Case Report

Postmortem Diagnostic Imaging to Evaluate Idiopathic Hypertrophic Cardiomyopathy in a Roborovski Hamster

Arezoo Ramezani1, Mohammad Molazem1*, Sarang Soroori1, Zahra Jafari Giv2, Sara Shokrpoor2, Urs Geissbühler3

1. Department of Radiology and Surgery, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran.
2. Department of Pathology, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran.
3. Department of Clinical Radiology, Vet Suiss Faculty, University of Bern, Bern, Switzerland.

* Corresponding Author:
Mohammad Molazem, Associated Professor.
Address: Department of Radiology and Surgery, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran.
Phone: +98 (912) 5868821
E-mail: mmolazem@ut.ac.ir

ABSTRACT

Idiopathic cardiomyopathy in hamsters can cause death due to cardiac failure. The current case study investigated the capability of imaging to reveal possible cardiomyopathy in a dead hamster. To this end, the cadaver of a 6-month-old male Roborovski dwarf hamster, which showed acute respiratory symptoms a few days before its death, was examined by virtopsy to discover the cause of death. Postmortem radiography was not efficient enough to evaluate the heart due to postmortem lung atelectasis that increases lung opacity and diminishes the contrast between lung and heart. Postmortem computed tomography can be helpful for the assessment of cardiac size. Consistent with postmortem echocardiographic studies, an increased thickness of the left ventricular parietal wall and the interventricular septum and dilation of the left atrium were observed. Thus, hypertrophic cardiomyopathy was determined by imaging and confirmed by the conventional necropsy approach. It showed that the cause of death was acute cardiac failure following idiopathic hypertrophic cardiomyopathy.

Keywords: Echocardiography, Hypertrophic cardiomyopathy, Postmortem, Roborovski hamster, Virtopsy
1. Case History

A breeder brought the cadaver of a 6-month-old male Roborovski dwarf hamster to the Veterinary Clinic of the University of Tehran after its abrupt death and upon the serial death of its brothers and sisters.

2. Clinical Presentations

The case had clinical symptoms of respiratory disorders and received antibiotic therapy without significant improvement.

3. Diagnostic Testing

Postmortem computed tomography, digital radiography, and echocardiography were performed almost 3 hours after death. The cadaver had a moderate rigor mortis, and during these 3 hours, it had been kept in a cold and dry bag. In this study, we aimed to uncover the cause of death of this hamster by virtopsy.

Radiography

Standard whole-body orthogonal left lateral and dorsoventral radiographs were performed on the cadaver. Wet hair artifact was visible around the body. Because of the rigor mortis, the forelimbs were superimposed in the cranial thorax, and the hindlimbs were not extended, resulting in compression in the abdominal cavity. Marked focal soft tissue swelling associated with gas inclusions was detected around the cervical region, possibly resulting from postmortem changes. There are two small tubular structures with mineral opacity in the cranioventral aspect of the abdominal cavity on both sides of the spine, which may be related to gastrointestinal contents. No skeletal abnormalities and the dental arcade were detected. However, the thoracic cardiac silhouette was not well delineated due to increased lung opacity caused by postmortem atelectasis. Postmortem changes comprised gas accumulation within the gastrointestinal tract (Figure 1).

Computed tomography

A native CT scan was performed (using Siemens SOMATOM® 2 detector scanner), and the images were reconstructed in orthogonal views. The heart’s maximum height, width, and length were 7.5, 5.5, and 8.5 mm, respectively (Figure 2). Two tubular heterogeneous mineral attenuating (HU=1000) structures were visible in the center of the abdomen in the intestinal segments that are dense intestinal contents; otherwise, the skeletal structures, thorax, and abdomen were within the normal range (Figure 3). The ratio of the heart diameter to the thoracic diameter was 8.47 mm/12.7 mm.

Echocardiography

Echocardiography was performed with a Vivid 7 ultrasound machine (GE Medical Systems, USA), connected to a multi-frequency (6-13 MHz) phased-array transducer. In the right parasternal long-axis study, the collapsed lumen of the heart could be detected by linear intraluminal hyperechogenicity. The thickness of the left ventricular parietal septum was 2.796 mm, and the thickness of the interventricular septum was 2.748 mm. The left atrium was also dilated, probably due to mitral valve regurgitation, but since we could not use color Doppler or pulse wave, we cannot say it with certainty (Figure 4).

All the images were then reviewed and edited by Horos software, version 3.3.6.

Necropsy was performed. Macroscopically, left ventricular hypertrophy was observed (Figure 5). Lungs and other organs exhibited normal appearance.

4. Assessments

In this research, we studied idiopathic cardiomyopathy in a deceased hamster by postmortem echocardiography. To the best of our knowledge, this is the first report of forensic echocardiography in a veterinary practice and may open a new door into further postmortem echocardiographic investigations.

