Macro anatomy of the organs of digestive and respiratory system of an adult male stork-billed Kingfisher (*Pelargopsis capensis*)

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Abstract

Kingfishers are good hunters of fish from ponds, rivers, canals, and from other wetlands. Kingfisher species are found in the oriental region and their scarcity in the New World and Palaearctic region denotes that little attention has been paid to ornithologists in this regard. Therefore, the purpose of this particular study was to describe the macro anatomical features of the organs of the digestive and respiratory systems of stork billed kingfisher and to compare them with domestic birds. This study showed that the beak was heavier and strong. The tongue showed a blunt apex with a central depression. The esophagus was a long thin-walled dilatable tube without any crop. Instead of the crop, it has the dilatation of the esophagus near the thoracic inlet. Gizzard was comparatively softer in consistency and jejunum was coiled in shape. Interestingly, there was no caecum and the colorectum was shorter in length. Considering the respiratory system,thelungs were longer in size harboring impressions of seven ribs. At the bifurcation of the trachea, there was a laterally compressed structure called the syrinx, similar to domestic chicken. All these anatomical modifications might be due to their environmental adaptation. Thus, this research will broadly help our clinicians and conservationist to take further steps toward disease diagnosis and monitoring the conservation of this species.

Keywords: Kingfisher, intestine, gizzard, syrinx, lung

Chapter 1

Introduction

Stork-billed Kingfisher (*Pelargopsis capensis*) is a rare resident bird in Bangladesh (Khan, 1982), and it is widely dispersed in India, Nepal, Myanmar, Thailand, and Indonesia. The species is usually found in all well-watered areas and is also common on wires of railroad tracks. It can also be found in marshy glades, mangroves, pools of the forest, and also in coastal creeks (Ali, 1996; Ali and Ripley, 1970). The stork-billed kingfisher species depend on five kinds of habitat such as lake, pond, stream, agricultural land, and forest, among which forests reside 43.23% of stork-billedkingfishers, and agricultural lands/channels reside 3.76% of stork-billed kingfisher (Kumar, 2016). It is categorized as Least Concern globally (IUCN, 2014:1) and Not Threatened in Bangladesh (IUCN-Bangladesh, 2000). Ecologists have seen a reduction in the populations of some species that are unique to the tropical Pacific Ocean and Southeast Asia and the islands (Montgomery, 2022). Due to their preferred habitat and feeding habits, kingfishers play an important role in the ecosystem. As they survive on small aquatic animals which are greatly affected by toxins in the water. Therefore, a strong kingfisher population typically indicates a healthy ecosystem. Nevertheless, very little research has been conducted on this species.

The stork-billed kingfisher is distinguished by its great size, blue wings, and large blood-red dagger-shaped beak (Ali, 1996; Ali and Ripley, 1970; Islam and Kamruzzaman, 2008) (Fig 1). The sexes are nearly identical, and the head is dark grayish brown (Ali and Ripley, 1970). The body is around 38 cm long, the wing is 15.7 cm long, the bill is 9 cm long, and the tail is almost 10 cm long (Ali and Ripley, 1970). The primary flight feathers are a richer blue, standing out against the light blue tail, and the bird has a light brown helmet, blue-green wings, coral-red feet, and dusky claws (Ali and Ripley, 1970; Islam and Kamruzzaman, 2008). The male members of the pied kingfisher are typically differentiated from the females by

having a double, complete, and black band-like structure in the region of their chests, but both sexes of the stork-billed kingfisher are nearly physically identical. The female resembles the male except that the lower mandible is orange-red with a black tip. The young have greener upper parts and paler underparts than the adult. Its beak is black, and its legs are initially black as well. they are mostly fish-eaters, the stork-billed kingfisher consumes a variety of foods including fish, frogs, lizards, young birds, and mice (Fry, 2000). The species also occasionally consumes water beetles, crabs, and other controllable prey (Ali, 1996).

They are susceptible to habitat loss from pollution or careless management of watercourses, and other threats. Kingfishers have a poor conservation status, which led to their inclusion on the Amber List. Relatively little research has been conducted concerning the anatomy of the viscera of the Kingfisher. Recently an adult male stork-billed kingfisher has enabled us, for the first time, to report the anatomical description of the organs of the digestive and respiratory system with the similarities and dissimilarities of the organs with the domestic birds. This may help better understand the physiological and pathological condition of this species.

