Case Report

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

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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

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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-mortise, 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 ultrasonography 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).

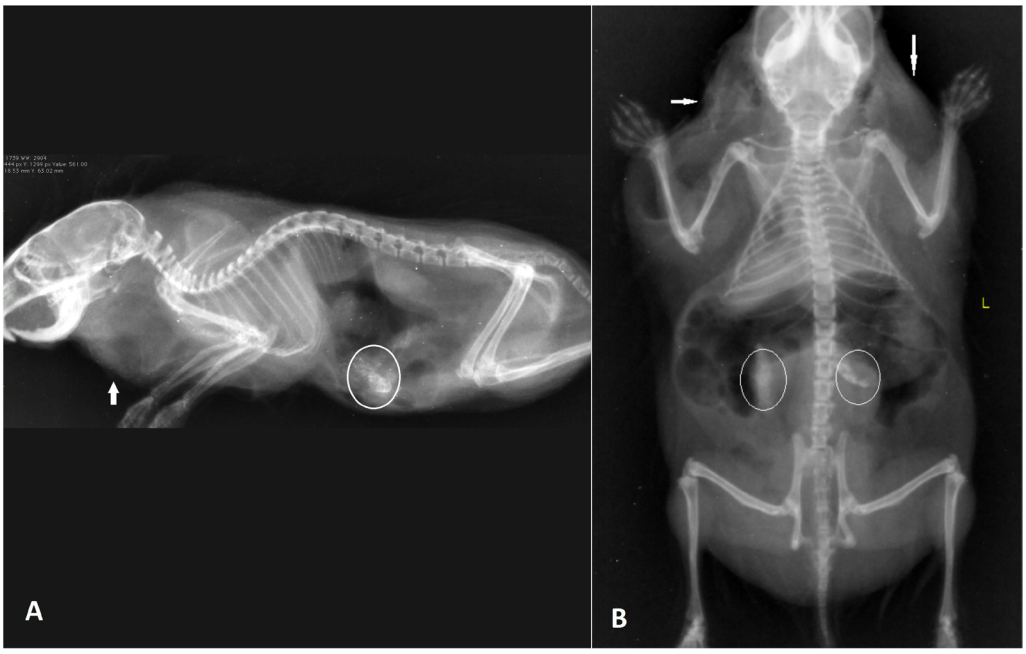

Figure 1. A) Lateral and B) Dorsoventral views of the cadaver of a Roborovski hamster

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.

