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Ultrasonography of coelomic organs in rescued black kites *(Milvus migrans)*

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Abstract

Fourteen rescued kites were examined at centers in Chennai and Ahmedabad between February and September 2024. Each bird underwent general examination and ultrasonographic evaluation using various probes and approaches including ventromedian, ventrocaudal, parasternal, and lateral views. Liver, gallbladder, gizzard, intestines, kidneys, and heart were assessed using ultrasound. Abnormalities such as hepatomegaly, nephromegaly, proventricular dilation, enteritis, and pneumocoelom were identified. The liver, gizzard, and intestines were consistently visualized, while spleen, kidneys, and reproductive organs were less commonly visualized.

Keywords: Avian, black kite, coelomic organs, ultasonography

Introduction

Black kites or small Indian kites (*Milvus migrans*) (Christie and Ferguson-Lees, 2010) are known to be urban raptors which live in a close proximity with humans. During Uttarayan festival where many Indians fly kites in large numbers, there have been many reports of these black kites getting injured and being presented to veterinarians for their treatment. This study describes the ultrasonographic findings of coelomic organs in rescued black kites.

Materials and Methods

The study was conducted at Madras Veterinary College, Chennai Tamil Nadu, Besant Nagar animal dispensary, Chennai, Tamil Nadu, and Jivdaya Charitable Trust, Ahmedabad, Gujarat during the months of February to September 2024. Permission was obtained from the Principal Chief Conservator of Forests and Chief Wildlife Warden, Government of Tamil Nadu (Proceeding No: WL5(A)/3066/2024 and Permission No: 35/2024 dated 26.06.2024). Fourteen black kites (*Milvus migrans*) (identified as BK1, BK2 etc.,) rescued and brought to the centre, were subjected to general examination followed by the ultrasonography examination. AEROSCAN-250 ultrasound machine at Madras Veterinary College, Chennai, U50 VET ultrasound machine at BMAD, Chennai and SonoSite M-Turbo at JCT, Ahmedabad, Gujarat were used for ultrasonographic examination. The probes used were linear array (8-12MHz), microconvex (7-10MHz) and phased array probe (2-5MHz) and microlinear probe (7-15MHz). The birds were presented either on dorsal recumbency or held in upright position. Some feathers on ventral region were parted or either plucked a bit before applying isopropanol or ultrasound gel for placing of the probe. The ultrasonography examination of the avian coelomic cavity was done as per Garret (2016).

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Fig. 2. a) Ventromedian, (b) Ventrocaudal, (c) Parasternal approaches, d) Left lateral and (e) Right lateral approaches.

Results and Discussion

The liver was visualized in all the birds examined and the details are depicted in Fig. 3-8. The liver parenchyma was of average echogenicity compared to the subcutaneous fat which was in agreement with Echols, (2006) and Varshney (2022). The appearance of the liver parenchyma was similar to the mammalian one (Koenhemsi 2019). Two lobes of the liver were visualized clearly (Da Silva *et al.,* 2024). The gallbladder in association with right lobe of the liver was easy to identify as it was hypoechoic in nature and was in agreement with Krautwald-Junghanns *et al.* (2001) and Da Silva *et al.* (2024). The portal vein in the left lobe was clearly visible due to thick hyperechoic wall and a hypoechoic lumen. Falciform fat appeared to be hyperechoic compared to the echogenicity of the liver but less than that of subcutaneous fats echogenicity. Colour doppler enabled visualization of blood vessels in liver and was in agreement with Pees *et al.* (2006). The liver of BKA1 was enlarged and appeared round and thicker. The echogenicity of the liver was homogenous which was in agreement with Knafo *et al.* (2011) and Koenhemsi (2019). An engorged hepatic vessel was also visualized in the liver parenchyma as described by previous authors (Fig. 9) (Pees *et al.,* 2006, Cusack *et al.,* 2016 and Dutton *et al.,* 2016). The post mortem examination of this individual confirmed the enlargement of the liver with rounded and thickened borders (Fig 10 and 11). In another black kite BKA8, a congested blood vessel on its long axis with hypoechoic lumen and hyperechoic wall (Figure 12 and 13) were visualized.

