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Original Research Article

ANATOMICAL STUDIES OF THE VOCAL CORD (SYRINX) OF MALE AND FEMALE CANARY (*SERINUS CANARIA*)

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ABSTRACT

The study was undertaken to investigate the gross and histological differences in the vocal organ (syrinx) of male and female canary (*Serinus canaria*). Ten (10) canary birds were used for this study (5 males and 5 females). The canary birds were sourced from surrounding villages of Zaria Local Government, Kaduna State, Nigeria. The live birds were transported to the Gross Anatomy Laboratory in the Department of Veterinary Anatomy Ahmadu Bello University Zaria. Each bird was euthanized using 100mg/kg sodium pentobarbitone injection intraperitoneally. A pair of scissors and scalpel blade was used to gently expose the syrinx following an incision on the lateral muscles of the neck. The syrinx was extracted and preserved in 10% formalin for histological evaluations. Grossly, the syrinx of canary birds is located at the bifurcation of the trachea as a bulge-like structure in both males and females. Male canary has a more prominent and massive syrinx with more trachea rings than their female counterparts. Histologically, male canary birds have more syringeal cartilages made of hyaline cartilage with definite roundish shape than their female counter parts. Prominent syringeal muscles were observed in male than female. In conclusion, the complexity of the syrinx of male canaries confers them a louder vocal sound (beautiful melody) which is deployed during courtship with female canary and also used as an armory against other males when courtship and mating has occurred.

Keywords: Canary, Syrinx, Syringeal cartilage, Syringeal muscle, Vocal cord.

INTRODUCTION

Canary birds belong to the family Fringillidae, order Passeriformes and class aves (Linnaeus 1758). Their generic name is *Serinus* with species *canaria* sub species *domestica* (Hawley *et al.,* 2011). They are the largest order of birds characterized by production of beautiful songs that inspires poets (Cornelia & Stefan, 2008). They constitute 50-60% of bird species in the world and contain about 35 species and 55 families with most caged birds belonging to these groups (Catchpole & Slatter, 2003). Canary birds have been extensively used in research to study neurogenesis in adult brain and the mechanism of song production in birds (Fernando, 2017). Many songbirds produce beautiful songs; however, not all songbirds produce pleasant-songs such as crows. Some well-known songbirds include: Canaries, Cardinals, Robins, Black birds, Blue birds, Nightingales, Sparrows, Finches, Larks, Swallows and Thrushes (Suthers, 2004). All song birds have well-developed vocal organ called Syrinx, Anisodactyl foot structure, Three unwebbed toes pointed cranially and One (hallux) pointed caudally (Suthers, 2004). Songbirds range in size from tiny kinglets and sunbirds to comparatively large crows (land birds) that live in a wide variety of habitats, ranging from open grassland to desert areas (Allyson *et al.*, 2015). In songbirds, males and females may have distinctly different brain structures, specifically in areas involved in the production of

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song. In many songbirds, males sing while females do not (or sing very little) (Eliot & Michael, 2005). The ability to sing is controlled by six different clusters of neurons (nuclei) in the avian brain. In male songbirds these nuclei can be several times larger than the corresponding cluster of neurons in females. In some species (e.g. Zebra finches), female may lack one of these regions (area X) entirely (Eliot & Michael, 2005).

The syrinx which is the voice producing structure in song birds may be located at the bifurcation of the trachea in to the two bronchi, or entirely in the trachea or bronchi (Suthers, 2001). It has a firm bony framework consisting of film-like vibrating internal membranes over which the exhaled air passes rapidly, producing all the many utterances of the birds therefore, and making it the most important organ in the bird sound production mechanism (Fernando, 2017). There are three types of Syrinx (namely: tracheal, bronchial and tracheobronchial) based on their positions (Yildiz *et al.,* 2003). Syringeal muscles are of both intrinsic and extrinsic origin (Iris & Coen, 2020). The major function of syrinx is vocalization; however, the syrinx probably helps to minimize the collapse or compression of the exchange tissue and the pulmonary airways during expiration by having a valve-like action at the beginning of expiration. The possible gross and histological differences in the vocal organ (syrinx) of male and female canary will add to the existing data on vocal dynamism of male and female canary which may help elucidate certain behavioural activities of the male canary in particular and male and female canary in general. Thus, the study was aimed at describing the anatomy of the syrinx in the male and female canary birds and comparing the findings for any possible sexual dimorphism.