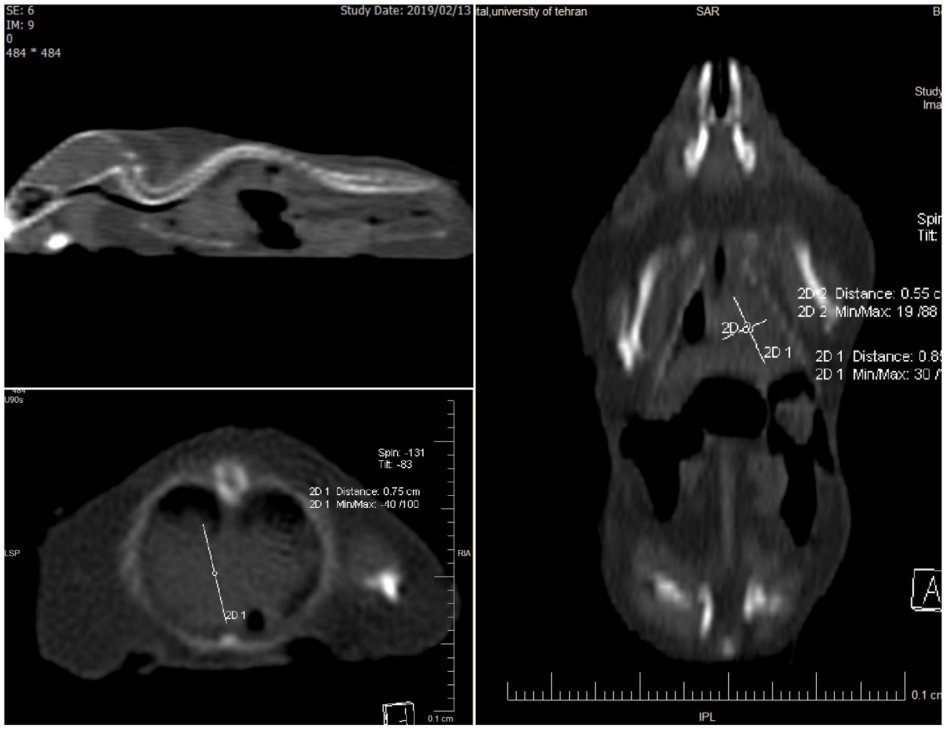

Figure 2. A) Sagittal, B) Axial and C) Dorsal plane CT scans of the cadaver of the Roborovski hamster

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.

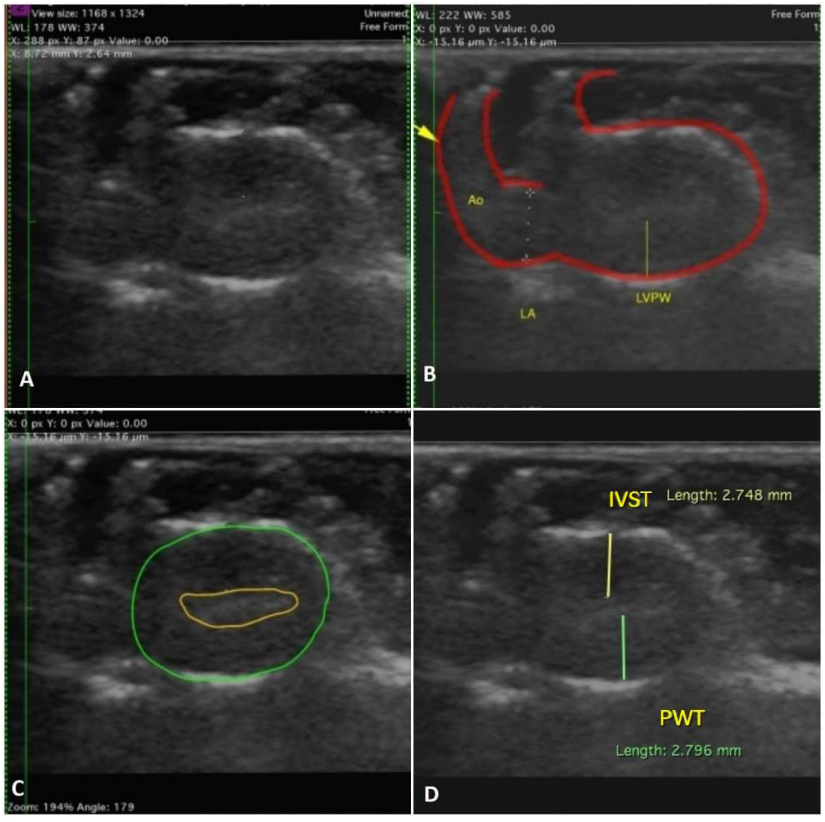

Figure 4. Echocardiographic examination of the Roborovski hamster heart, right parasternal long axis view (A, B, C, and D)

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.

Figure 5. A and B) Dissection of the heart

Note the left ventricular hypertrophy.

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). Hamsters with heart disease show various clinical signs, including pulmonary manifestations, lethargy, and edema. Some may be very mild and take a long time to be diagnosed (Soroori et al., 2020). Some common heart diseases affecting geriatric hamsters are dilative cardiomyopathy and atherosclerosis, which can contribute to atrial thrombosis (Keeble & Meredith, 2009). Hypertrophic cardiomyopathy is less prevalent (Kubiak, 2020; Dutton, 2020). There is little information about the Roborovski hamster breed, and most of the studies are based on Syrian hamsters because they are more popular as pets and laboratory animals (Keeble & Meredith, 2009).

