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Origin and Distribution of the Sciatic Nerve in Santa Inês Ovines

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ABSTRACT

Background: The anatomical study of the sciatic nerve is of utmost importance for several areas of knowledge, especially anesthesia in the clinical surgical area, once it is the largest nerve in the body, reaching the hindlimb distal end. **Objective:** Based on the need to describe relevant data on ovines of the Santa Inês breed, especially regarding the morphology of those animals, the objective of this study was to elucidate the origin and distribution of their sciatic nerve. **Results:** By dissecting, it was verified, in every animal, that the right sciatic nerve was formed by ventral branches of L6, S1, and S2. The left sciatic nerve presented the same formation in 29 individuals; one animal also showed the participation of S3 in its formation. Sciatic nerves were distributed in the muscles of the thigh gluteal, caudal, and lateral regions. The terminal branches were identified as the tibial, common peroneal, and lateral sural cutaneous nerves.. **Conclusion:** From the results, it was possible to observe that, in ovines of the Santa Inês breed, sciatic nerves originated from ventral branches of the spinal nerves L6, S1, and S2, and L6, S1, S2, and S3 ($p=0.2462$), between the antimeres. Regarding the sciatic nerve distribution along its path, in relation to the antimeres, it ceded branches to the corresponding biceps femoris ($p=0.0748$), gluteobiceps ($p=0.2462$), quadratus femoris ($p=0.0002$), deep gluteal ($p<0.0001$), semitendinosus ($p=0.2462$), and semimembranosus ($p<0.0001$) muscles.

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INTRODUCTION

The anatomical study of the sciatic nerve is of utmost importance for several areas of knowledge, especially anesthesia in the clinical surgical area, once it is the largest nerve in the body, reaching the hindlimb distal end. In surgical procedures for hindlimbs, it is possible to avoid general anesthesia or neuraxial blockade – brain and spinal cord, blocking the sciatic nerve, and achieving satisfactory results (WINNIE *et al*. 1973).

The knowledge of its arrangement, considering its origin and distribution, allows the treatment of injuries caused, eventually, by very large fetuses, implants of intramedullary pins, or medication application with an erroneous needle use (MOLENAAR, 1997). Partial injuries in the sciatic nerve may lead the animal to allodynia – a pain sensation that, usually, would not be sensed by a certain long lasting stimulus, either mechanical or thermal, apart from generating changes among peptide neurotransmitters and receptor expression in the spinal cord dorsal horn, what alters thermal and mechanical nociception (MALMBERG, A.B. & BASBAUM, A.I., 1998).

Based on the need to describe relevant data on ovines of the Santa Inês breed, especially regarding the morphology of those animals, the objective of this study was to precisely elucidate the origin and distribution of their sciatic nerve.

MATERIAL AND METHODS

Ovine stillbirth fetuses of the Santa Inês breed were collected over the years 2006-2010 at the Sheep Management Center, in Água Limpa Farm, belonging to the University of Brasília. There were 30 fetuses, which were 12 males and 18 females. For animal preservation, intracavitary and intramuscular injections of a 10% formaldehyde aqueous solution were administered. Fetuses were then immersed and maintained into the same solution until dissection.

In order to identify the origins of the sciatic nerves of both antimeres, incisions were made in the right and left abdominal walls, in the dorsoventral direction, from the dorsal tangent median line to the costal arch, up to the sternum xiphoid cartilage, and in the craniocaudal direction, from the first incision, towards the linea alba,

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up to the caudal border of the pubic symphysis, which was disarticulated. Hindlimbs and abdominal walls were laterally taken apart. Viscera of the pelvic cavity were removed so that it was possible to visualize the origins of the right and left sciatic nerves.

For the identification of the sciatic nerve distribution, a circular incision was made in the skin, in the middle third of the leg, followed by another perpendicular incision and, from the latter, proceeding to the thigh medial aspect up to the ventral midline. Another incision was performed around the caudal base, anus and external genitalia, so that skin and subcutaneous tissue of the gluteal regions, thigh and leg could be removed. A cut was then made in the gluteobiceps at the femur greater trochanter level, separating superficial gluteal and biceps femoris muscles, dissecting middle and accessory gluteal muscles and severing them in their respective insertions for the identification of the studied nerve muscular branches.

Data were submitted to Kolmogorov-Smirnov normality and Chi-Square tests, using GraphPad Prism® 6, a software for statistical analysis. Means were considered statistically significant when $p \leq 0.05$. The nomenclature used for designation of the anatomical structure is in accordance with Nomina Anatomica Veterinaria (I.C.V.G.A.N., 2012).