MATERIALS AND METHODS

EXPERIMENTAL ANIMALS

Ten (10) canary birds (5 males and 5 females) were sourced from surrounding villages of Zaria Local Government, Kaduna State, Nigeria. They were transported live in standard laboratory cages to the Gross Anatomy laboratory in the Department of Veterinary Anatomy Ahmadu Bello University, Zaria.

EXTRACTION OF SYRINX

Each canary bird was euthanized by administering 100mg/kg sodium pentobarbitone injection intraperitoneally (Bryony *et al.,* 1997). The bird was then placed on dorsal recumbency, the filoplume around the neck was carefully pluck and the skin exposed. A pair of scissors and scalpel blade was used to carefully incise the lateral muscles of the neck, thereby exposing the trachea with the syrinx at the bifurcation. The exposed syrinx was carefully extracted. Photographs were taken using canon digital camera power shot (SX170 IS) with 64-megapixel sensor. Histological pictures were taken using light microscope (Amscope, T120B) and a digital microscope camera (DCM 510 megapixel, ScopePhoto® China) at ˣ40, ˣ100, ˣ250, ˣ400.

HISTOLOGICAL EVALUATION

The extracted syrinx was fixed in 10% formalin for 24hour, dehydrated through series of ascending concentrations of ethanol (70%, 80%, 95%, and 100%) for 30 minutes, 2hrs, 2hrs and 2hrs respectively at room temperature. Cleared in xylene, embedded in paraffin wax and sectioned at 5µm. Haematoxylin & Eosin stain was used for general histological evaluation (Kiernan, 2007).

ETHICAL STATEMENT: The experimental procedures were approved by the Institutional Animal Ethics Committee of Ahmadu Bello University Zaria-Nigeria with an approval number ABUAUC/2020/014.

RESULTS

GROSS OBSERVATIONS: The syrinx in both male and female was located at the ventrolateral aspect of the trachea close to its bifurcation as a bulge-like structure. The trachea was caudally separated into left and right primary bronchi which also ran into the left and right lungs respectively (Figure I and II). The laryngeal mound appeared as a prominent elevation opening into the larynx at the base of the tongue (Figure I). The trachea was 7cm long in both sexes and began at the level of the larynx consisting of tracheal cartilages and muscles and terminates at its bifurcation into the bronchi (Figure I and II). Male canary had a larger and more distinct syrinx by subjective visual observation compare to their female counterparts (Figure I). There are more trachea rings in male canaries than females.

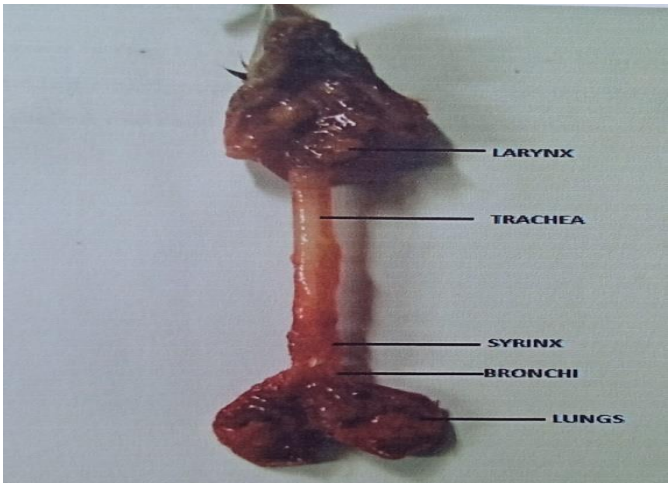

Figure I: Gross picture of the respiratory system of male canary showing a well-developed syrinx at the bifurcation of the trachea into the bronchi which leads to the left and right lungs respectively. The trachea showed numerous cartilaginous rings.

