Original Contribution

GROSS ANATOMY OF SOME DIGESTIVE ORGANS OF THE DOMESTIC CANARY (*SERINUS CANARIA*)

H. Hristov*, D. Vladova, D. Kostov, R. Dimitrov

Department of Veterinary Anatomy, Histology and Embryology, Faculty of Veterinary Medicine, Trakia University, Stara Zagora, Bulgaria

ABSTRACT

PURPOSE: The domestic canary (*Serinus canaria*) is a widely spread representative of the largest avian order *Passeriformis*. The increased interest to canaries as pets, the scarce anatomical data and the frequently encountered digestive tract pathology are the motives of the present study.

The purpose of the research was to investigate the normal anatomy and topography of some digestive organs of the domestic canary.

MATERIALS AND METHODS: The corpses of 12 canaries at 2 years of age were investigated. The bodies were divided into 2 groups of 6 birds each. The birds from group I were dissected and anatomo-topographic features of some digestive organs were examined *in situ*. The obtained data were used in bodies from group II for determination of percutaneous anatomic projections of the gizzard, duodenum, ileum and the liver. The sternal margo caudalis, last pair of ribs and os pubis were used as bone markers for more precise projections. After determination of percutaneous projections of organs, the bodies of canaries from group II were subjected to dissection for comparison of anatomical findings.

RESULTS: The anatomo-topographic features of some digestive organs of the domestic canary and associated normal anatomic percutaneous projections were determined and documented.

CONCLUSION: The results could serve for macroscopic *in vivo* and pathoanatomical diagnostic studies, as well as for prophylaxis of digestive organs' illnesses.

Key words: anatomy, domestic canary, digestive tract

INTRODUCTION

The domestic canary (*Serinus canaria*) is a widely spread member of the largest avian order – *Passeriformis* (1). The domestication of the canary dates back to the 15th century, while its common rearing in Europe as a pet – to 17th century (2). Nott et al. (2) reported that canaries comprise 15-20% of caged birds in North Europe. In South Europe, canaries are more prevalent, and in France, their number accounts for 46% of companion birds (3).

On the basis of literature reports, the rearing of canaries as pets is often accompanied by pathological states in some digestive organs – stomach, small intestine and liver (4-9). Pathological changes in these organs result in *in vivo* disorders of the normal anatomical relationships of organs, manifested with

various extent of displacement of their anatomo-topographic boundaries.

With this respect, digestive tract pathology requires precise anatomical data that could be reliably used in ante- and post mortem diagnostics.

Digestive tract anatomy of different avian species – carnivore, fish-eating, herbivore etc. is extensively studied (10-17). It should be noted that the anatomic features of the digestive tract of the canary (which feeds on grain) are incomplete and should not be interpolated. Also, according to available literature data, the information for the anatomo-topographic location of digestive organs and their relationships in canaries is scarce and contradictory, which undoubtedly narrows the diagnostic potential.

The frequent occurrence of pathological states and the few anatomical data that could be of

*Correspondence to: Hristo Hristov, Department of Veterinary Anatomy, Histology and Embryology, Faculty of Veterinary Medicine, Trakia University, 6000 Stara Zagora, BULGARIA, e-mail: klokkende@abv.bg

use to clinical diagnostic practice were the reasons for performing the present study.

The purpose of the research was to investigate the normal anatomy and topography of some digestive organs of the domestic canary.

MATERIALS AND METHODS

Twelve clinically healthy domestic canaries at the age of 2 years were euthanised according to Appendix No 4 to art. 22, point 1 of Ordinance 20/01.11.2012 stipulating the minimum requirements for protection and humane attitude to experimental animals and facilities for their use, rearing and/or delivery. The experimentation protocol was compliant to permit No 123 issued by BFSA.

The bodies were divided into 2 groups of 6 birds each. The birds from group I were dissected and anatomic-topographic features of some digestive organs were examined *in situ*. The obtained data were used in bodies from group II for determination of percutaneous anatomic projections of the gizzard, duodenum, ileum and the liver. The sternal margo caudalis, last pair of ribs and os pubis were used as bone markers for more precise projections. After determination of percutaneous projections of organs, the bodies of canaries from group II were subjected to dissection for comparison of anatomical findings.

