., 2021).

In the field of veterinary medicine, chimerism in animals has been little studied and reported in the scientific literature. However, there are some cases documented in several species, including dogs (FALLER et al., 2020; LIN et al., 2019), cats (CERÓN-MUÑOZ et al., 2020), cattle (AGERHOLM et al., 2009), horses (MÜLLER et al., 2007) and pigs (SCHOOK et al., 2015). It is worth highlighting that knowledge of these cases is important to improve the understanding of chimerism in animals and its clinical implications (MÜLLER et al., 2007; FALLER et al., 2020; LIN et al., 2019),

In dogs, chimerism has been reported in different breeds, including Boxers, Dobermans and Pit Bulls. And although chimerism in dogs is relatively rare, these cases highlight the importance of considering this condition in animals that have unusual clinical or genetic characteristics. Therefore, in view of the above, the objective of this work was to report a case of chimerism in a dog undergoing surgery, describing the clinical, genetic and histological characteristics of the affected animal.

## CASE REPORT

A male canine, mixed breed (SRD), weighing 12 kg and 2 years old, was seen at the Veredas veterinary clinic (Nova Lima - MG). The owner's main complaint referred to the congenital malformation that the animal had and the damage it caused to the animal's quality of life.

During clinical and semiological examination, it was noted that the patient had duplicate pelvic limbs, penis, urethra and urinary vesicles. Furthermore, the organs of the urinary system in the right antimere showed atrophy that caused disorders. Vital parameters were within normal limits, as were the mucous membranes, which were normal colored.

The following complementary and pre-operative tests were requested: blood count, urea, creatinine, ALT, alkaline phosphatase, total proteins and fractions, coagulogram and electrocardiogram. Once all levels were normal for the species, the animal was sent to the Veterinary Hospital of Arnaldo University (Belo Horizonte - MG) to undergo double limb amputation.

Three surgical interventions followed to amputate the limbs. At the end, the animal's better quality of life was noticeable, as it no

longer showed pathological gait and was no longer injured frequently. The result, comparing the initial and final clinical presentation, can be seen below in Figure 1.

**Figure 1**: Recording before and after amputation of anomalous pelvic limbs

Source: the own author

The patient continued to be monitored at the Veredas clinic, where approximately one year after the aforementioned amputation it was observed that the patient had persistent injuries to the right penis. The organ in question remained exposed, showed dry mucosa, licking by the patient, pain and inflammation. However, it was not possible to differentiate between priapism, paraphimosis or an abnormality in its conformation.

Aiming to alleviate clinical symptoms, the patient underwent clinical treatment using meloxicam 0.1mg/kg SID for 5 days; dipyrone 25mg/kg TID for 5 days; neomycin ointment 5mg/g + zinc bacitracin 250 IU/g topical for 10 days and use of an Elizabethan collar.

Remission of symptoms was observed after approximately 5 days of treatment, but the condition recurred 30 days after the end of the medication.

At this time, an ultrasound examination was performed, which revealed the following changes highlighted below: duplication of urinary vesicles, hypoplastic right anterior bladder, thickened walls, urinary sediments suggesting cystitis. Duplicity of the prostate, right gland with a coarse appearance and cavitary structure (cyst). Right kidney with partial loss of corticomedullary definition/ relationship. Pelvic dilation measuring 0.76x0.27x0.0.45 cm. Pelvic wall measured 0.09 cm, suggesting nephropathy. Duplicate testicles (four in total), two in the scrotum and two others with reduced size in the abdominal cavity in the hypogastric region.

Furthermore, during the ultrasound examination, the patient's urethral probe was performed in the left urethra and when an attempt was made to probe the contralateral penis, it was not possible to progress with a urinary probe, suggesting a urethral stricture.

In this context, one of the reasons for the patient's discomfort was attributed to cystitis caused by urethral stricture. That said, cystitis treatment began (return to the previous protocol, adding cephalexin 20mg/kg BID) and then a computed tomography scan was performed for operative planning (Figure 2). The tomographic examination, in addition to confirming the ultrasound data, showed the presence of pelvic duplicity.

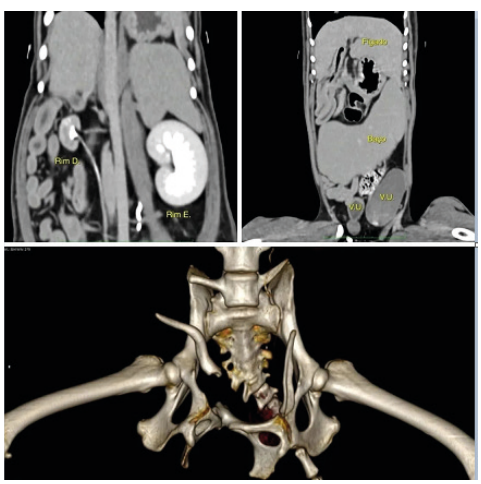

Figure 2: Tomographic examination indicating embryonic fusion

Source: the own author

Complementary laboratory tests were again requested and did not indicates pathological changes.