Results:

Origins of the right and left sciatic nerves were the ventral branches of L6, S1, and S2, or L6, S1, S2, and S3 (Graph 1 and Figure A). Thus, the sciatic nerve innervates gluteus, thigh, leg, and foot muscles (Figure D).

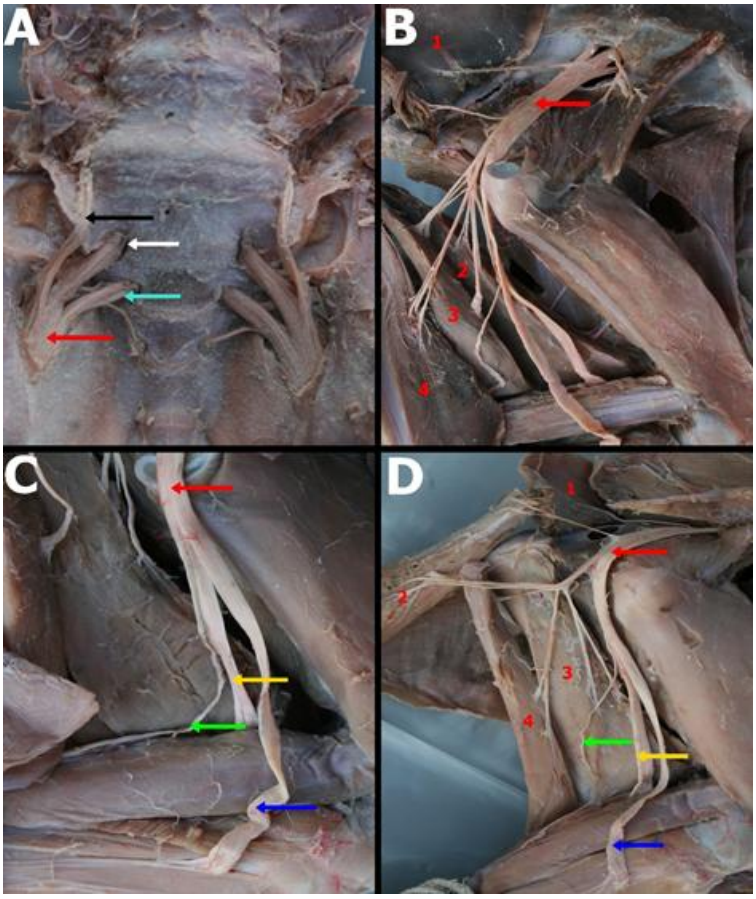
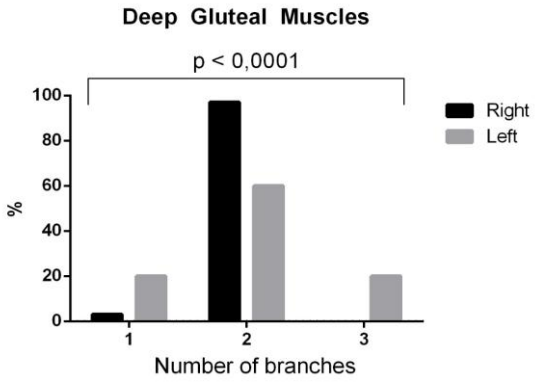


Fig. 1: Sciatic nerve distribution in the ovine. Black arrow: last lumbar ventral branch (L6); white arrow: S1; light blue arrow: S2; red arrow: sciatic nerve; green arrow: lateral sural cutaneous nerve; yellow arrow: tibial nerve; blue arrow: common peroneal nerve. A – Ventral view of the last lumbar vertebra and sacrum, demonstrating the origin of the sciatic nerve; B – Medial view of the hindlimb, 1: superficial gluteal muscle, 2: semimembranosus muscle, 3: semitendinosus muscle, 4: biceps femoris muscle; C – View of the sciatic nerve termination; D – Lateral view of the hindlimb, 1: superficial gluteal muscle, 2: biceps femoris muscle, 3: semimembranosus muscle, 4: semitendinosus muscle.



Graph 1: Mean and standard deviation of the obtained values from the origins of the right and left sciatic nerves. The presence of brackets between columns indicates statistical difference ($p \leq 0.05$) between values.

