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Original Article

Gross anatomical syringeal structures of goose (*Anser anser domesticus*)

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ABSTRACT

Objective: The main purpose of this study was to give detailed information on the position and normal anatomical syringeal structure in goose which had received a little attention in the field of veterinary anatomy.
Materials and methods: Six (3 females and 3 males) adult geese weighing 2-4 Kg were used. The goose was slaughtered and its body cavity was opened to detect *in situ* position of the syrinx. Then the syrinx were dissected and fixed in 10% formaldehyde for 48 h and then kept in 70% ethanol for 2 h.
Results: Anatomical examination showed that the syringes of these birds were located in the thoracic cavity at the bifurcation of the trachea. The syrinx was tracheobronchial type formed by tracheosyringeal cartilages, bronchosyringeal cartilages, pessulus, medial and lateral tympaniform membranes, interbronchial ligament and foramen as well as extrinsic syringeal muscles.
Conclusion: There were some similarities and some differences of the anatomical structures of the syrinx of goose and that of other bird species. No differences between male and female syrinx were observed.

KEYWORDS

Anatomy; Syrinx; Goose

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INTRODUCTION

Geese are waterfowl belonging to the tribe Anserini of the family Anatidae. The sound of the birds is produced via the larynx by the vibration of the air flowing through it. Birds produce sounds during migration, during mating or all year long (Al-Badri et al., 2014). There are three types of syrinx; bronchial, tracheobronchial and tracheal syrinx (Baumel et al., 1993). Previous morphological features of syrinx were examined in many bird species such as guinea fowl (Al-Bishtue, 2014), Iraqian Duck (Ali et al., 2015), Japaneses quail (Cevik-Dermirkan et al, 2007), turkey (Kookhdan et al., 2012), goose (Onuk et al., 2010), white pekin duck (Mohamed, 2017), jungel crow (Tsukahara et al., 2008), ostrich (Yildiz et al., 2003), bursa roller pigeon (Yildizet al., 2005) and mallard duck (Yilmaz et al., 2012), The present investigation was done to give detailed information about the gross anatomical syringeal features of the syrinx of the geese.

MATERIALS AND METHODS

This study has been conducted with the geese according to the international ethical standard, by giving minimum pains to the bird.

A total of six (3 females and 3 males) adult geese weighing 2-4 Kg were used. They were collected from local farms in Egypt. According (Al-Bishtue, 2014), the geese were anaesthetized with an IM injection of ketamine (at 50 mg/kg bwt) and xylazine (at 20 mg/kg bwt). Then the geese were slaughtered by cutting the blood vessels of the neck. The body cavity was carefully opened to observe topographic position of syrinx in situ at the terminal end of the trachea. The trachea with the syrinx were carefully removed and dissected by removing the remaining fat and connective tissue. The specimens were fixed in 10% formaldehyde for 48 h and then kept in 70% ethanol for 2 h to acquire a clear vision of the cartilages. The anatomical structure of the syrinx was examined and gross photos were taken using a digital camera (12 mega pixels). Nomina Anatomia Avium that was proposed by Baumel et al. (1993) was used for nomenclature of the structure of the syrinx.

RESULTS

Syrinx of male and female geese was observed inside the thoracic cavity between the terminal part of the trachea and initial parts of the primary bronchi and ventral to the esophagus. It was located at the base of the heart. Syrinx of goose was tracheobronchial in type. The syrinx was composed of tracheosyringeal cartilages, tympanum, bronchosyringeal cartilages, the pessulus at the tracheal bifurcation, two pairs of vibrating medial and lateral tympaniform membranes, interbronchial ligament and foramen and extrinsic syringeal muscles (**Figures 1-3**).

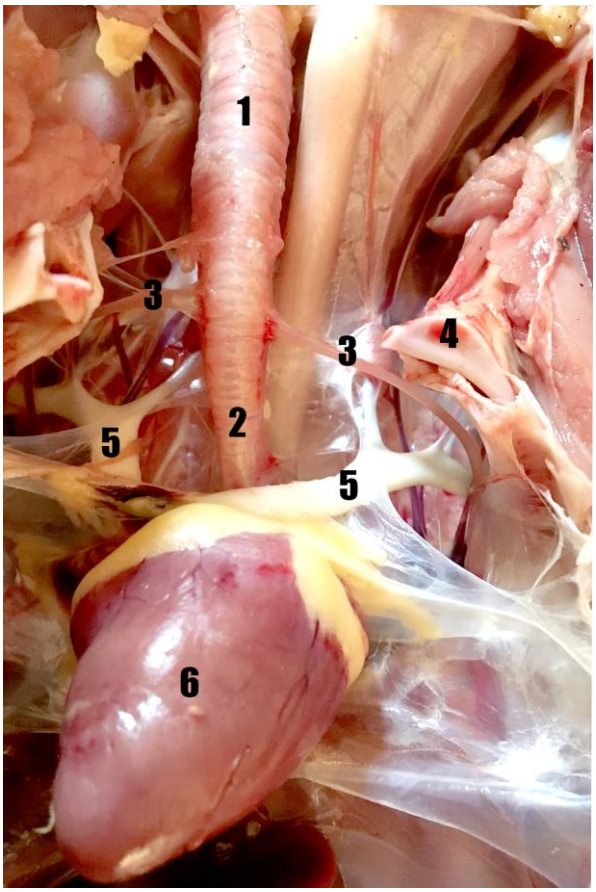

Figure 1. In situ Ventral View of the Syrinx in the goose. 1. Trachea; 2. Tympanum; 3. Sternotracheal muscles; 4. Sternum; 5. Right and left brachiocephalic trunks; 6. Heart.