Dissection was performed after fixation of bodies on a sheet of 1 mm square graph paper. The results were documented with camera NIKON Coolpix S500 (Japan).

RESULTS

Ventral dissection inspection with preserved sternum

The *in situ* macroscopic anatomical finding demonstrated that the cranioventral half of the left abdominal part of the body cavity was occupied by gastric pars muscularis. Anatomic-topographically pars muscularis had a biconvex shape and lied from the left side on the soft abdominal wall, posterior to sternal margo caudalis and in the angle between os pubis and the last rib (**Figure 1**).

The duodenum was located on the right side of the median plane. Both duodenal parts: pars descendens and pars ascendens formed a U-shaped arc (ansa duodenalis), in which the dorsal surface was concave. Ansa duodenalis, together with the pancreas situated within, lied straight on the right soft abdominal wall and attained the cloaca.

Between the duodenal pars descendens and the right ventricular surface, a segment of the ileum could be observed; its course was parallel to the duodenum and lied on the midline, directly on the ventral soft abdominal wall. From normal anatomy point of view, the caudal margin of the liver was delineated by sternal margo caudalis.

Figure 1. Ventral dissection inspection of the canary's body cavity with preserved sternum. Carina sterni (CS), margo caudalis of the sternum (arrows), pars muscularis of the stomach (V), duodenum (D), os pubis (P), ileum (*), cloaca (C)

Ventral dissection inspection with removed sternum

After removal of the sternum, the liver was visualised in the caudoventral thoracic part of the body cavity and proximally, attained the

transverse plane drawn through the 3rd pair of ribs (**Figure 2**). The organ was divided into two lobes – larger right and smaller left. The heart was inserted cranially between the two hepatic lobes. *In situ*, lobus sinister lied

ventrally to the proventriculus. After dissection and lifting of the lobe, the initial part of proventriculus gastris was revealed – it began at the midline of the base of the heart, at 4-6 mm distance posterior to the tracheal bifurcation. The proventriculus was observed between ribs III–VII, it had a cone shape and

longitudinal axis directed caudally to the left, touching the rib wall at the last three ribs. Dorsolaterally, in the angle outlined by the left ventricular wall and the transverse plane through apex pubis of both pubic bones, the caeca were identified. The rectum was directed caudomedially and ended blindly in the cloaca.

Figure 2. Ventral dissection inspection of the canary's body cavity with removed sternum. Heart (Cr), left hepatic lobe (HS), right hepatic lobe (HD), proventriculus gastris (PV), ventriculus gastris (V), duodenum (*), pancreas (P), ileum (I); cecum (c), rectum (R), cloaca (Cl), right side marker (D)

Left lateral dissection inspection with preserved sternum

At the level of the last rib, the gastric pars glandularis passed into a distinct intermediate part and terminated in ventriculus gastris. This finding was well visible in dissection with left ventrolateral inspection of the body cavity (**Figure 3**). This approach revealed additional possibilities for anatomical inspection of the gizzard and adjacent organs. The left and ventral surfaces of pars muscularis touched the soft abdominal wall. Dorsomedially, the ventriculus was adjacent to the jejunum and the distal part of the ileum, while cranioventrally – to the left hepatic lobe and the spleen. Dorsally to the ventricular wall were located the left kidney and the left testis with adjoined spermatic cord (in males) and the left ovary and oviduct (in females). Left ventrolateral inspection detected only few segments of the jejunum without distinct delineation of the loops along its length.

