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A comparative gross study on the Plexus Sacralis of the magpie (Pica pica) and chukar partridge (Alectoris chukar)

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ABSTRACT

Objective: The aim of the study is to compare the detection of plexus sacralis and its branches of Magpie (Pica pica) and Chukar partridge (Alectoris chukar) and to correlate the anatomic differences between these studied species.

Materials and Methods: In the study, 20 each magpies and Chukar partridges were used. Under anesthesia, the studied birds were sacrificed. Then all the nerves separating from the plexus sacralis were separately dissected and photographed

Results: In wingeds, plexus sacralis usually occurs as a result of a combination of ventral primary branches of 1-5 sacral spinal nerves. In the study, it was observed that formation of plexus sacralis and general anatomic distribution of nerves arising from plexus in both the species were similar with other species of birds. However, nerves forming the plexus sacralis and their branches were thicker in Chukar partridge than Magpie.

Conclusion: In conclusion, in the Magpie and Chukar partridge, anatomical distribution and nerve structure of plexus sacralis were determined, and it was observed that there was no major anatomical difference between them.

Keywords: *Chukar partridge, Magpie, Plexus sacralis*

INTRODUCTION

Magpies, living in the geography including Asia, Europe and North America, belong to Corvidae family. Magpies in Turkey is called " *Pica pica* " known as European Magpie (Hayman et al., 2005; Anonym, 2014). Partridges belong to the Pheasin (Phasinidae) family (Özçelik, 1995; Robbins, 1998; Kırıkçı and Çetin, 1999). They live in the region stretching from the Balkans to Central and Northwest Anatolia (Gaudioso et al., 2002).

Plexus sacralis in wingeds birds is formed by the combination of primary ventral branches of 1-5th sacral spinal nerve in three roots; truncus cranialis, truncus medianus and truncus caudalis (Baumel, 1975; Baumel et al., 1993). It is called "nervus (n.) bigeminus" which is the last of these branches forming plexus sacralis and the nerve is connected to plexus sacralis by distal of plexus pudendus through caudal branch (Baumel et al., 1993; Serbest et al., 1993; Dursun, 2002; El-Mahdy et al., 2010). Nervus gluteus caudalis, nervus cutaneus femoris caudalis, rami (rr.) musculares, nervus ischiadicus, nervus tibialis and nervus peroneus come out from plexus sacralis in domestic birds (Nickel et al., 1977; Dursun, 2002).

Nervus ischiadicus the thickest nerve of plexus sacralis and also named as “siatic nerve”, is divided into nervus peroneus (nervus fibularis) and nervus tibialis in the medial part of proximal of articulatio genu (Doğuer and Erençin, 1964; Nickel et al., 1977;

Baumel et al., 1993; Dursun, 2002). In rock partridge and Japanese quail n. peroneus proceeds to the distal part of femur with n. tibialis as a single stem. It separates from n. tibialis in the proximal of articulatio genu and after then divides into a slim branch n. peroneus superficialis and a thick branch n. peroneus profundus (Can, 2011).

In the literature, it is seen that although there are many scientific studies on the plexus sacralis in different animal species, there are not enough studies on the plexus sacralis in birds, especially wild bird. The aim of the study is to compare the plexus sacralis and its branches of Magpie and Chukar partridges and to investigate the variances in both studied species.

MATERIALS and METHODS

This study is according to the examination made by the Atatürk University Veterinary Faculty, Ethics Subcommittee (Decision no:2014/9). In the study, 20 Magpies and 20 Chukar partridges were used. Then, arteria carotis communis of each anesthetized Magpies and Chukar partridges was cut and blood was shed, an incision was made through the ventromedian line longitudionally in the abdominal region. The abdominal organs were taken out and were immersed in 10% formaldehyde solution for dissection. The nerves composing the plexus sacralis were dissected and photographed. The terms in Nomina Anatomica Avium (NAA) (Baumel et al., 2013) were used as base in the process of naming of the nerves and the surrounding anatomical formations.