Hypertrophic cardiomyopathy is a heart disease associated with an abnormal ventricular wall and interventricular septum thickening with normal or diminished left ventricular dimensions. Hypertrophic cardiomyopathy is prevalent most commonly among feline and affects 10%-15% of them compared to other animal species (Freeman et al., 2017; Simpson et al., 2017). Cardiomyopathy (both dilative and hypertrophic) in Syrian hamsters is an autosomal recessive disease with a phenotypic expression in 100% of the affected line (Factor et al., 1988). Notably, over 90% of hamsters with hypertrophic cardiomyopathy die of premature congestive heart failure (Factor et al., 1988; Strobeck et al., 1979).

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.

5. 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.

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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References

Babaei, H., Razmaraii, N., Assadnassab, G., Mohajjel Nayebi, A., Azarmi, Y., & Mohammadnejad, D., et al. (2020). Ultrastructural and echocardiographic assessment of chronic doxorubicin-induced cardiotoxicity in rats. *Archives of Razi Institute*, *75*(1), 55–62. [DOI:10.22092/ari.2019.116862.1177] [PMID] [PMCID]

Chon, S. B., Shin, S. D., Na, S. H., Cho, Y., Jung, H. S., & Choi, J. H., et al. (2017). Search for structural cardiac abnormalities following sudden cardiac arrest using post-mortem echocardiography in the emergency department: A preliminary study. *Journal of the Korean Society of Emergency Medicine*, *28*(1), 124-132. [Link]

Dutton M. (2020). Selected veterinary concerns of geriatric rats, mice, hamsters, and gerbils. The veterinary clinics of North America. *Exotic Animal Practice*, *23*(3), 525–548. [DOI:10.1016/j.cvex.2020.04.001] [PMID] [PMCID]

Factor, S. M., Cho, S. H., Scheuer, J., Sonnenblick, E. H., & Malhotra, A. (1988). Prevention of hereditary cardiomyopathy in the Syrian hamster with chronic verapamil therapy. *Journal of the American College of Cardiology*, *12*(6), 1599–1604. [DOI:10.1016/S0735-1097(88)80031-7] [PMID]

Freeman, L. M., Rush, J. E., Stern, J. A., Huggins, G. S., & Maron, M. S. (2017). Feline hypertrophic cardiomyopathy: A spontaneous large animal model of human HCM. *Cardiology Research*, *8*(4), 139–142. [DOI:10.14740/cr578w] [PMID] [PMCID]

Keeble, E., & Meredith, A. (2009). *BSAVA manual of rodents and ferrets*. Hoboken :Wiley. [Link]

Ker, J., Toit-Prinsloo, L. D., Van Heerden, W., & Saayman, G. (2010). Post-mortem echocardiography as a guide to cardiac autopsy-a worthwhile concept? *Clinical Medicine Insights. Cardiology*, *4*, 59–61. [DOI:10.4137/cmc.s5676] [PMID] [PMCID]

Krautwald-Junghanns M. E., Pees, M., & Reese S. (2010). *Diagnostic imaging of exotic pets: Birds-small mammals-reptiles*. Hanover: Schlütersche. [Link]

Kubiak, M. (2020). *Handbook of exotic pet medicine*. Hoboken: John Wiley & Sons, Ltd. [DOI:10.1002/9781119389934]

McDonough, S. P., & Southard, T. (2017). *Necropsy guide for dogs, cats, and small mammals*. Hoboken: Wiley. [DOI:10.1002/9781119317005]

Parry, N. M. A., & Stoll, A. (2020). The rise of veterinary forensics. *Forensic Science International*, *306*, 110069. [DOI:10.1016/j.forsciint.2019.110069] [PMID]