Healthy spleen was not visualized in any of the these birds which was in agreement with Da Silva *et al.* (2024). The gizzard was easily identifiable in all black kites and appeared hypoechoic (Fig 14-17) with hyperechoic contents and was in agreement with reports of Dietz *et al.* (1999) and Krautwald-Junghanns *et al.* (2010). Proventriculus was visualized only in two black kites and both were abnormally distended (Figure 18 -21) Abnormally distended proventriculus could be due to foreign body, neurogenic proventricular dilatation disease (PDD) where massive dilatation of the proventriculus is seen, infection by *Macrorhabdus ornithogaster*, *Streptococcus* spp. or *Escherichia coli* and vitamin A deficiency (Samour, 2015). Mejia-Fava *et al.* (2013) visualized a proventriculus of an umbrella cockatoo (*Cacatua alba*) suffering from proventricular nematodiasis. Intestines with peristalsis with hyperechoic intestinal content (Fig 22 -23) were visualized which was in agreement with Krautwald-Junghanns *et al.* (2010). The empty cloaca was difficult to visualize under ventrocaudal approach. When the cloaca is filled with liquid content the internals could be visualized as oval or roundish with thin regular hypoechoic fluid (Fig 24 and 25).

The normal urogenital tract was not visualized. (Hofbauer *et al.,* 1999) and (Krautwald-Junghanns *et al.,* 2010). The long axis view of the kidneys was unachievable, which may be due to interference by the feathers. No ovaries or egg like structures were visible on ultrasound.

Liver was used as the acoustic window to visualize the heart with the ventromedian and parasternal approach for the black kites as described by Beaufrere *et al* (2012). The avian heart was similar to that of mammalian heart (Chitty and Lierz, 2008). The visualization of the hypoechoic left ventricle, right ventricle, aorta, left atrium and hyperechoic interventricular septum, was in agreement with Samour (2015). In the three chambered view of heart the two ventricles (the left being larger than the right) along with aorta above the right ventricle was visualized and the findings were in agreement with Krautwald-Junghanns *et al.* (2010). The interventricular septum was hyperechoic in nature whereas the ventricles and the atrium and the aorta were hypoechoic which was in agreement with Rembert *et al.* (2008) and Samour (2015).

Acknowledgments

The authors are thankful to authorities of Principal Chief Conservator of Forests and Chief Wildlife Warden, Government of Tamil Nadu, Besant Memorial Animal Dispensary (BMAD), Chennai, Tamil Nadu, Jivdaya Charitable Trust, Ahmedabad, Gujarat for their cooperation, permission to use their birds of prey and their veterinarian's assistance for performing this ultrasonography study. The authors are thankful to the Department of Wildlife Science, Madras Veterinary College, TANUVAS for their help.

Fig.3. Visualization of black kite (BKC1) liver and heart and other parts in dorsal positioning with a linear probe (8-12MHz) on the ventromedian approach.

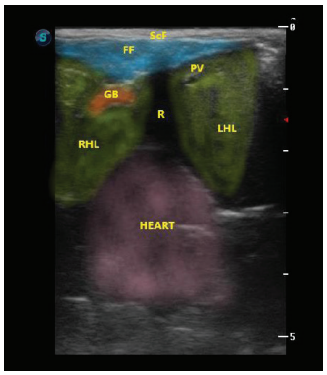

Fig.4. Demarcations highlighting, RHL-Right hepatic lobe, LH-Left hepatic lobe, GB-Gallbladder, PV-Portal vein, R-Ridge, FF-Falciform fat, ScF-Subcutaneous fat and heart.

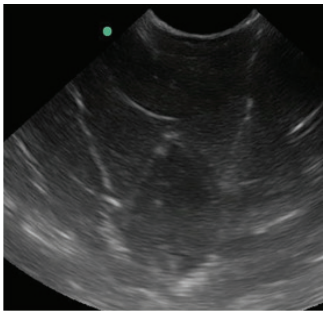

Fig.5. Visualization of black kite (BKA2) liver and heart and other parts in dorsal positioning with a microconvex probe (7-10MHz) on ventromedian approach.

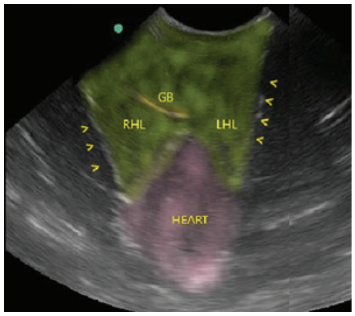

Fig.6. Demarcations highlighting, Normal liver border with (<) sharp edges, RHL-Right hepatic lobe, LHL-Left hepatic lobe, GB-Gallbladder and heart.