RESULTS

Plexus Sacralis: It was determined that plexus sacralis in Magpie and Chukar partridge was formed as a result of union of primary ventral branches of 5 (5-9) synsacral spinal nerves. (Figure 1a). It was determined that ventral branches of 5th and 6th synsacral spinal nerves formed "truncus cranialis", 7th synsacral spinal nerve formed "truncus medianus" alone and ventral branches of 8th and 9th synsacral spinal nerves formed "truncus caudalis" (Figure 1b).

Nervus ischiadicus: It was seen that after its formation in pelvis, nervus ischiadicus progresses to caudolateral and passes through for. (foramen) ischiadicum. Nervus ischiadicus divided into four branches as common stem of nervus peroneus and nervus tibialis, nervus coxalis caudalis, nervus cutaneus femoris caudalis and rami musculares (Figure 2c-d).

Nervus coxalis caudalis: In both the species under this study, it was observed that it proceeds to cranioventral shortly after leaving n. ischiadicus in line of foramen ischiadicum and innervates the anterior part of m. (musculus) biceps femoris giving two branches (Figure 2c-d).

The Common Stem of nervus peroneus and nervus tibialis: It was observed that this common stem was the thickest branch among the branches given by n. ischiadicus in Magpie. When it reached medial aspect of the femur it divided into n. peroneus and n. tibialis between the 1/3 inferior of femur and the proximal part of articulatio genu (Figure 2a-c, Figure 2c). It was observed that in Chukar partridge, these two nerves (nervus peroneus and nervus tibialis), which separated from the same root, continued independently of each other in the lower 1/3 of the femur. The nerve located anteriorly and surrounded by a weak sheath was the nervus peroneus, while the posterior nerve was the nervus tibialis. It was observed that the nervus cutaneus suralis was separated from the nervus tibialis (Figure 2b-d, Figure 2d).

Nervus cutaneus suralis: It was observed that in Magpie n. cutaneous suralis originated from the common stem of n. peroneus and n. tibialis (Figure 2a). In Chukar partridge n. cutaneous suralis separated from n. tibialis at the medial aspect of the femur after n. tibialis and n. peroneus separated from each other (Figure 2b).

Nervus peroneus: It was seen that in Magpie n. peroneus gave a thin branch n. paraperoneus shortly after, n. peroneus and tendons of m. biceps femoris, pass from ansa mm. (musculi) iliofibularis at the caudolateral of articulatio genu proceeding to cranial after it separated from n. tibialis. It was determined that n. peroneus gave thin muscular branches at the underside of for. interosseum proximale and then proceeded to the distal part of leg. It was determined that it divided into two main branches as nervus peroneus superficialis and nervus peroneus profundus at 1/2 of ossa cruris (Figure 1c, 1e). It was determined that in Chukar partridge n. peroneus divided into n. peroneus profundus after it gave thin muscular branches whose numbers differed between 2-3 in the direction of cranial in the lateral aspect of proximal part of leg on os fibula turned to craniolateral leaving n. paraperoneus in the proximal part of ossa cruris shortly after it passed from ansa mm. iliofibularis in the caudolateral of art. (articulatio) genu.