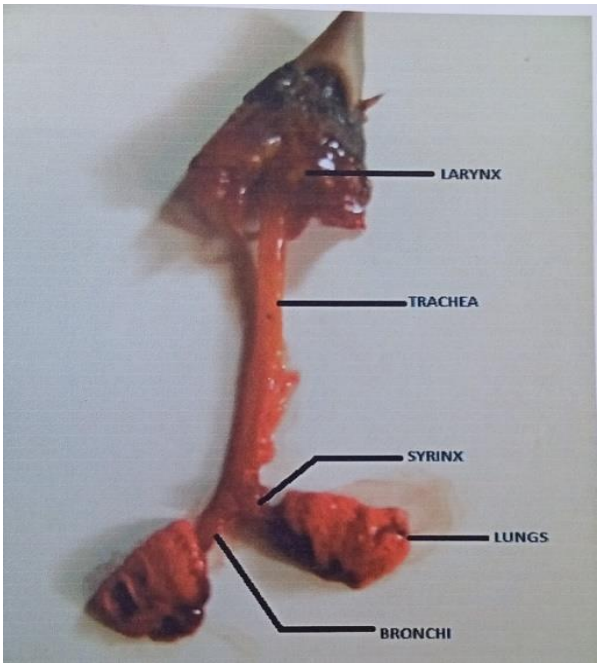

Figure II: Gross picture of the respiratory system of female canary showing the syrinx at the bifurcation of the trachea into bronchi which leads to the left and right lungs respectively. The trachea showed fewer rings.

HISTOLOGICAL OBSERVATIONS

The syrinx of male canary birds contained more syringeal cartilages made of hyaline cartilage compare to their female counterpart (Figure III). The luminal surface of the syrinx of male canaries contained numerous mucosae compared to those of females (Figure V). Female canaries had poorly developed tunica adventitia with fewer syringeal cartilage compare to their male counterparts (Figure VI).

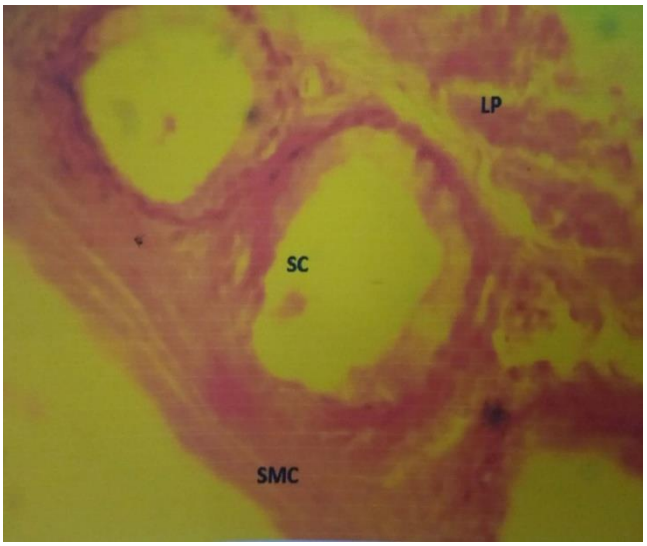

Figure III: Photomicrograph of the syrinx of male canary showing the syringeal cartilage (SC), Syringeal mucosa (SMC) and the lamina propria (LP). H&E X400.

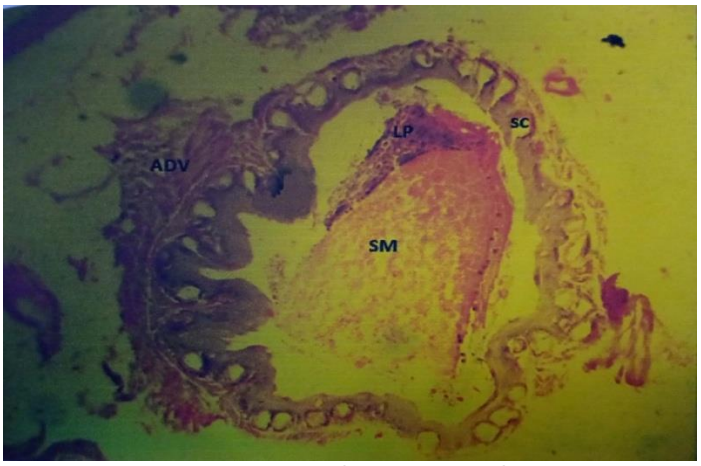

Figure IV: Photomicrograph of the syrinx of male canary showing well-developed syringeal muscles (SM), Syringeal cartilage (SC), tunica adventitia (ADV) and the lamina propria (LP). H&E X40.