With regard to the terminations of the studied nerves, it was possible to observe that these were distributed to the biceps femoris muscle, emitting three or four branches (Graph 2); gluteobiceps muscles; quadratus femoris and semitendinosus, for which transferred up to two branches (Graphs 3, 4, and 5); deep gluteal muscles, innervated by up to three branches (Graph 6); twin muscle, with only one branch (Graph 7); and, finally, semimembranosus muscle with a more extensive innervation that may reach up to six branches (Graph 8 and Figure B). According to Figure C, for all instances, both left and right sciatic nerves branched in lateral sural cutaneous nerve, tibial nerve, and common peroneal nerve.

Discussion:

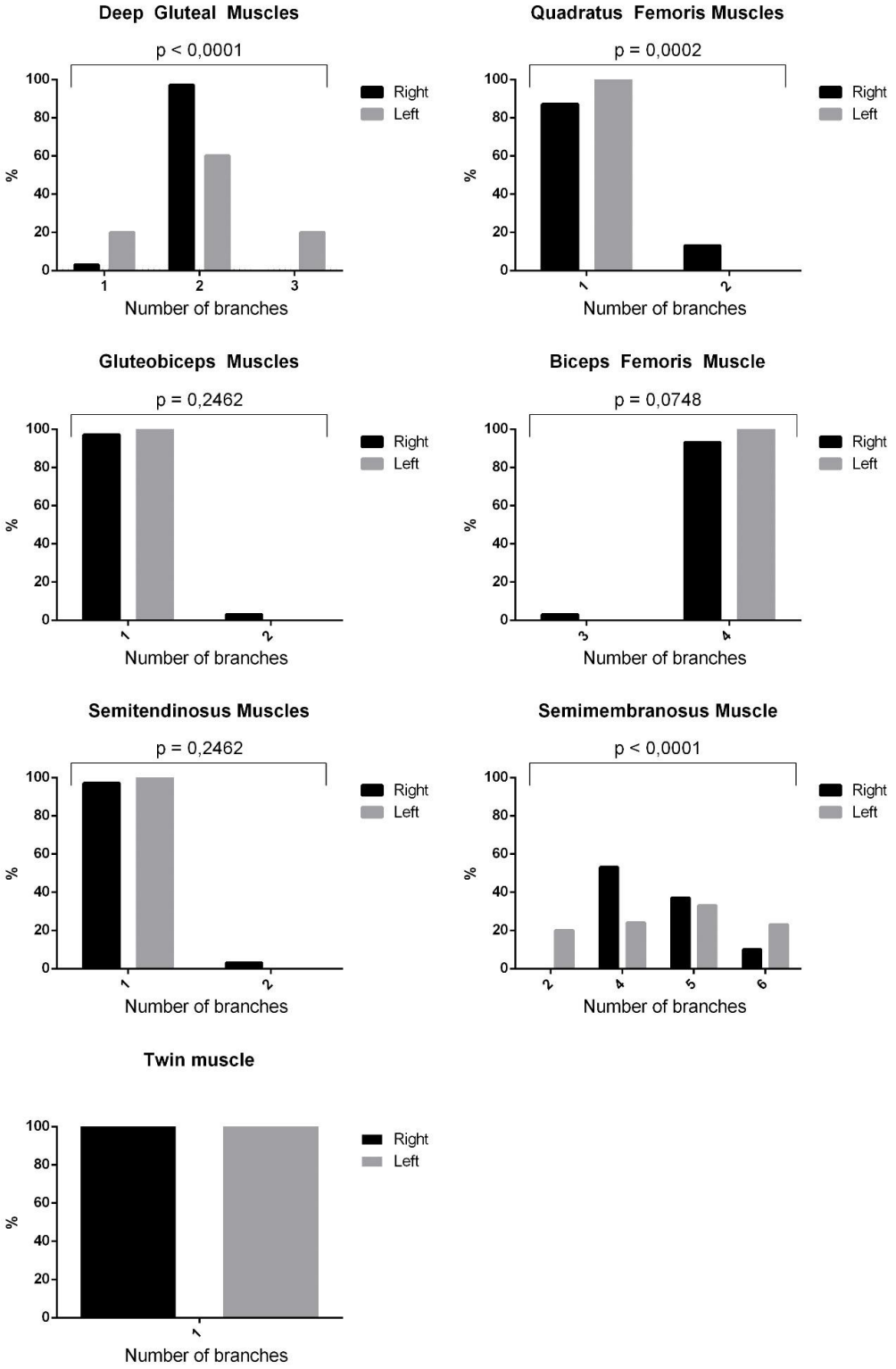
Besides the anatomical contribution, this study helped to understand the anatomical distribution of the sciatic nerve, thus avoiding the occurrence of traumatic injuries of the peripheral nerves by needle puncture, deposited drug, hematoma pressure, or a fibrous tissue around the nerve. RIET-CORREA *et al*. (2002) affirmed that injuries in the lumbosacral plexus cause hindlimb paralysis, or paresis, that may result in null reflexes and sensitivity. According to the observed in this study, the sciatic nerve covers a long path from its origin to its termination. It maintains its superficial arrangement just after origin and emergence of the pelvic cavity; then, along its near distal path in the thigh, it is partially covered by muscle groups. Since this nerve can be affected by traumatic injuries, specific studies on the inherent particularities about its arrangements are necessary for different animal species.