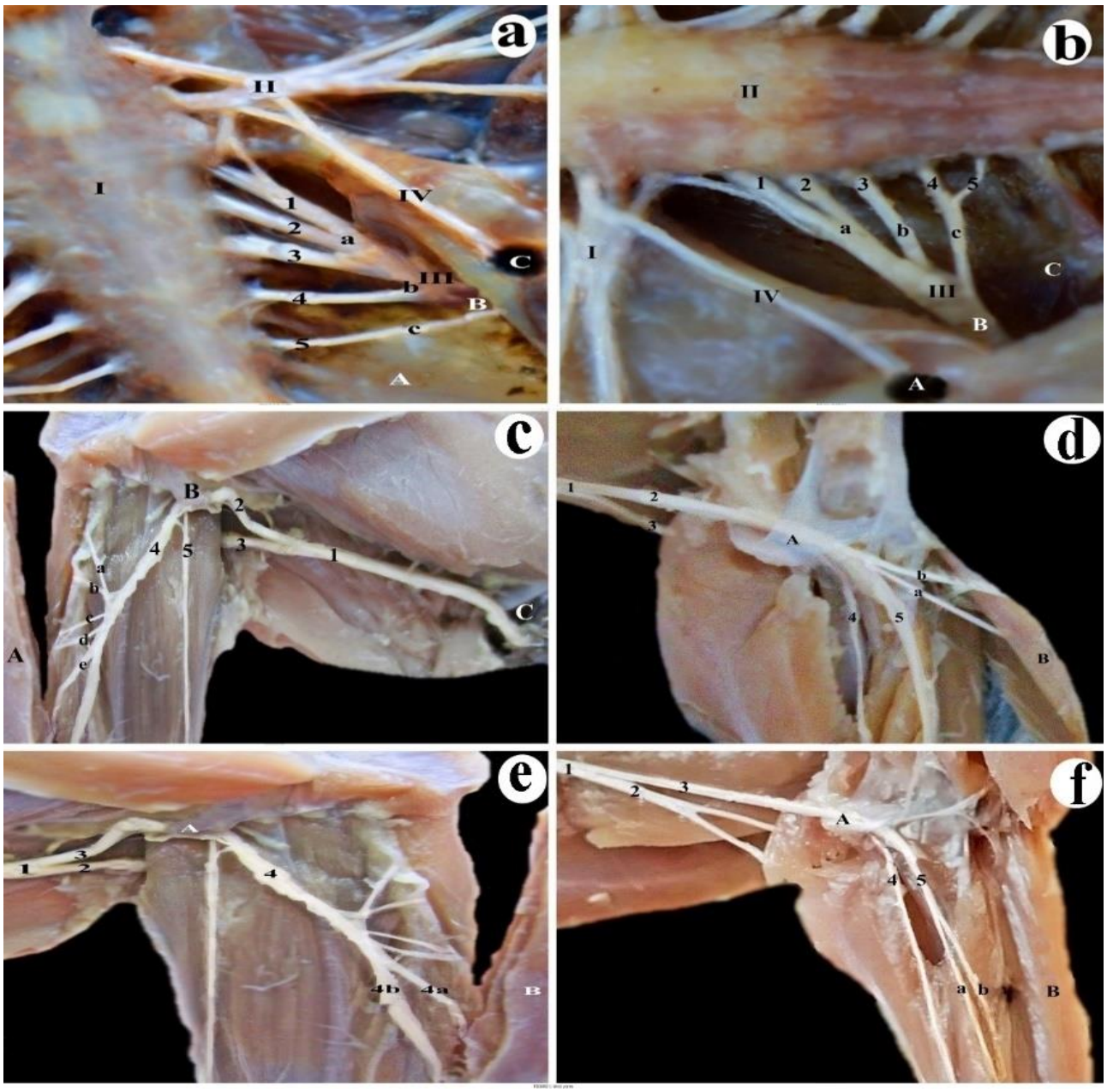

Figure 1. Gross anatomical views of plexus sacralis, n. peroneus, its branches and n. peroneus superficialis et profundus;

a: Plexus sacralis and formation of n. ischiadicus in Magpie, left caudoventral view; *I: Synsacrum, II: Plexus lumbalis, III: Plexus sacralis, IV: N. obturatorius, 1-5: Ventral branches of 5-9. synsacral spinal nerves, a: Truncus cranialis, b: Truncus medianus, c: Truncus caudalis, A: Fossa renalis caudalis, B: N. ischiadicus, C: Foramen obturatum.*