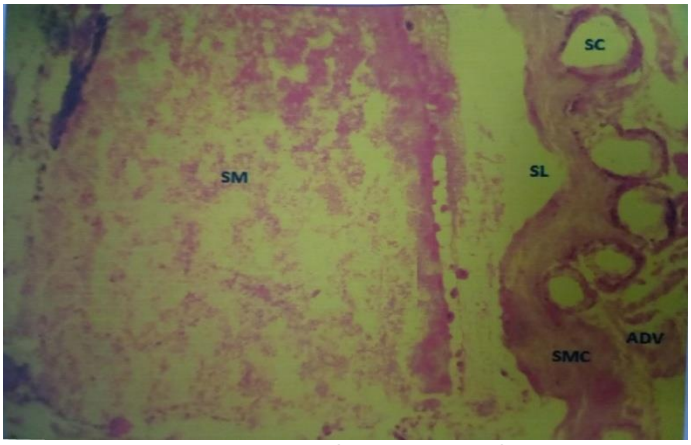

Figure V: Photomicrograph of the syrinx of male canary showing well-developed syringeal muscles (SM), Syringeal cartilage (SC), tunica adventitia (ADV), numerous syringeal mucosa (SMC) and the syringeal lumen (SL). H&E X100.

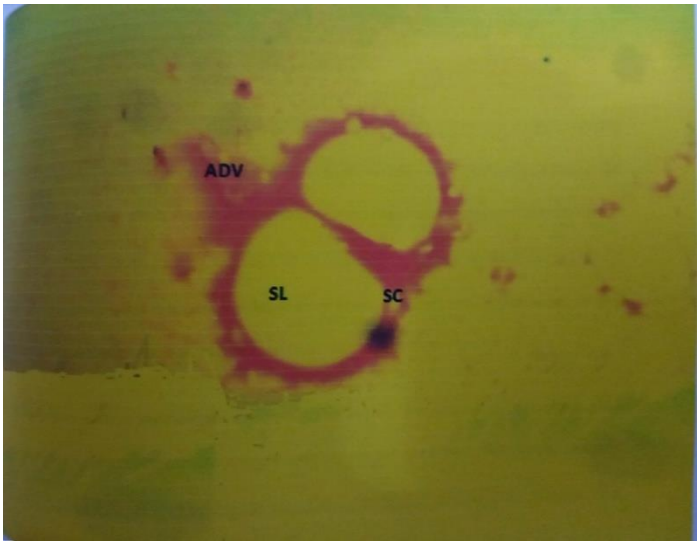

Figure VI: Photomicrograph of the syrinx of female canary showing the syringeal cartilage (SC), tunica adventitia (ADV) and the syringeal lumen (SL). H&E X40.

DISCUSSION

The syrinx (vocal cord) is the sound producing organ in song birds (Yildiz *et al.*, 2003). In male canary, the syrinx is often well developed and prominent than those seen in female canaries; this is similar to the findings of Burke *et al.* (2007) who reported a well-developed syrinx in the respiratory system of quails (*Cornixcornix japonica*). Male canaries were observed to have more syringeal rings compare to the female counterpart; this might contribute to the ability of male canaries to produce longer and high intensity sounds, this is similar to the findings of Myers (1917) who reported that male aquatic ducks have well developed tympanum which projects beyond the trachea wall compare to their female counterparts. Male canary birds also have well-developed syringeal cartilages made of hyaline cartilage, while, their female counterparts have poorly developed syringeal cartilages; this confers the syrinx of male canaries a better flexibility during sound production, this is in agreement with the findings of Ames (1971) who reported a well-developed syrinx in male ducks which allow for better sound production than female ducks. The syrinx of male canaries showed well-developed syringeal muscles compared to those of female canaries, this may be because male canaries produce longer and high intensity songs which is often helpful during sex determination. This is in agreement with the findings of Burke *et al.* (2007), who reported that male quails have well-developed syringeal muscles which confers better sound production ability in the males than in their female counterpart.

CONCLUSION

The size and shape of the syrinx influence the quality of sound production. Thus, male canary birds produce better sound than their female counterpart due to the presence of prominent syrinx which is characterized by well-developed syringeal cartilages and muscles.

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CONFLICT OF INTEREST: No conflict of interest.

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