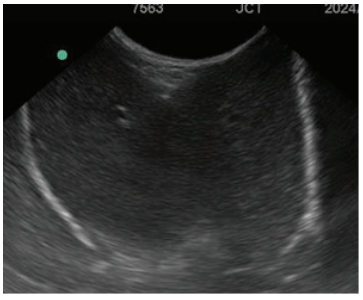

Fig.7. Ultrasound showing hepatomegaly of (BKA1), rounded and thickened liver borders away from each other in dorsal positioning with a microconvex probe (7-10MHz) placed on ventromedian approach.

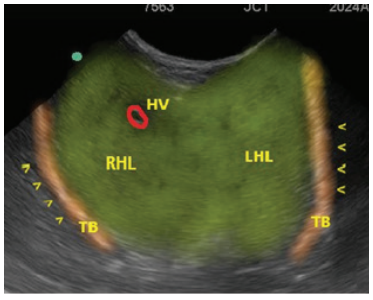

Fig.8. Demarcations highlighting, RHL-Right hepatic lobe, LHL-Left hepatic lobe where both are homogenous, with TB-Thickened borders away from each other marked with (>) and HV-Hepatic vein.

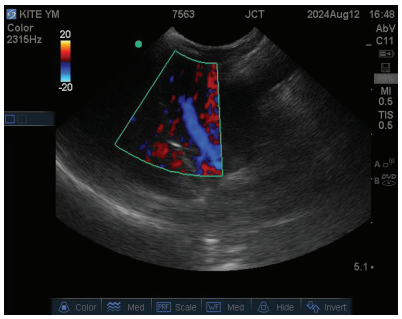

Fig.9. Visualization of engorged blood vessel by colour doppler in the hepatic parenchyma of (BKA1) in dorsal positioning by a microconvex probe (7-10 MHz) with a ventromedian approach

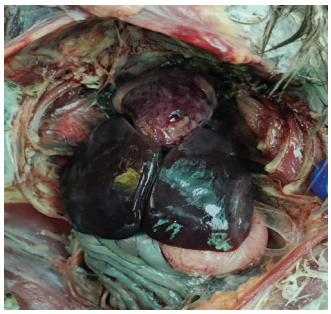

Fig.10. Hepatomegaly confirmed on necropsy of BKA1 as it is almost covering majority of the gizzard and the borders appearing rounded.

Fig.11. Enlarged liver with thickened, rounded border of BKA1

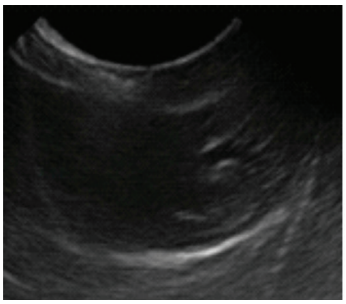

Fig.12. Congested hepatic vessel of BKA8 on longitudinal axis and a slightly enlarged liver visualized in dorsal positioning by a microconvex probe (7-10 MHz) on a ventromedian approach.

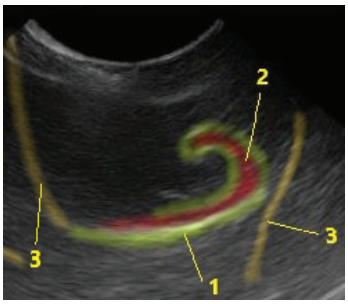

Fig.13. Demarcations highlighting, 1) Hyperechoic wall of the congested vessel, 2) Hypoechoic lumen of the congested vessel and 3) Borders of the enlarged liver away from each other.

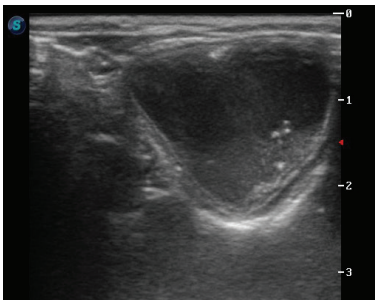

Fig.14. Visualization of gizzard and contents of BKC1 parts in dorsal positioning with a linear probe (8-12MHz) on ventromedian approach.

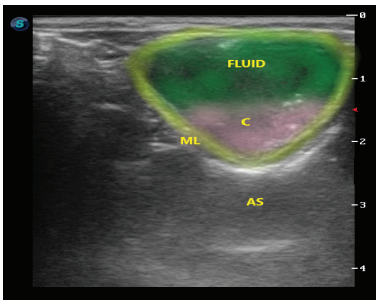

Fig.15. Demarcations highlighting, ML-Muscular layer of gizzard with fluid, C-Contents and AS-Acoustic shadow

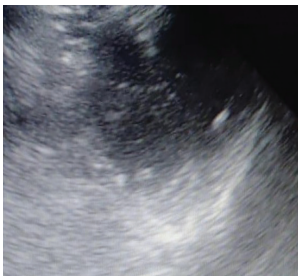

Fig.16. Visualization of gizzard and contents of BKA10 in dorsal positioning with a microconvex probe (7-10MHz) on ventromedian approach.