b: Plexus sacralis and formation of n. ischiadicus in Chukar partridge, left ventrolateral view; *I: Plexus lumbalis, II: Synsacrum, III: Plexus Sacralis, IV: N. obturatorius, 1-5: Ventral branches of 5-9. synsacral spinal nerves, a: Truncus cranialis, b: Truncus medianus, c: Truncus caudalis, A: Foramen obturatum, B: N. ischiadicus, C: Fossa renalis caudalis.*

c: N. peroneus and its branches in Magpie, left lateral view; *1: The common stem of n. peroneus ve n. tibialis, 2, 4: N. peroneus, 3: N. tibialis, 5: N. paraperoneus, a-d: Muscular branches of n. peroneus, e: N. peroneus superficialis, A: M. tibialis cranialis, B: Ansa mm. İliofibularis, C: Foramen ischiadicum.*

d: N. peroneus and its branches in Chukar partridge, right lateral view; *1: The common stem of n. peroneus ve n. tibialis, 2, 5: N. peroneus, 3: N. tibialis, 4: N. paraperoneus, a, b: Muscular branches of n. peroneus, e: N. peroneus superficialis, A: Ansa mm. İliofibularis, B: M. tibialis cranialis.*

e: N. peroneus superficialis et profundus in Magpie, right lateral view; *1: The common stem of n. peroneus ve n. tibialis, 2: N. tibialis, 3, 4: N. peroneus, 4a: N. peroneus profundus, 4b: N. peroneus superficialis, A: Ansa mm. İliofibularis, B: M. tibialis cranialis.*

f: N. peroneus superficialis et profundus in Chukar partridge, right lateral view; *1: The common stem of n. peroneus ve n. tibialis, 2: N. tibialis, 3, 5: N. peroneus, 4: N. paraperoneus, a: N. peroneus superficialis, b: N. peroneus profundus, A: Ansa mm. İliofibularis, B: M. tibialis cranialis.*