Objectives

- To explore the anatomical features that are unique to the species and similarities with other avian species.
- To create a baseline study for future research on the pathological condition of the species which may help in the conservation of this species.

Chapter 2

Materials and Methods

Recently, a kingfisher was found dead in a jungle near DC hill of the Chattogram metropolitan area. Then it was wrapped in a polythene bag and brought to the Chattogram Veterinary and Animal Sciences University (CVASU) through an ice box on the same day. The expert postmortem team examined the kingfisher and found a clean body surface with some rough feathers in various body regions. It was 35 cm in length. It was identified as a stork-billed kingfisher by the characteristic features of the bird such as buff underparts and a rich green-blue upper portion, blue wings and tail, and a rump of paler blue with a big scarlet bill (Stavenga et al., 2011). Moreover, it was identified as a male bird by observing the testicles during dissection. The cause of death was unknown. No pathognomonic lesions were found after postmortem examination.

2.2 Sample Collection and biometry: Standard protocol was followed for the postmortem examination of the dead bird. Biometry of the different organs was performed in situ and ex-situ using a measuring tape.

Chapter 3

Results

3.0 External morphology

The bird had greenish wings and tail, and dark olive-brown head, a [light brown colored neck, and underparts with a large scarlet bill and legs were bright red, rich green-blue upper portion, bluer wings and tail, and the rump was cyan. The upper beak was 7 cm long, the lower beak was 8 cm. From point of beak to tip of the tail, the length was 45 cm. From point of the beak to the base of the tail, the length was 25 cm. The tail length was 10 cm. The head diameter was 10.5 cm. The wing length was 23 cm for both the right and left wings. In both legs, the 1st digit had a single phalanx, 2nd digit had 2 phalanges, 3rd digit had 3 phalanges and the 4th one had 4 phalanges.

Figure 1: External morphology of a stork-billed Kingfisher. a) upper beak, b) lower beak, c) light brown colored neck, d) wing of cyan in color.

3.1 Anatomy of the viscera

3.1.1 Digestive system: Total visceral mass of the digestive system was 12.15 gm.

Tongue: The tongue had a blunt apex. The apex was concave lightly. It was 1.5 cm in length and 1 cm in width.

Esophagus: The proventriculus and oropharynx are connected by a long, elastic thin-walled tube called the esophagus. It was located dorsally on the right side of the neck to the trachea. The length of the esophagus was 8 cm.

Proventriculus and gizzard: The proventriculus was 1.8 cm in length. The gizzard was 2.5 cm in length and 2 cm in width with soft consistency.

Crop: Crop was absent. But, there was dilatation of the esophagus near the thoracic inlet.