Right lateral dissection inspection with preserved sternum

The jejunum loops were well visualised during the right lateral dissection (**Figure 4**). Normally, the jejunum formed a helix with the shape of a wide-based cone, whose apex was situated at 3-4 mm behind the last right rib. The jejunum occupied the right dorsal caudal part of the common body cavity and dorsally passed partially on the left to ventriculus gastris. Dorsally, the jejunum touched the two kidneys, and in male canaries – the right testis and the adjoined spermatic cord. Craniodorsally, the jejunal helix touched the right lung, cranioventrally – the right lobe of the liver and on the right side – the last ribs and the soft abdominal wall. Ventrally from the right, the helix lied on the concave dorsal surface of ansa duodenalis with the embedded pancreas. Thus positioned, the jejunal helix covered only the right surface of ventriculus gastris and permitting just a limited area of its ventral surface to touch directly the soft abdominal wall.

Figure 3. Left lateral dissection inspection of the canary's body cavity with preserved sternum. Carina sterni (CS), margo caudalis of the sternum (MC), liver (H), rib (r), proventriculus gastris (PV arrow), ventriculus (V), duodenum (D), jejunum (J), ileum (*), cecum (c), rectum (R), cloaca (Cl)

Anatomo-topographically, the right hepatic lobe, unlike the left one, did not touch pars muscularis of the stomach and caudally attained the transverse plane through the

penultimate rib. The anatomical position of the right lobe of the liver was intimately close to the cranial parts of the duodenal arc and the pancreas.

Figure 4. Right lateral dissection inspection of the canary's body cavity with preserved sternum. Carina sterni (CS), margo caudalis of the sternum (MC), liver (H), lung (Pu), rib (r), pars ascendens of the duodenum (Da), pars descendens of the duodenum (Dd), pancreas (P), jejunum (J), cloaca (C)

Percutaneous anatomic projections of some digestive tract organs

The percutaneous anatomical projection of ansa duodenalis, along with the pancreas, was presented on the right half of the soft abdominal wall, comprising and filling the space between the median plane, sternal margo caudalis, the last rib, os pubis dextra and the cloaca (**Figure 5**).

Ventriculus gastric was projected on the left side of the soft abdominal wall, posterior to the

sternal margo caudalis and between the planes through apex pubis and the last rib.

A part of the ileum was outlined on the midline of the soft abdominal wall, between ansa duodenalis and the right ventriculus surface, keeping its median course backward to the cloacal area.

Normally, the liver was not projected on the soft abdominal wall. The organ remained covered by the sternum, and its caudal margin was marked by the transverse plane through margo caudalis sterni.

Figure 5. Anatomical projections of some digestive organs on the ventral soft wall of the canary's body cavity. Carina sterni (CS), margo caudalis of the sternum (arrows), ventriculus gastris (V), ansa duodenalis and pancreas (D), os pubis (P), ileum (*), cloaca (C)

DISCUSSION

The available literature data on digestive tract organs in domestic and some wild bird species indicate that the gastric pars proventricularis has a fusiform shape, while pars muscularis – predominantly biconvex (11, 18-23). Our results showed that in domestic canaries, similarly to other bird species, pars muscularis had a biconvex shape while pars proventricularis was cone-shaped in contrast to what is generally acknowledged. Also, our results evidenced that the canary proventriculus touched the rib wall and was located between ribs III-VII. These facts add to the description given by Gadzhev (18), who defined the planes between the 4th and 7th thoracic vertebrae as topographic margins for chicken proventriculus.

As in some domestic bird species, the dorsal surface of canary's pars glandularis touched the liver lobus sinister but not the caeca. According to our results, caeca of *Serinus canaria* were highly rudimentary and lied dorsocaudally in the body cavity, in the angle formed by the left ventricular wall and the transverse plane through apex pubis.

Gadzhev (18) described that pars muscularis of gallinaceous birds had a caudoventrally inclined longitudinal axis with anatomical position between T7 and the 12th lumbosacral vertebra. A similar caudoventral slope of pars muscularis was observed in the current study, demonstrating a certain anatomical similarity of *Serinus canaria* with domestic and some wild avian species (23). Unlike falcons, the

ventral surface of the proventriculus in canaries did not touch the sternum, while the liver remained inserted within.

