



Outcome and survival in canine sick sinus syndrome and sinus node dysfunction: 93 cases (2002–2014)

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Abstract *Introduction:* To evaluate the clinical presentation, diagnosis, treatment, and outcomes of a group of dogs with sinoatrial node abnormalities.

Animals: Ninety-three client-owned dogs at a referral institution.

Materials and Methods: Medical records were reviewed for clinical history, diagnostic testing, and medical or permanent artificial pacemaker (PAP) treatment. Owners or veterinarians were contacted for long-term follow-up.

Results: Sixty-one dogs were symptomatic for their bradyarrhythmia and were diagnosed with sick sinus syndrome (SSS). Thirty-two dogs were asymptomatic for their bradyarrhythmia and were diagnosed with sinus node dysfunction (SND). Miniature Schnauzers, West Highland White terriers, Cocker spaniels, and female dogs were overrepresented. Medical management with positive chronotropic drugs successfully controlled syncope long-term in 54% of SSS dogs, and acted as a bridge to PAP in 20%. Positive atropine response predicted medical treatment success. Forty-six percent of SSS dogs eventually underwent PAP implantation. Median survival time was approximately 18 months in SND and SSS dogs regardless of treatment strategy. Congestive heart failure (CHF) associated with progressive valvular heart disease occurred commonly in all groups, particularly in dogs with bradycardia–tachycardia syndrome.

Conclusions: Sinus node dysfunction and SSS represent a spectrum of sinoatrial node disease, which for some dogs may also involve a component of autonomic dysfunction. Dogs with SND do not require treatment. Dogs with SSS often require treatment to reduce the frequency of syncope; medical management is

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often useful, particularly in atropine responsive dogs. Prognosis of SSS with treatment is good, though development of CHF does not appear to be mitigated by treatment.

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Abbreviations

ATE	arterial thromboembolism
BTS	bradycardia–tachycardia syndrome
CHF	congestive heart failure
ECG	electrocardiogram
IQR	interquartile range
NCSU	North Carolina State University
NSR	normal sinus rhythm
PAP	permanent artificial pacemaker
RS	recurrent syncope
SAN	sinoatrial node
SCD	sudden cardiac death
SND	sinus node dysfunction
SSS	sick sinus syndrome
SVT	supraventricular tachycardia

Introduction

Sick sinus syndrome (SSS) is a common bradyarrhythmia in both humans and dogs, and is the second most common indication for canine permanent artificial pacemaker (PAP) implantation [1–5]. Although a definitive electrophysiologic diagnosis of SSS requires demonstration of abnormal sinus node recovery time or sinoatrial conduction time after overdrive pacing [6], in practice, a clinical diagnosis of SSS is often made based on abnormal sinoatrial node (SAN) activity on the surface electrocardiogram (ECG), with corresponding clinical signs of low cardiac output (i.e. syncope, staggering, weakness). Common ECG findings in SSS include physiologically inappropriate sinus arrhythmia and sinus bradycardia, periods of sinus arrest, and/or paroxysmal supraventricular tachycardia (SVT) alternating with bradycardia (sometimes called ‘bradycardia–tachycardia’ syndrome, BTS) [7].

Nomenclature regarding the diagnosis of SSS is imprecise and inconsistent in both human and veterinary literature. Some authors contend that the ‘syndromic’ diagnosis of SSS requires the presence of clinical signs (most commonly syncope), and that similar ECG findings in an asymptomatic patient warrant a diagnosis of sinus node dysfunction (SND) rather than SSS [8,9].

Additionally, some authors consider SSS to include only patients with intrinsic structural SAN disease, excluding patients with a component of autonomic dysfunction (as evidenced by positive response to atropine) [10,11]. Other authors consider these two patient populations as subgroups within the umbrella diagnosis of SSS [6,8,9,11–13].

Despite the prevalence of this bradyarrhythmia in dogs, there are no large-scale retrospective studies evaluating outcome and survival in dogs with SSS or SND. In the veterinary literature, SSS has been described in case reports and small case series in a total of 32 dogs [6,7,14–23]. Authors of these studies suggest that some dogs with SSS will respond to atropine or oral positive chronotropic drugs [15,17,18], potentially implying a component of autonomic dysfunction or inappropriate response to normal vagal tone, but the actual frequency and clinical implication of such response remains unknown. Treatment of dogs in these case reports varies widely and includes no treatment [19,20,22], medical management, [6,14,18], and PAP implantation [6,7,15,16,21,23]. Whether these selected case reports are representative of the general population of dogs with SSS is unknown, and the long-term outcome of these treatment strategies has not often been described. A larger number of dogs with SSS have been documented within retrospective studies of canine PAP placement [1–3,24–26]. However, these studies include primarily SSS patients that underwent PAP implantation, and most of these authors group SSS with other bradyarrhythmias when describing patient presentation, diagnosis, and outcome. Sudden cardiac death (SCD) is considered to be a rare outcome in SSS for both dogs [6,15,23] and humans [8,27]. Though reported occasionally in dogs post-PAP implantation [1,2], SCD has not been reported in an untreated or medically treated dog with SSS.

The goal of this study was to describe the clinical presentation, diagnosis, treatment, and outcome of SSS in a large population of dogs at a referral institution. Specifically, we sought to determine the effectiveness of medical treatment in the subset of patients with SSS who received positive chronotropic drugs, and to identify

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