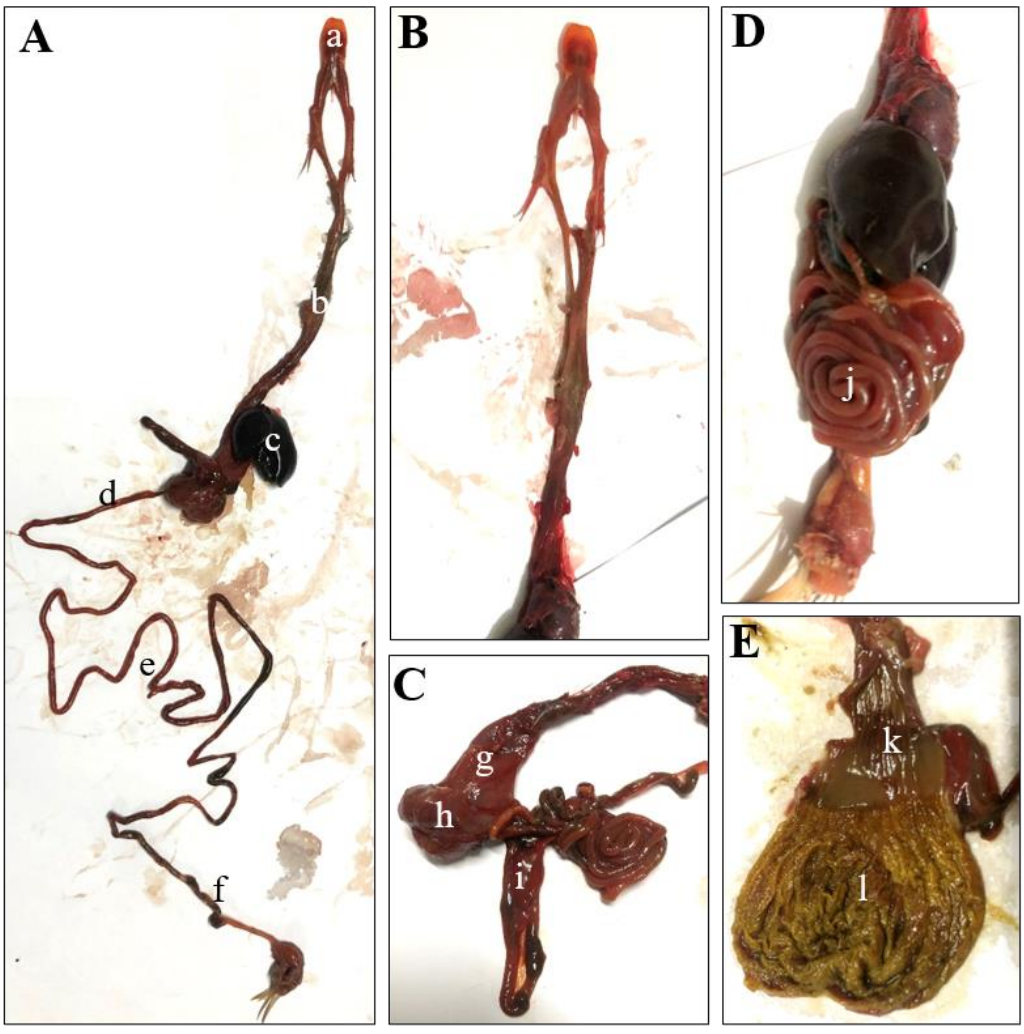

Fig. 2: A) The digestive system of a stork-billed Kingfisher, (a) tongue, (b) esophagus, (c) liver, (d) duodenum (e) jejunum, (f) colorectum B) Tongue and oesophagus (C) Proventriculus (g), gizzard (h) and loop of duodenum containing pancreas (f) D) Liver and coiled intestine (j). E) Internal feature of the proventriculus (k) and gizzard (l)

Small intestine: The small intestine consisted of the duodenum, jejunum, and ileum. The length of the duodenum was 8 cm, the jejunum was coiled and 46 cm long. The ileum was 8 cm long. Duodenum had ascending and descending part containing the pancreas.

Large intestine: The large intestine consisted of an approximately 7 cm long colorectum where the caecum was absent. Thus the junction between small and large intestine was indistinct.

Liver: The liver along with gall bladder weighed 3.23 grams. The liver consisted of 2 lobes. The right lobe is bigger than the left lobe.