Virtual autopsy (virtopsy) is a novel approach in the veterinary necropsy procedure that uses different imaging modalities, namely radiography, computed tomography, magnetic resonance imaging, and ultrasonography, to aid postmortem evaluations. Since virtopsy aims to analyze images and add value to forensic medicine, its application can assist with the pre-autopsy diagnosis (Parry & Stoll, 2020; Thali et al., 2009). Although conventional necropsy is extensively employed to determine the cause of death in veterinary practices, minimally invasive postmortem imaging, which is more economical and has more precise results, can be a proper substitution for aggressive methods. In veterinary postmortem examinations, the smaller the animal is, the more we rely on histopathology than necropsy to spot lesions (McDonough & Southard, 2017).
Figure 1. A) Lateral and B) Dorsoventral views of the cadaver of a Roborovski hamster

Marked focal soft tissue swelling associated with gas inclusions was detected around the cervical region, which seems to result from postmortem changes (solid arrows). Forelimbs were superimposed on the cranial thorax, and the hind limbs were not extended, resulting in abdominal cavity compression. The cardiac silhouette was not visible due to increased lung opacity caused by postmortem atelectasis. Two mineral densities were visible at the cranioventral aspect of the abdominal cavity on both sides of the spine, which seemed to be due to gastrointestinal contents (circles). Gas accumulation within the gastrointestinal tract was followed by postmortem changes.

Figure 2. A) Sagittal, B) Axial and C) Dorsal plane CT scans of the cadaver of the Roborovski hamster

The heart’s maximum height, width, and length were 7.5, 5.5, and 8.5 mm.
Figure 3. A) Sagittal B) Axial and C) Dorsal plane CT scans of the cadaver of the Roborovski hamster. Two tubular mineral attenuating (HU=1000) structures are visible in the center of the abdomen (circles). The skeletal structures, thorax, and abdomen are within normal limits.

Figure 4. Echocardiographic examination of the Roborovski hamster heart, right parasternal long axis view (A, B, C, and D). B) Red line depicts the heart contour, including the aorta (AO), left atrium (LA), and left ventricular parietal wall (LVPW). C) The collapsed lumen of the heart could be detected by the linear intraluminal hyperechogenicity shown by the yellow line. D) The left ventricular parietal septum (PWT) thickness was 2.796 mm, and the interventricular septum (IVS) thickness was 2.748 mm.
Even though thoracic radiography and CT scan are helpful in the determination of cardiac diseases in exotic animals (Krautwald et al., 2010), they are inappropriate for postmortem inspection of the heart due to alveolar atelectasis which negatively affects the imaging contrast, compared to echocardiography. Postmortem echocardiography has been performed on the human heart as another diagnostic modality to autopsy to reveal a specific cause of death in infants to increase the diagnostic yield of the autopsy (Ker et al., 2010) and to assess the chamber size and left ventricular wall thickness (Chon et al., 2017). Likewise, echocardiography is the method of choice in dogs and cats for diagnosing cardiac malfunction and cardiac geometry in exotic companion mammals or animal models (Mitchell & Tully, 2016; Babaei & Razmaraii, 2020). However, considering the advantage of the postmortem echocardiography and based on the normal cardiac size of Syrian hamsters (which is 0.1±0.01 cm for posterior wall thickness [PWT] and 0.1±0.01 cm for interventricular septal thickness [IVST]), we made a diagnosis of idiopathic cardiomyopathy in the deceased hamster (Salemi et al., 2005). The limitation of this report is lacking histopathology and a control postmortem study on a hamster with a normal heart of the same age. However, this unique case report can be a start for using postmortem echocardiography in small animals.

Conclusion

In conclusion, postmortem echocardiography in postmortem hamsters is a non-invasive and quick method to evaluate possible heart diseases like cardiomyopathies.
Ethical Considerations

Compliance with ethical guidelines

There were no ethical considerations to be considered in this research.

Funding

This research did not receive any grant from funding agencies in the public, commercial, or non-profit sectors.

Authors’ contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

Acknowledgments

The authors express their appreciation to everyone that assists us in this study.

References


گزارش موردی

استفاده از اکوکاردیوگرافی در مطالعات پس از مرگ در تشخیص کارديومیوپاتی هیپرتروفیک ایدیوپاتیک در لاشه یک رأس همستر نژاد روپورسکی

آزی روپورسکی، محمد ملازم، سارنگ سروری، زهرا جعفری گیو، سارا شکرپور

گروه آسیب‌شناسی، گروه جراحی و رادیولوژی، گروه جراحی و رادیولوژی، گروه جراحی و رادیولوژی

کاردیومیوپاتی ایدیوپاتیک در همسترها می‌تواند به دلیل ایجاد نارسایی قلبی منجر به مرگ شود. هدف این مطالعه موردی بررسی توانایی روش‌های تصویربرداری تشخیصی در آشکارسازی کاردیومیوپاتی هیپرتروفیک عارضه ی احتمالی بود که با انجام کلیینیک تایید شد و علت مرگ نارسایی حاد قلبی به دنبال کاردیومیوپاتی هیپرتروفیک تشخیص داده شد.

کلیدواژه‌ها: اکوکاردیوگرافی، کارديومیوپاتی هیپرتروفیک، مطالعات پس از مرگ، کلیینیک، گروه جراحی و رادیولوژی