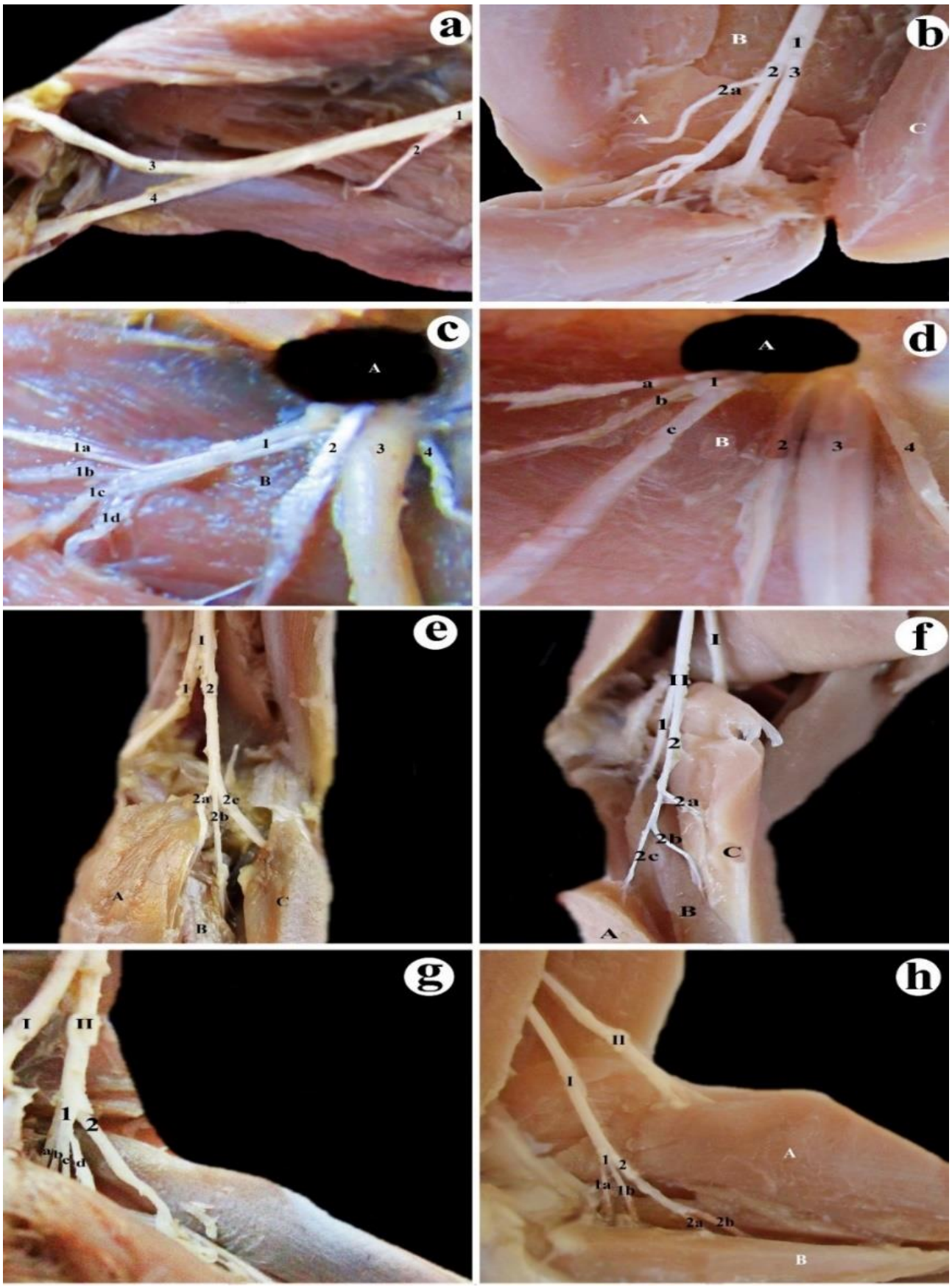

Figure 2. Gross anatomical views of n. cutaneus suralis, rami musculares, n. tibialis, its branches and n. tibialis lateralis et medialis;

a: N. cutaneus suralis in Magpie, left lateral view; *1: The common stem of n. peroneus ve n. tibialis, 2: N. cutaneus suralis, 3: N. peroneus, 4: N. tibialis.*

b: N. cutaneus suralis in Chukar partridge, right lateral view; *1: The common stem of n. peroneus ve n. tibialis, 2: N. tibialis, 2a: N. cutaneus suralis, 3: N. peroneus, A: M. puboischiofemoralis lateralis, B: M. caudofemoralis, C: M. biceps femoris.*

c: N. ischiadicus and its branches in Magpie, right lateral view; *1: Rr. musculares, 1a, 1b, 1c, 1d: Branches of rr. musculares, 2: N. cutaneus femoris caudalis, 3: The common stem of n. peroneus ve n. tibialis, 4. N. coxalis caudalis, A: Foramen ischiadicum, B: M. ischiofemoralis.*

d: N. ischiadicus and its branches in Chukar partridge, right lateral view; *1: Rr. musculares, a, b, c: Branches of rr. musculares, 2: N. cutaneus femoris caudalis, 3: The common stem of n. peroneus ve n. tibialis, 4: N. coxalis caudalis, A: Foramen ischiadicum, B: M. ischiofemoralis.*

e: N. tibialis lateralis and its branches in Magpie, left caudolateral lateral view; *I: N. tibialis, 1: N.tibialis medialis, 2: N. tibialis lateralis, 2a, 2b, 2c: The muscular branches of n. tibialis lateralis, A: M. flexor perforans et perforatus digiti III, B: M. flexor perforans et perforatus digiti II, C: M. gastrocnemius pars lateralis.*

f: N. tibialis lateralis and its branches in Chukar partridge, right caudolateral lateral view; *I: N. peroneus, II: N.tibialis, 1: N. tibialis medialis, 2: N. tibialis lateralis, 2a, 2b, 2c: The muscular branches of n. tibialis lateralis, A: M. flexor perforans et perforatus digiti III, B: M. flexor perforans et perforatus digiti II, C: M. gastrocnemius pars lateralis.*