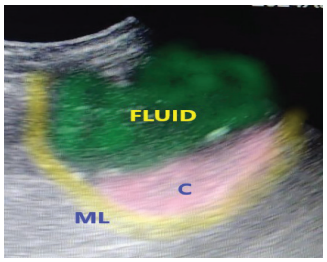

Fig.17. Demarcations highlighting, ML-Muscular layer of gizzard with fluid and C-Contents.

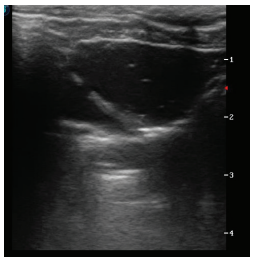

Fig.18. Visualization of proventricular-gizzard junction and contents of BKC1 in dorsal positioning with a linear probe (8-12MHz) on left lateral approach

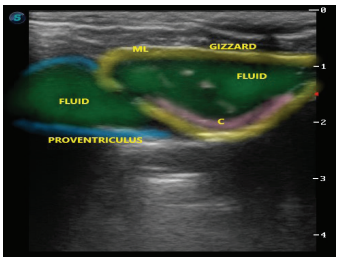

Fig.19. Demarcations highlighting, where proventriculus filled with fluid is indicated in blue and gizzard in yellow, ML-Muscular layer of gizzard with fluid and C-Content

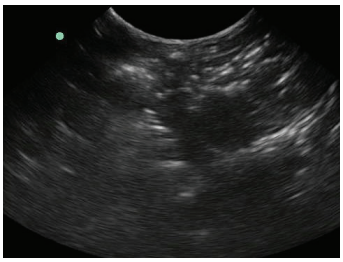

Fig.20. Visualization of the impacted proventriculus and gizzard BKA2 in dorsal positioning with a microconvex probe (7-10MHz) placed laterally on left side

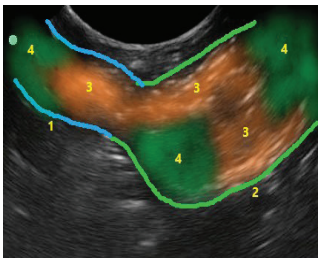

Fig.21. Demarcations highlighting, Proventriculus (1) and gizzard (2) filled with hyperechoic contents (3) and fluid (4)

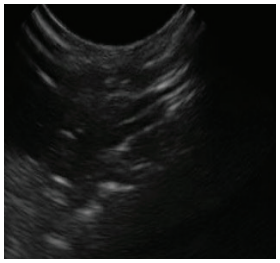

Fig.22. Visualization of normal intestine of BKA6 on a longitudinal section in dorsal positioning with a microconvex probe (7-10MHz) on ventrocaudal approach

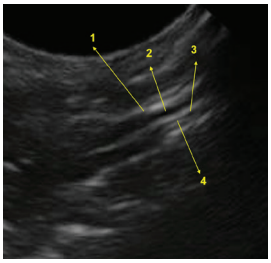

Fig.23. Demarcations highlighting, 1) Serosa, 2) Muscularis, 3) Mucosa and 4) Contents

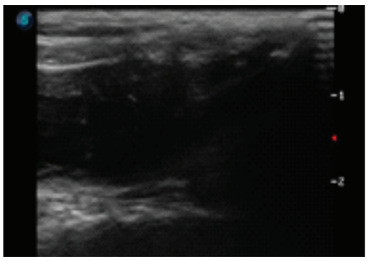

Fig.24. Visualization of normally distended cloaca of BKC1 with fluid in it by dorsal positioning with a linear probe (8-12MHz) directly over it in dorsal presentation

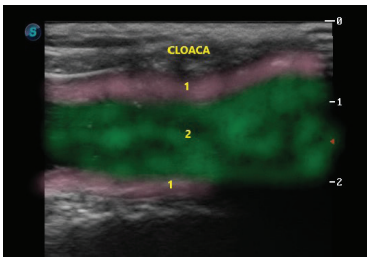

Fig.25. Demarcations highlighting, 1) Mucosa and 2) Fluid

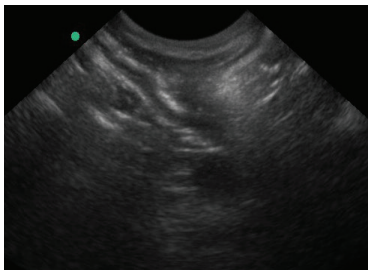

Fig.26. Visualization of inflamed intestinal segment of BKA6 in dorsal positioning with a microconvex probe (7-10MHz) on a ventrocaudal approach