Aiming for a less invasive and safer approach, it was decided to divide the surgical intervention into two stages. Preoperatively, the animal underwent solid fasting for approximately 8 hours and water fasting for 2 hours. The region to be approached was prepared by performing a ventral trichotomy, involving the foreskin and adjacent regions. The preputial sheath, together with the penis, scrotum and nearby regions, were washed with an aqueous solution of 2% chlorhexidine digluconate and 0.5% alcoholic chlorhexidine.

The procedure began as a standard orchiectomy of the testicles in separate scrotal bags, where each bag stored a gonad. The patient had two ectopic rudmentary testicles in addition to discontinuity in the abdominal wall in the umbilical (hernia) and caudal regions close to the pelvis, where intracavitary testicles were located. This way, a pre-retro umbilical incision, standard ligation of both spermatic cords and standard closure of the cavity were performed (Figure 3).

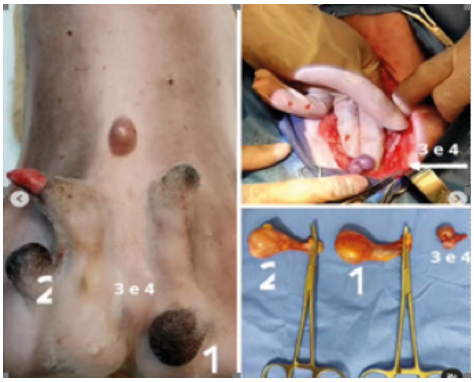


**Figure 3:** Area covered and morphology of ectopic and eutopic testes.

Source: the own author

The procedure was extended to remove the right penis, already showing necrosis in the glans, persistent exposure and discomfort for the animal. An incision was made covering the penis and scrotum (ablation), ligation of preputial arteries and veins, penis retraction, ligation of penile veins and arteries, positioning of a temporary tourniquet in the basal region of the organ and then amputation in a region more proximal to the bone. Due to the rudmental conformation of his entire right antimetrium, the urethral lumen was extremely small; targeting was carried out with a number 22 catheter and then difficult probing with a number 4 urethral probe (Figure 4).

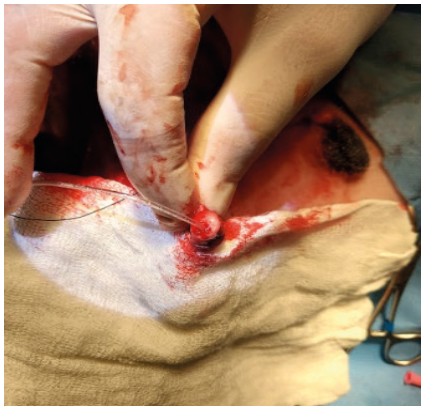

Figure 4: Penis probing after amputation

Source: the own author

With the aid of a 3.5x magnifying glass, the urethra was located, incised, and fixed to the skin with 4-0 pliglicaprone suture. At the last stage of the procedure, standard closure of the penectomy, subcutaneous reduction in a Cushing pattern and modified sultan dermorrhaphy were performed (Figure 5).

Figure 4: Final appearance after first intervention

Source: the own author

A total of 90 days after the intervention, the patient underwent a new clinical and ultrasound evaluation, where it was possible to notice stenosis of the urethral lumen, at the site of its exposure there was a small fistula draining urine and purulent secretion (Figure 5). On ultrasound examination, the right urinary bladder (rudimentary) was poorly filled.

Figure 5: Fistula in urestrostomy

Source: the own author

Based on the aforementioned findings, the clinical team opted for a new intervention, this time with the aim of remedying urethral stricture, prostatic secretion and urinary stasis; the decision was made to remove an organ from the right genitourinary tract.

The intervention began with pre-retroumbilical celiotomy until adequate visualization of target structures. After renal visualization and ratification of relevant hypoplasia, nephrectomy was performed with ligatures of the renal artery and vein separately with 3-0 caprofyl suture, exposure of the ureter and following its path to the urinary bladder.

