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REVIEW

# Sequential segmental classification of feline congenital heart disease



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Received 31 December 2014; received in revised form 1 April 2015; accepted 21 April 2015

## KEYWORDS

Cat;  
Cardiovascular;  
Cardiac;  
Sequential segmental  
analysis

**Abstract** Feline congenital heart disease is less commonly encountered in veterinary medicine than acquired feline heart diseases such as cardiomyopathy. Understanding the wide spectrum of congenital cardiovascular disease demands a familiarity with a variety of lesions, occurring both in isolation and in combination, along with an appreciation of complex nomenclature and variable classification schemes. This review begins with an overview of congenital heart disease in the cat, including proposed etiologies and prevalence, examination approaches, and principles of therapy. Specific congenital defects are presented and organized by a sequential segmental classification with respect to their morphologic lesions. Highlights of diagnosis, treatment options, and prognosis are offered. It is hoped that this review will provide a framework for approaching congenital heart disease in the cat, and more broadly in other animal species based on the sequential segmental approach, which represents an adaptation of the common methodology used in children and adults with congenital heart disease.

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## Introduction

Congenital heart disease (CHD) accounts for a small subset of cats presenting for veterinary care, estimated at 5–15% of cardiac disease in this species.<sup>1,2</sup> However, the spectrum of CHD is broad

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**Abbreviations**

|           |  |
|-----------|--|
| AS        | aortic stenosis  |
| ASD       | atrial septal defect   |
| AVSD      | atrioventricular septal defect                               |
| CHD       | congenital heart/cardiovascular disease                      |
| CHF       | congestive heart failure                                     |
| CTA       | computed tomography angiography                              |
| CTS       | cor triatriatum sinister                                     |
| DCRV      | double-chambered right ventricle                             |
| DORA      | double outlet right atrium                                   |
| DORV      | double outlet right ventricle                                |
| EFE       | endocardial fibroelastosis                                   |
| LA        | left atrium/atrial   |
| LV        | left ventricle/ventricular                                   |
| MVD       | mitral valve dysplasia                                       |
| MVD-S     | mitral valve dysplasia with stenosis                         |
| NT-proBNP | amino terminus of the pro-hormone B-type natriuretic peptide |
| PA        | pulmonary artery/arterial                                    |
| PAPVC     | partial anomalous pulmonary venous connection                |
| PDA       | patent ductus arteriosus                                     |
| PFO       | patent foramen ovale   |
| PHT       | pulmonary arterial hypertension                              |
| PS        | pulmonary valve stenosis                                     |
| RA        | right atrium/atrial  |
| RV        | right ventricle/ventricular                                  |
| TAPVC     | total anomalous pulmonary venous connection                  |
| TGA       | transposition of the great arteries                          |
| TOF       | tetralogy of Fallot  |
| TOF-PA    | tetralogy of Fallot with pulmonary atresia                   |
| TVD       | tricuspid valve dysplasia                                    |
| UAPA      | unilateral absence of a pulmonary artery                     |
| VSD       | ventricular septal defect                                    |

and complex, making the diagnosis, treatment, and prognosis for these animals more challenging. Accurate diagnosis and successful management of CHD offers potential benefits and impact on patient morbidity and survival. For example, correctly diagnosing and closing a patent ductus arteriosus (PDA) can add a decade or more to a cat's life.

Cats with complex or severe CHD might be examined within the first days to weeks of life due to failure to thrive, dyspnea, cyanosis, or syncope.<sup>3</sup> However, most kittens with severe cardiovascular malformations are believed to die early in life and prior to veterinary examination. The more common presentation of feline CHD is that of an asymptomatic pet with an appointment for a wellness exam. Auscultation of these cats is often the earliest clue that CHD is present. Much less often, a cat with CHD is examined later in life for congestive heart failure (CHF), syncope, or

cyanosis due to previously undetected CHD. For certain vascular anomalies, clinical signs may relate to body systems other than cardiovascular, such as regurgitation in the kitten with a vascular ring anomaly.

This paper provides an overview of CHD in the cat. The review first considers etiology and prevalence, followed by examination and therapy of the cat with CHD, and finally specific congenital defects. The latter are organized by sequential segmental analysis with respect to their morphologic lesions, diagnostic testing, treatment options, and prognosis.

### **Etiology of congenital cardiovascular disease**

The precise etiology of CHD in veterinary species is seldom known. In humans, CHD is the most

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