g: N. tibialis medialis and its branches in Magpie, left lateral lateral view; *I: N. tibialis lateralis, II: N.tibialis medialis, 1: The cranial branc of n. tibialis medialis, 2: The caudal branch of n. tibialis medialis, a-d: The muscular branches of n. tibialis medialis cranialis.*

h: N. tibialis medialis and its branches in Chukar partridge, right lateral lateral view; *I: N. tibialis medialis, II: N.tibialis lateralis, 1: The proximal branch of n. tibialis medialis, 1a, 1b: The muscular branches, 2: The caudadistal branch of n. tibialis medialis, 2a, 2b: The muscular branches, A: M. gastrocnemius pars lateralis. B: M. gastrocnemius pars medialis.*

It was determined that in Chukar partridge thin muscular branches separated from n. peroneus to cranial at the lateral aspect of the upper part of leg, then one of two main branches took part in the caudal proceeding to distal was n. peroneus superficialis. It was detected that it took part as n. metatarsalis dorsalis lateralis on upside of leg passed from retinaculum extensorium tibiotarsi (Figure 1d, 1f).

Nervus tibialis: It was determined that in Magpie n. tibialis separated from the common stem at inferior 1/3 of femur. Then it ran towards caudal of art. genu and divided into two main branches going towards medial and lateral at the dorsal of ansa mm. iliofibularis, the branch going towards lateral was n. tibialis (suralis) lateralis and the thick branch going towards medial was n. tibialis (suralis) medialis (Figure 2e, 2g).

It was seen that in Chukar partridge nervus tibialis separated from the common stem of n. tibialis and nervus peroneus at 1/2 of the femur gave a thin branch nervus cutaneus suralis. It was observed that nervus tibialis divided into two branches as nervus tibialis medialis and nervus tibialis lateralis at inferior 1/3 of the femur (Figure 2f, 2h). Nervus tibialis lateralis divided into three branches (Figure 2f). It was seen that nervus tibialis medialis in proximal portion divided into two branches, proceeded cranially on the medial part of leg, the other branch of it separated towards caudodistal divided into two branches and dispersed in the caudal part of leg (Figure 2h).

In the study anatomical distributions and nerve structures of plexus sacralis belonged to Magpie and Chukar partridge species were determined and it has been revealed that there were some anatomical differences between them. The anatomical differences between Magpie and Chukar partridge whose plexus sacralis researched and with other species could be listed as follows:

- Truncus cranialis was formed by ventral branches of 5th and 6th synsacral spinal nerves in the two species, truncus medianus was formed by ventral branches of 7th and 8th synsacral spinal nerves in Magpie and ventral branches of 7th synsacral spinal nerve in Chukar partridge, truncus caudalis was formed by ventral branches of only 9th synsacral spinal nerve in Magpie and ventral branches of 8th and 9th synsacral spinal nerves in Chukar partridge.

- Nervus cutaneus suralis originated from common stem of nervus peroneus and nervus tibialis in Magpie and from nervus tibialis in Chukar partridge.

DISCUSSION

It was reported that this number is generally 6 in domestic birds (Nickel et al., 1977; Dursun, 2002) and white turkey (Istanbullugil, 2008), 5 in hen (Serbest et al., 1993), 5 or 6 in turkey (Serbest, 2000), 5 in goose (Serbest, 2000), 5 in owl (Akbulut et al., 2015). As the obtained data are partially similar to the literature information.

Can and Özdemir (2012) in rock partridge, Serbest et al. (1993) in hen, Akbulut and et al. (2015) in owl, reported that ventral branches of the first two synsacral spinal nerves in cranial participates in the formation of plexus sacralis composed the truncus cranialis, the third branch alone composed truncus medianus, the fourth and fifth branches together composed truncus caudalis.