The procedure continued with a joint approach to the urinary bladder and prostate, where they form isolated, rudmentary bladder ligaments, prostatic vascularization ligatures and subsequent thermal excision of the prostatic urethra (Figure 6).

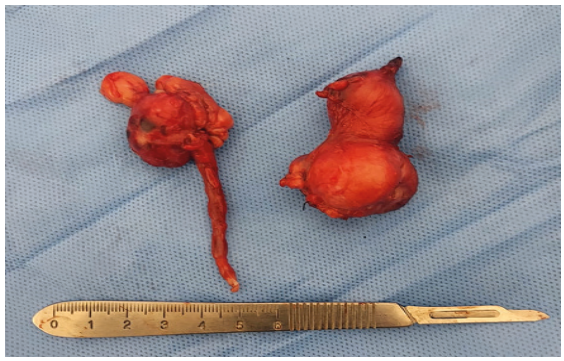

**Figure 6:** Kidney, prostate and urinary bladder (right antimere)

Source: the own author

The patient remained hospitalized for 72 hours. As postoperative medication, amoxicillin with clavulanate 22mg/kg BID for 7 days was prescribed; meloxicam 0.1mg/kg SID for 5 days; dipyrone 25mg/kg TID for 5 days; tramadol 4mg/kg TID for 5 days. It was also recommended to clean the surgical scar with saline solution every 12 hours.

There were no complications with the patient between surgery and 120 days of evaluation after surgical intervention. The animal remained stable, maintaining urinary flow, appetite and habits.

## DISCUSSION

A clinical case of a two-year-old canine diagnosed with chimerism was presented. In this sense, it is worth highlighting that although the literature determines that the majority of chimeras are asymptomatic (SILVA et al., 2021), the animal presented physical abnormalities and associated conditions.

As described by Granzen (2014) and Luiz (2018), natural chimerism occurs in three distinct forms: tetragametic chimerism, parthenogenetic chimerism and fetal-maternal microchimerism. In the present case, the animal was possibly tetragametic chimeric, that is, its condition came from a pregnancy that began with twins, one of which interrupted its development, and its

cells were absorbed by the twin who is still alive. Therefore, at birth this animal presented its own genetic material, and a small part of genetic material originating from the twin, which predisposed it to duplicate pelvic limbs, penis, urethra and urinary vesicles. Another clinical finding that reinforces this theory of embryonic fusion inherent to chimerism is the fact that pelvic duplicity was observed in the tomographic examination.

Confirmation of tetragametic chimerism could be done through genetic testing. Collection of hair samples and buccal swabs provides a non-invasive method of obtaining DNA, facilitating diagnosis at an early age and improving ease of sample collection and transport rather than the alternatives of tissue or blood collection (DREGER; SCHMUTZ, 2012).

Surgery for double pelvic limb amputation proved to be well indicated due to the fact that the animal had a better quality of life after surgery. However, on the other hand, it also highlighted the importance of veterinarians extending their clinical analysis in order to identify other pathological conditions associated with chimerism, such as cryptorchidism and the predisposition to urogenital changes.

Considering the malformation of the genitourinary system in duplicate due to tetragametic chimerism, the animal was diagnosed with cystitis related to urethral stricture. This finding corroborates what was described by Weisse et al. (2011) who showed that the prevalence of cystitis in dogs with urethral stricture was 32.5%, suggesting a strong correlation between the two conditions. Furthermore, Berent and Weisse (2014) state that urethral stricture may be a predisposing factor for the development of cystitis in dogs.

The animal was also subjected to penectomy, which according to Holt et al. (2017) must be seen as a viable treatment option for dogs with urethral stricture refractory to other therapies, and nephrectomy, which according to Troncoso et al. (2015) is a safe and effective procedure for treating dogs with atrophied kidneys, as in the present case.

Furthermore, once cryptorchidism was confirmed, castration was recommended, corroborating what was described by Swenson et al. (2013) who described that neutering cryptorchid dogs is important to prevent the spread of the cryptorchid gene, which can be transmitted to future generations. According to a study by Swenson et al. (2013), castration is the most effective way to reduce the prevalence of cryptorchidism in the canine population, which, if left untreated, can predispose to the development of neoplasms.

## CONCLUSION

Even without proof through DNA, the case cited shows us the incidence and need to correct anomalies caused by chimerism and congenital alterations. Chimerism could have important implications in veterinary medicine, especially in relation to DNA testing and organ transplants. Furthermore, studying chimerism in animals can provide insights into how genetic diversity can affect health and adaptation to environmental changes. However, it is important to remember that chimerism is a rare phenomenon and that many cases are still unknown, so more research is needed to fully understand its implications.

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