Most of the tracheosyringeal cartilages were fused together and ossified to form the tympanum except the first two cartilages which were separate and form a circle. The tympanum had two processes, right and left, in its dorsal and ventral aspects in which the lateral tympaniform membranes were attached caudolaterally. The caudaomedial aspect of the tympanum has an ossified plate, the Pessulus.

The bronchosyringeal cartilages were six pairs in number. The primary right and left bronchi were connected by a strong interbronchial ligament. Also, there was interbronchial foramen between the pessulus and interbronchial ligament.

The medial tympaniform membrane lied in the medial aspect of the syrinx and it attached from the caudal end of the pessulus and extended until the level of the second bronchosyringeal cartilage. The lateral tympaniform membrane lied on the lateral aspect of the syrinx, which

stretched between the caudo-lateral tympanum and the first bronchosyringeal cartilage.

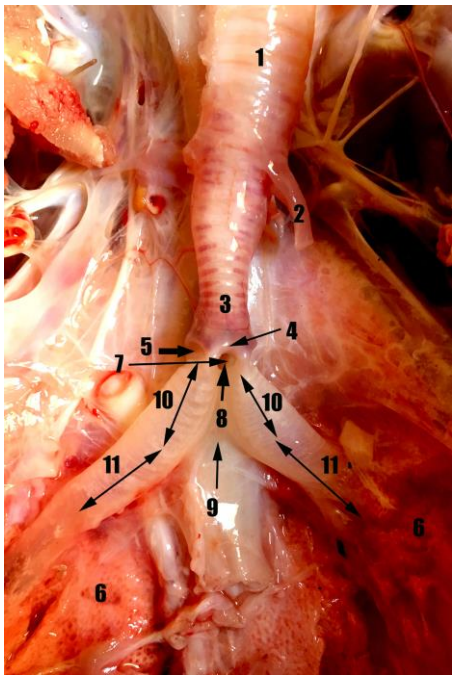

Figure 2. In situ Ventral View of the Syrinx in the goose (after removal of the heart). 1. Trachea; 2. Sternotracheal muscles; 3.Tympanum; 4. Pessulus; 5. Lateral tympaniform membrane; 6. Lungs; 7. Medial tympaniform membrane 8. Interbronchial foramen 9. Interbronchial ligament; 10. Bronchosyringeal cartilages 11. Right and left primary bronchi.

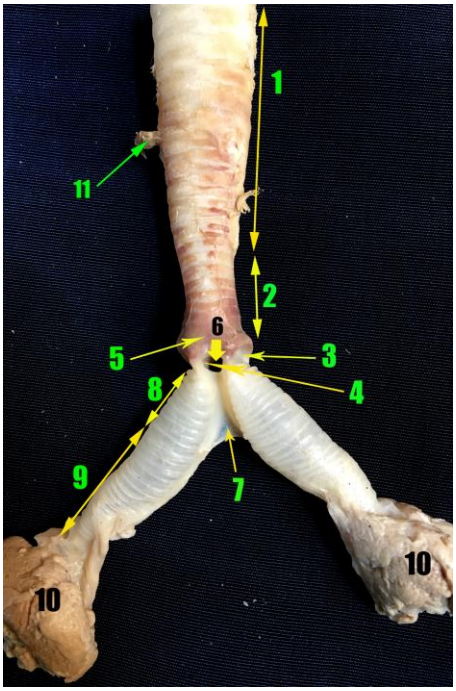

Figure 3. Ventral View of isolated fixed syrinx in the goose. 1. Trachea; 2.Tympanum; 3. Lateral tympaniform membrane; 4. . Medial tympaniform membrane; 5. Pessulus; 6. Interbronchial foramen; 7. 7. Interbronchial ligament; 8. Bronchosyringeal cartilages; 9. Right and left primary bronchi 10. Lungs; 11. Sternotracheal muscles.

Syrinx of goose had two pairs of the extrinsic syringeal muscles; the tracheolateral and the sternotracheal muscles. Tracheolateral muscles were originated from the larynx and located laterally in both sides of the lower part of the trachea. Sternotracheal muscles were originated from the interior of the sternum to insert on both sides of the trachea, cranial to the tympanum.

The syrinx had no intrinsic syringeal muscles in the goose. There was no sexual dimorphism in the gross anatomical structure of the syringes of male and female goose.