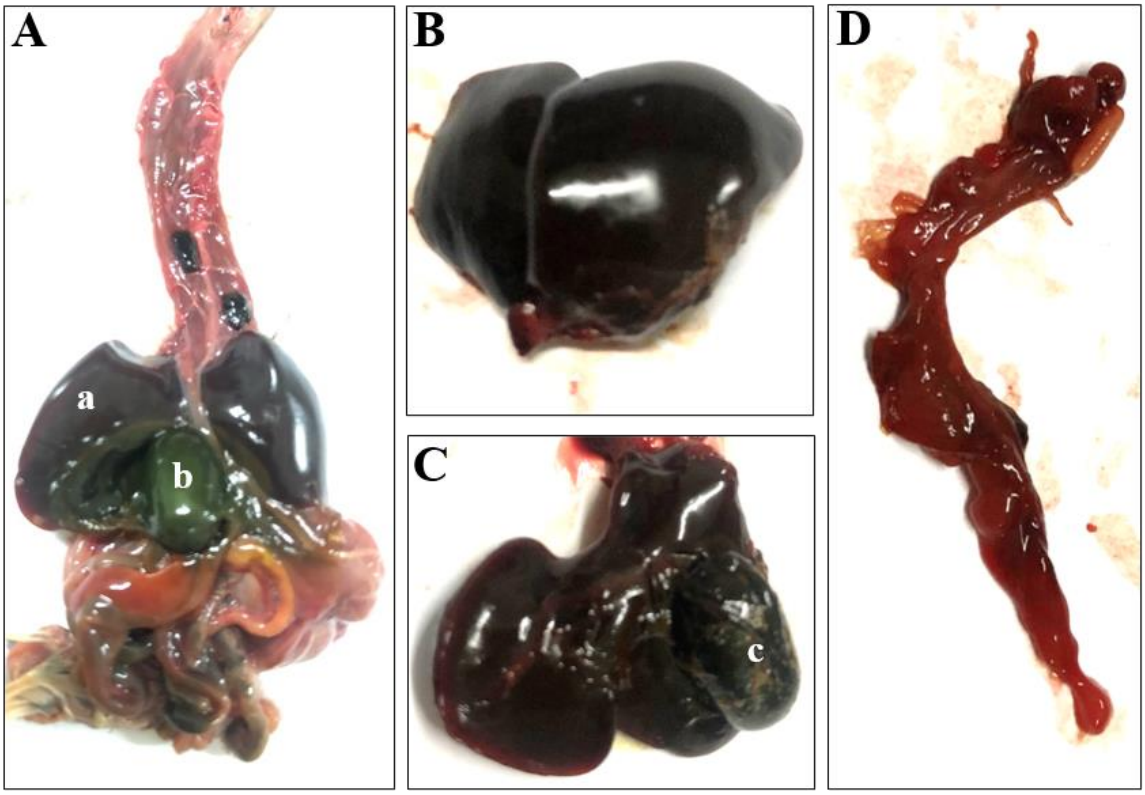

Fig. 3: A) The accessory digestive organs of a stork-billed Kingfisher, (a) liver, (b) gall bladder. B) Parietal surface of the liver, (c) gall bladder (C) Visceral surface of the liver with gall bladder D) Pancreas

Gall bladder: The gall bladder was located beneath the right lobe of liver. It was oval shaped or pear shaped.

Pancreas: It was 1.2 cm in length and 0.6 cm in width. The length of the pancreas continued up to half of duodenal loop.

Spleen: The spleen was elongated. It was 4 cm in length and the weight was 0.15 g.

3.1.2 Respiratory system

Lungs: The weight of the lungs with the trachea was 2.27 g. The length of the lungs was 2.8 cm and the width was 1.3 cm at the mid position. Among the 8 (T1 to T8), 7 ribs made impressions on the dorsal surface of each lung.

Trachea: The trachea with syrinx was 7 cm long. The syrinx consisted of soft tissue (muscles, connective tissue, nerves, and blood vessels) and cartilages at the bifurcation of the trachea. The length of the primary bronchus was 0.9 cm.