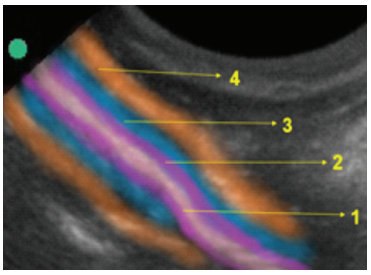

Fig.27. Demarcations highlighting, Arrangement of the intestinal layers as follows 1) Lumen with contents, 2) Mucosa, 3) Muscularis and 4) Serosa (Thickened)

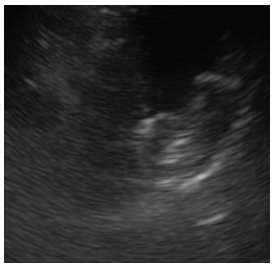

Fig.28. Visualization of enlarged kidneys (both) of BKA9 in cross section in association with renal fossa in dorsal positioning with a microconvex probe (7-10MHz) on ventrocaudal approach

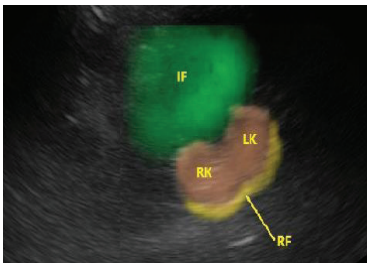

Fig.29. Demarcations highlighting, RK-Right kidney, LK-Left kidney both of them lying in the renal fossa (RF) with hypoechoic Intestinal fluid (IF)

Fig.30. Visualization of horizontal apical four chamber view of BKC1 heart in association with liver in upright position with a microconvex probe (3.6-12.8 MHz) on ventromedian approach

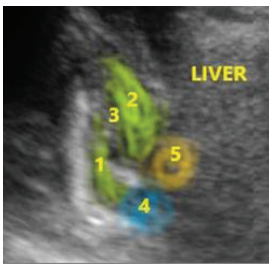

Fig.31. Demarcations highlighting, 1) Right ventricle, 2) Left ventricle, 3) Inter ventricular septum, 4) Aorta and 5) Left atrium and liver

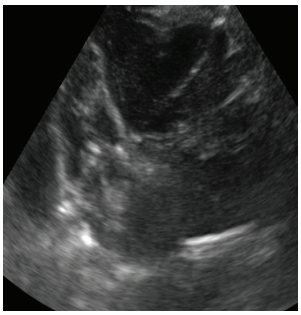

Fig.32. Visualization of parasternal apical three chamber OF BKC1 heart view in upright position by placing the microconvex probe (3.6-12.8MHz) parasternally behind the last rib

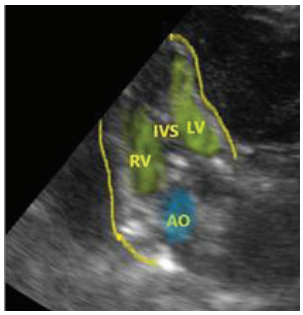

Fig.33. Demarcations highlighting, RV-Right ventricle, LV-Left ventricle, IVS-Inter ventricular septum and AO-Aorta

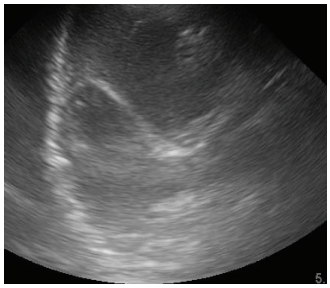

Fig.34. Poor visualization of heart of BKA1 in association with liver in dorsal positioning with a microconvex probe (7-10MHz) on ventromedian approach

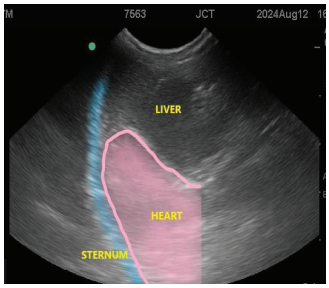

Fig.35. Demarcations highlighting, Heart lying on sternum in association with liver

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