It was reported that this nerve is formed by the combination of ventral branches of the first four

synsacral spinal nerves composing the plexus sacralis in domestic birds (Nickel et al., 1977; Martin et al., 1994; Dursun, 2002). İstanbullugil (2008) and Can (2011) reported that the second branch separates from n. ischiadicus is n. coxalis caudalis and it proceeds to craniocaudal.

It was determined that in the study unlike the literature in Magpie n. coxalis caudalis exits from dorsocranial of common stem of n. peroneus and n. tibialis, in Chukar partridge it exits from cranial of this stem and they innervate the cranial part of m. biceps femoris as two branches (Doğuer and Erençin, 1964; Istanbullugil, 2008; Can, 2011).

The information that in domestic wingeds (Nickel et al., 1977; Dursun, 2002), owl (Akbulut et al., 2015), Japanese quail (Can and Özdemir, 2011) and rock partridge (Can and Özdemir, 2012) the nerve that is one of the nerves composing the common stem of n. peroneus and n. tibialis is n. peroneus in cranial and the one in caudal is n. tibialis is similar to study findings.

Baumel (1975) reported that n. cutaneous suralis separates from n. tibialis in the medial of femur and innervate the region skin proceeding to distal as in Chukar partridge, Akbulut and et al. (2015) reported that in owl the mentioned nerve separates from n. tibialis side of common stem at 2-2.5 cm above of separating point of n. tibialis and n. peroneus.

It was determined that this nerve separates from caudal part of plexus lumbosacralis according to Jungherr et al. (1969) from plexus sacralis according to Dursun (2002), Nickel et al. (1977), from common stem of n. tibialis and n. peroneus in the same cover with n. paraperoneus according to El- Mahdy et al. (2010) and Akbulut et al. (2015).

El-Mahdy et al. (2010) in ostrich, Balkaya and Özüdoğru (2016) in sparrow hawk determined that, like the findings in Magpie, n. peroneus gives muscular branches innervating musculus tibialis cranialis, musculus fibularis longus, musculus extensor digitorum longus in the proximal part of leg and divides into n. peroneus superficialis et profundus after proceeding to distal on the lateral surface of leg. Similar to domestic birds (Nickel et al., 1977; Dursun, 2002) n. peroneus composes n. peroneus superficialis et profundus after it gives thin muscular branches in Chukar partridge. It was seen that some findings found in the study are not similar to some studies (Nickel et al., 1977; Dursun, 2002). Can (2011) reported that n. peroneus profundus divides into 4 branches in Japanese quail and 5 in rock partridge and İstanbullugil (2008) reported that it divides into 6 in white turkey. On the other hand, it was observed that differently from literature findings (Fitzgerald, 1969; Nickel et al., 1977; Istanbullugil, 2008¸Bentley and Poole, 2009; El-Mahdy et al., 2010) n. peroneus profundus is seen prominently in Magpie and visits lateral and medial bifurcation after passes through retinaculum extensorium tibiotarsi.

Some researchers (Nickel et al., 1977; Dursun, 2002) reported that in wingeds n. tibialis gives r. (ramus) lateralis and r. medialis and these two branches innervate popliteal region, m. gastrocnemius and the flexor muscles on the posterior surface of calf. It has been reported that the first branch given by nervus tibialis before n. tibialis lateralis divides into et medialis in sparrow hawk (Balkaya, 2012), pigeon (Balkaya, 2012), Japanese quail (Can and Özdemir, 2011), rock partridge (Can and Özdemir, 2012) and ostrich (El-Mahdy et al., 2010) is n. paraperoneus.

CONCLUSION

In conclusion, in the Magpie and Chukar partridge, anatomical distribution and nerve structure of plexus sacralis were determined, and it was observed that there was no major anatomical difference between them. It has been thought that this study will contribute the scientific studies to be done in this direction and the literature related to the subject.

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