Our results demonstrated that the right surface of ventriculus gastris was largely covered by the jejunal helix, permitting only a small part of the gizzard to be in contact with the ventral soft abdominal wall. The helical loops are similar to those in pigeons (19), making up a wide-base cone helix whose greater part was located dorsally in the right abdominal cavity. The canary's ileum formed arcs as in domestic birds. Gadzhev (18) did not provide information about anatomical contact between the ileum and soft abdominal wall of birds, which is proved by our results about *Serinus canaria*. Vrakin et al. (20) described avian ileum as a short part situated dorsally to the duodenum among the caeca. We could add further to the data of Gadzhev (18) and Vrakin et al. (20) that domestic canary's ileum touched the soft wall in the median plane of the common body cavity. In this part, the anatomic position of the ileum was between ansa duodenalis and the right ventricular wall, and the median course was caudally preserved up to the cloacal area.

According to our results, there was a substantial resemblance between the anatomical features of some digestive organs in *Serinus canaria* and Blue-and-Yellow Macaws (*Ara ararauna*) (22). The latter described the intestinal conglomerate as being with a helical shape with centripetal and centrifugal loops filling mainly the caudal part

of the body cavity. As in *Ara ararauna*, ansa duodenalis of canaries was U-shaped and lies on the soft body cavity wall. This anatomic position of the duodenal arc covered ileal loops leaving only a small median segment in touch with the soft abdominal wall. A similar anatomical structure of the duodenum was described by Bailey et al. (12) in bustards, but data demonstrated significant differences in the caecal structure. Unlike bustards whose caeca are developed with distinct neck, body and apex, the paired cecum in canaries is highly rudimentary and millet grain-sized. Our results showed that the rectum of *Serinus canaria* was anatomically similar to that of the bustard, relatively short and without clear transition to the cloaca.

Our data add further information to the body of knowledge in domestic birds, including turkeys, e.g. that the liver of these species had two lobes and an intermediate part (18, 24). The authors affirmed that the two hepatic lobes were equally developed and anatomically adjacent to the gizzard. The liver of *Serinus canaria* was bilobed – lobus sinister and lobus dexter. Lobus sinister lied ventrally to the gastric pars glandularis and its visceral surface touched the ventriculus gastris. Our findings showed that ventriculus gastris of *Serinus canaria* lied posterior to hepatic lobus comparably to the position of this organ in quails and pigeons (25). Lobus dexter was the relatively bigger lobe, which did not however touch ventriculus gastris. our results were in line with the data of Matsumoto et al. (26), showing that the right hepatic lobe of budgerigars (*Melopsittacus undulatus*) was better developed and also added that unlike budgerigars, there was no contract between the right hepatic lobe and ventriculus gastris of *Serinus canaria*.

The literature data about the caudal margin of avian liver are scarce (18, 19). According to the present study, the liver of *Serinus canaria* is caudally determined by the transverse plane through the sternal margo caudalis. This fact was supposed to be a valuable contribution to the anatomical findings of digestive tract organs in *Serinus canaria*. On the other hand, the indentified caudal margin of the liver in canaries should be interpreted as a fact of high diagnostic value taking into consideration the commonly seen digestive organ pathological states (4-6). Surely, the pathological alterations in digestive tract are associated to ante mortem anatomical disposition characterised with impaired normal relationships between the organs and various extent of dislocation of

their topographic boundaries. This assumption is supported by the data of Sandmeier (27), who emphasized that the liver of *Serinus canaria* moved in caudal direction when proventriculus dilation was present. Therefore, the determination of the caudal margin of the liver is an anatomical and diagnostic marker not only of the liver, but also of the entire alimentary tract.

Our study would not be valuable enough if studied anatomical aspects could not be useful for the prophylaxis or clinical diagnostics of digestive tract pathology. The lack of information in reviewed literature allowed us to be the first to describe the surface anatomical projections of ansa duodenalis, together with the pancreas, the ileum and ventriculus gastric.

CONCLUSION

The determination of anatomical features of gastrointestinal organs, whose pathology is frequent in canaries (*Serinus canaria*) reared as pets and the description of surface anatomical projections of organs are useful anatomical markers in veterinary diagnostic practice.

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