Regarding the sciatic nerve origin, LIMA *et al*. (2008) and MARTINS *et al*. (2013) affirmed that these nerves presented different origins, and may emerge from the ventral branches of the last lumbar and first sacral nerves. In ruminants, the configuration that defined, with a percentage above 50%, that the sciatic nerve origin was the ventral branches of L6, S1, and S2, was verified by CAMPOS *et al*. (2003) for zebu-crossed bovine fetuses, with an index of 63.33%, and by FERRAZ *et al*. (2006) for all animals they evaluated. LIMA *et al*. (2008), when studying goats (*Capra hircus*) of the Saanen breed, observed that the sciatic nerve origin occurred from L6 to S2 in 93.3% of those animals; the same result was found for Santa Inês ovines. Other configurations indicated contributions of L5 (16.7%) and S3 (20%) in zebu-crossed bovines (CAMPOS *et al*. 2003). LIMA *et al*. (2008) reported that, in goats, there was a 6.7% contribution of S3 in the sciatic nerve formation. However, in Santa Inês ovines, the contribution of L5 was not noted. The different arrangements cited in the literature and, also, those observed in Santa Inês ovines, showed that sciatic nerves may originate from the last ventral branches of the lumbar nerves up to the sacral ones. Above all, especially for ruminants, it was not possible to establish a pattern, but a proposition for a general characterization according to, of course, the available literature.

According to LIMA *et al*. (2008), goats of the Saanen breed presented the same sciatic nerve configuration as Santa Inês ovines; also, the branch distribution for the twin muscle was similar to that described by MOLENAAR (1997) and CAMPOS *et al*. (2003). In relation to the musculature of the thigh caudal region, in the studied animals, it received branches of the sciatic nerve in both antimeres, what was also described by LIMA *et al*. (2008) as a characteristic of ruminants.

Regarding the cranial gluteal nerve, its forming fibers originated from L6 and S1 in 60% of the cases, and from L6, S1, and S2, in 40% of the individuals. SCHALLER (1999) affirmed that the cranial gluteal nerve had its origin from L5 to S1, what is different from the results obtained for Santa Inês ovines, as the caudal gluteal nerve, in 100% of the samples, originated directly from the sciatic nerve and branched in the superficial gluteal

muscle in both antimeres. Therefore, it is believed that there was certain specificity for animals of the Santa Inês breed.



Graph 2: Branch frequency and Chi-Square test, at 5% significance level, of the distribution of right and left sciatic nerves in the muscles.

In relation to the termination of the right and left sciatic nerves of Santa Inês ovines, it was noted that these emitted the tibial, common peroneal, and lateral sural cutaneous nerves (Figure C). This was also evidenced by LIMA *et al*. (2008), who described that the terminal branches of the sciatic nerves originated distally to the

femur greater trochanter in both antimeres. Generally speaking, the terminal branches of the sciatic nerve, in ruminants, were distributed in the leg and foot muscles, and in the lateral cutaneous region of the leg.

Conclusions:

From the results, it was possible to observe that, in ovines of the Santa Inês breed, sciatic nerves originated from ventral branches of the spinal nerves L6, S1, and S2, and L6, S1, S2, and S3 ($p=0.2462$), between the antimeres. Regarding the sciatic nerve distribution along its path, in relation to the antimeres, it ceded branches to the corresponding biceps femoris ($p=0.0748$), gluteobiceps ($p=0.2462$), quadratus femoris ($p=0.0002$), deep gluteal ($p<0.0001$), semitendinosus ($p=0.2462$), and semimembranosus ($p<0.0001$) muscles.

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