Salemi, V. M., Bilate, A. M., Ramires, F. J., Picard, M. H., Gregio, D. M., & Kalil, J., et al. (2005). Reference values from M-mode and doppler echocardiography for normal Syrian hamsters. *European Journal of Echocardiography: The journal of the Working Group on Echocardiography of the European Society of Cardiology*, *6*(1), 41–46. [DOI:10.1016/j.euje.2004.06.001] [PMID]

Simpson, S., Rutland, P., & Rutland, C. S. (2017). Genomic insights into cardiomyopathies: A comparative cross-species review. *Veterinary Sciences*, *4*(1), 19. [DOI:10.3390/vetsci4010019] [PMID] [PMCID]

Soroori, S., Rostami, A., Zangisheh, M., & Shamohamadi, P. (2020). [Echocardiography of Syrian hamster (mesocricetus auratus) and diagnosis of 22 cases of atrial thrombosis (Persian)]. *Journal of Veterinary Research*, 75(1), 126-129. [DOI:10.22059/JVR.2018.257592.2795]

Strobeck, J. E., Factor, S. M., Bhan, A., Sole, M., Lie w, C. C., & Fein, F., et al. (1979). Hereditary and acquired cardiomyopathies in experimental animals: Mechanical, biochemical, and structural features. *Annals of the New York Academy of Sciences*, *317*, 59–88. [DOI:10.1111/j.1749-6632.1979.tb56511.x] [PMID]

Thali, M., Dirnhofer, R., & Vock, P. (2009). *The virtopsy approach: 3D optical and radiological scanning and reconstruction in forensic medicine*. Boca Raton: Taylor & Francis. [DOI:10.1201/9780849381898]

Mitchell, M., & Tully, M. (2016). *Current therapy in exotic pet practice*. Ontario: Saunders. [Link]

گزارش موردی

استفاده از اکوکاردیوگرافی در مطالعات پس از مرگ در تشخیص کاردیومیوپاتی هیپرتروفیک ایدیوپاتیک در لاشه‌ی یک رأس همستر نژاد روبروفسکی

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چکیده

کاردیومیوپاتی ایدیوپاتیک در همسترها می‌تواند به دلیل ایجاد نارسایی قلبی منجر به مرگ شود. هدف این مطالعه موردی بررسی قابلیت روش‌های تصویربرداری تشخیصی در آشکارسازی کاردیومیوپاتی در لاشه‌ی یک همستر بود. به همین منظور، جسد همستر نر شش ماهه نژاد روبروفسکی، با علائم تنفسی حاد در مدت زمان چند روزه قبل از مرگش توسط روش‌های ویرتوپسی مورد مطالعه قرار گرفت. در تصاویر رادیوگرافی پس از مرگ به دلیل آتلکتازی ایجاد شده ناشی از تغییرات پس از مرگ، امکان بررسی ریه و قلب وجود نداشت. سپس سیتیا-سکن پس از مرگ به منظور ارزیابی قلب انجام شد که امکان بررسی ابعاد قلب را فراهم کرد. در نهایت در بررسی های اکوکاردیوگرافی پس از مرگ، افزایش ضخامت دیواره ی جانبی بطن چپ و دیواره ی بین بطنی و اتساع دهلیز چپ مشاهده شد. براساس نتایج بدست آمده توسط تصویربرداری پس از مرگ کاردیومیوپاتی هیپرتروفیک عارضه ی احتمالی بود که با انجام کالبدگشایی تایید شد و علت مرگ نارسایی حاد قلبی به دنبال کاردیومیوپاتی هیپرتروفیک ایدیوپاتیک تشخیص داده شد.

کلیدواژه‌ها: اکوکاردیوگرافی، کاردیومیوپاتی هیپرتروفیک، مطالعات پس از مرگ، ویرتوپسی، همستر روبروفسکی

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