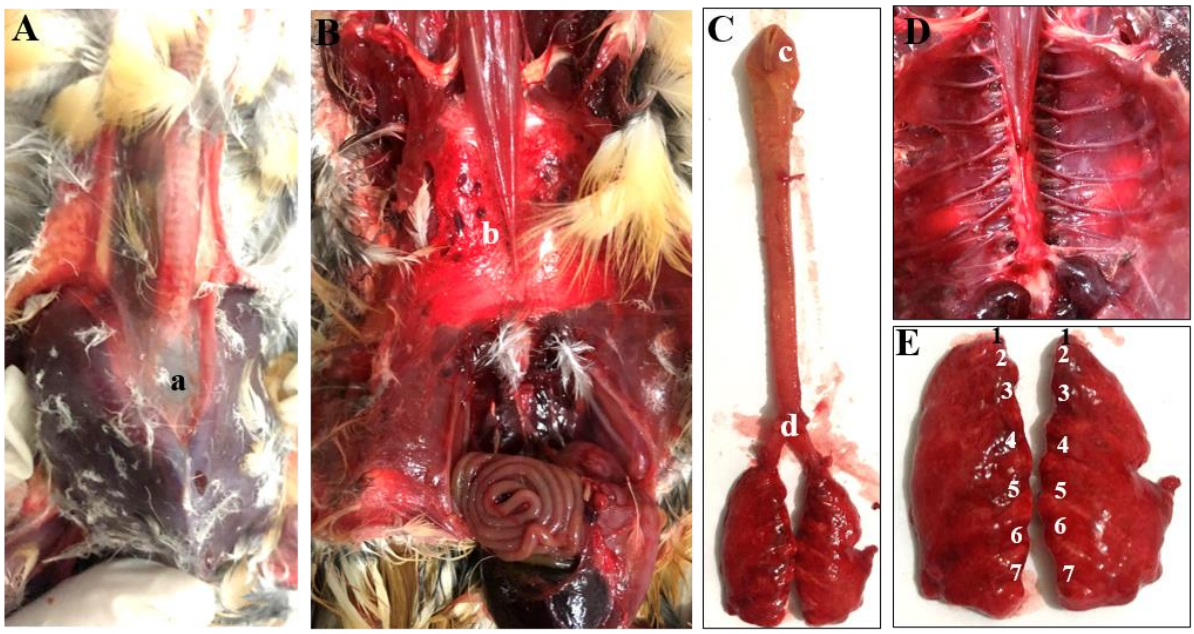

Fig. 4: Organs of the respiratory system of a stork-billed Kingfisher. A) Interclavicular air sac, (a) B) Lungs, (b) *in situ.* C)Trachea with lungs, (c) larynx, (d) syrinx D) Thoracic cage with ribs E) Lungs with rib marks (1-7).

Chapter 4

Discussion

The structure of the different organs of the kingfisher indicates some similarities and dissimilarities with other avian species. The male and female stork-billed kingfishers were almost similar morphologically. Though there is no size difference in both sexes of pied kingfisher, the male members can usually be distinguished from the females by having a double, complete, and black band-like structure in the chest region. In addition, the female pied kingfishers contain a single, broken transversely band-like structure in their chest (Islam and Kamruzzaman, 2008). In case of the small intestine of the kingfisher, it was coiled in structure which is not seen in the case of chicken. (Marchewka et al., 2021). Both ceca are absent in the Piciformes (most woodpeckers), Apodiformes (hummingbirds and swifts) Corcaciiformes (Kingfishers, hornbills, the hoopoe), Columbiformes (pigeons), Coliiformes (mousebirds), Cuculiformes, Psittaciformes, parrotlets (McLelland, 1989). Avian caecum plays an important function in the prevention of colonization of pathogen, eliminating toxic compounds, digesting nutrients, and absorbing ingested nutrients (Tan et al., 2019) but caecum was absent in the kingfisher. As the kingfisher mostly rely on aquatic species for feeding, it may have a little importance of cecum for fiber digestion. Thus it may lack cecum in its digestive system. Similar to the gall bladder of other avian species, the gall bladder of the kingfisher was also pear-shaped.

The tongue of kingfisher had blunt apex which was concave lightly but the tongue of domestic turkey is triangular in shape and is merged by a lingual frenulum to the surface of beak cavity (KingaSkieresz-Szewczyk et al., 2021). The esophagus of the kingfisher was long, elastic and located dorsally on the right side of the neck to the trachea similar to the esophagi of other avian species (Mobini, 2022). The length of the esophagus was 8 cm whereas the

length of a broiler chicken is 18.8±4 cm (Kokoszyński,2017). The gizzard of chicken is keratinous and horny (Nasrin and Siddiqi, 2012) but the gizzard of kingfisher appeared to be soft in consistency. In avian species, the most important function of the crop is the storage of ingested feed (Bolton ,1965) along with absorptive and digestive capability but the crop in kingfisher was absent. In case of the small intestine of the kingfisher, the length is 62 cm but in case of chicken average length of the small intestine is 140.1 cm (Marchewka et al., 2021). The average of liver weight was 8.09±1.05 g and 35.05±7.15 g respectively in layer and broiler chicken (Karthika et al., 2019) and in the kingfisher, the weight of the liver was 3.23 grams. Similar to the gall bladder of other avian species, the gall bladder of the kingfisher was also pear shaped. The pancreas of the kingfisher also located within a loop of the duodenum similar to other avian species (Klasing, 2006). In case of chicken, the spleen. Similar to the syrinx of other birds, the kingfisher also possessed syrinx which control labial tension and air flow (Riede and Goller, 2010).

Conclusion

For the first time, we described the anatomical features of the organs of the digestive and respiratory systems of a male stork-billed kingfisher. This study could be used as a basis for research on the pathophysiology of this species. Moreover, this data may contribute to a better understanding of the postmortem examination and disease diagnosis and thus improve the strategies for the conservation of this species.

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