DISCUSSION

The current investigation revealed that the syrinx of the goose was tracheobronchial type simulated that reported by Al-Bishtue (2014) in guinea fowl, Frank et al. (2007) in mallard, Cevik-dermirkan et al. (2007) in quails, Kadhim et al. (2017) in black Francolin, Mohamed (2017) in white pekin ducks, Nickel et al. (1977) in hen, Onuk et al. (2010) in goose and Yildiz et al. (2003) in ostrich. On the other hand, the syrinx of song birds consists of a bronchial part, tracheal or both (Seller, 2002).

The obtained results were parallel to those described by Arican et al. (2007) in white turkey, Mohamed (2017) in white pekin ducks, Onuk et al. (2010) in goose and Yilmaz et al. (2012) in mallard that the syrinx was located inside the thoracic cavity lies between the caudal portion of the trachea and the beginning of the two primary bronchi, ventral to esophagus and at the base of the heart.

The obtained results reported that the first two cartilage rings of the tracheosyringeal cartilages were separate, while the rest of these cartilages were fused and ossified to form the tympanum, simulated that reported in goose (Onuk et al., 2010). However, the tympanum is formed by 2, 3, 4 or 5 rings in turkey, francolin, mallard and sea gulls (Kookhdan et al., 2012; Yilmaz et al., 2012; Ince et al., 2012; Kadhim et al., 2017).

It was recorded in our study that the pessulus in geese was composed of ossified tissue; the same findings were also in guinea fowl (Al-Bishtue, 2014), indigenous male turkey (AL-Mussawy, 2011), avian (Baumel et al., 1993), white pekin ducks (Mohamed, 2017), goose (Onuk et al., 2010), mallard (Yilmaz et al., 2012) and songbirds (Warner, 1972). However (Baumel et al., 1993) in oscine and Yildiz et al. (2005) in pigeon stated that the pessulus is formed by a double-folded mucous membrane. On the other hand the pessulus is absent in penguins (Tasbas et al., 1986).

The obtained results were parallel to those described in in goose (Onuk et al., 2010) that the bronchosyringeal cartilages were 6 in number, while the bronchosyringeal cartilages are 3 in guinea fowl and francolin (Al-Bishtue, 2014; Kadhim et al., 2017), 4 in turkey (Kookhdan et al., 2012), 5 in pigeon (Yildizet al., 2005) and 7 in sea gulls (Ince et al., 2012).

Our results achieved that the male goose do not have syringeal bulla, a result which was in a line with that obtained in ostriches (Yildiz et al., 2003). While König and Liebich (2001) in male anatidae and Yilmaz et al. (2012) in male mallard reported that the syringeal bulla is present.

The current work under discussion revealed that the lateral tympaniform vibrating membrane was attached between first bronchosyringeal cartilage and tympanum; similar result was recorded by Frank et al. (2007) in mallard and Yildiz et al. (2005) in pigeon. While, in sea gulls (Ince et al., 2012) this membrane was present between the first and second bronchosyringeal cartilages.

The current work under discussion revealed that the medial tympaniform membranes were attached from the caudal aspect of the pessulus up to the level of the second bronchosyringeal cartilage. Similar result was mentioned in goose (Onuk et al., 2010). While, this membrane extends up to third bronchosyringeal cartilage in mallard and ostriches (Yildiz et al., 2003; Yilmaz et al., 2012). On the other hand, Ince et al. (2012) stated that this membrane extends and up to 7th bronchosyringeal cartilages in sea gulls.

The two syringeal muscles of the syrinx of the goose were tracheolateral and sternotracheal which situated at the lateral aspects of the trachea simulated that given by Kabak et al (2007) in long-legged buzzard, Mohamed (2017) in white pekin ducks, Tasbas et al. (1994) in denizli cock, Yilmaz et al. (2012) in mallard and Yilmaz et al. (2012) in mallard. On the other hand, intrinsic syringeal muscles are found in songbirds and parrots (Larsen and Goller, 2002).

There was interbronchial foramen between bronchidesmus and pessulus, similar result was mentioned by Al-Bishtue (2014) in guinea fowl, AL-Mussawy (2011) in indigenous male turkey, Ince et al. (2012) in sea gulls, Khaksar et al. (2012) in turkey, Yilmaz et al. (2012) in mallard and Mohamed (2017) in white pekin ducks. The latter foramen was termed by Warner (1971) as the subpessular air space. Moreover, interbronchial ligament connecting the primary bronchi in the present study was similar to many birds, while Yildiz et al. (2005) reported that this ligament is absent in Bursa roller pigeon.

CONCLUSION

The anatomical structure of syringes of male and female goose was examined. The results indicated that the topographical of the syrinx was similar to the syrinx of other birds. There were some similarities and some differences of the anatomical structures of the syrinx of goose and that of other bird species. There was no marked sexual dimorphism in syringeal structure in the male and female goose.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

AUTHORS' CONTRIBUTION

The author collected the samples, carried out the research, wrote and revised the manuscript

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