ECG of the Month

A 17-year-old 7.1-kg (15.6-lb) neutered male cat with a previous history of third-degree atrioventricular (AV) block and congestive heart failure was examined as part of a cardiac reevaluation. On physical examination, the cat's heart rate was noted to be much higher than that recorded previously, and 6-lead ECG was performed.

ECG Interpretation

On the 6-lead ECG recording, the P waves initially had an apparent consistent relationship with the subsequent QRS complexes and initially appeared to be normal sinus complexes **(Figure 1)**. However, a P wave with no associated QRS complex was present intermittently and the following P wave occurred just prior to the QRS complex, which remained identical to the previously recorded QRS complexes, suggesting that the atria and ventricles were depolarizing independently of each other. The P-P intervals were consistent throughout the tracings. Depolarization of the atria and ventricles independently of each other yet at similar rates is termed isorhythmic atrioventricular dissociation (IAVD).

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Discussion

Atrioventricular dissociation is defined as an independent beating of the atria and ventricles and is a result of slowing of the dominant pacemaker of the heart (typically the sinus node) that allows escape of a subsidiary or latent pacemaker, acceleration of a latent pacemaker that overrides the normal dominant pacemaker, or a block (generally at the AV node) that prevents impulses formed at the dominant pacemaker from reaching the ventricles and suppressing the latent pacemakers.[1] There are several types of AV dissociation including AV junctional rhythms during sinus bradycardia, accelerated junctional rhythm, and ventricular and third-degree AV block.[2] The cat of the present report had third-degree AV block, which was the cause of the AV dissociation. Owing to the independent impulse firing from the atria and ventricles, the cat's heart rate increased under the influence of the more dominant pacemaker. In contrast to dogs, third-degree AV block in cats is typically not life threatening because many affected cats have no

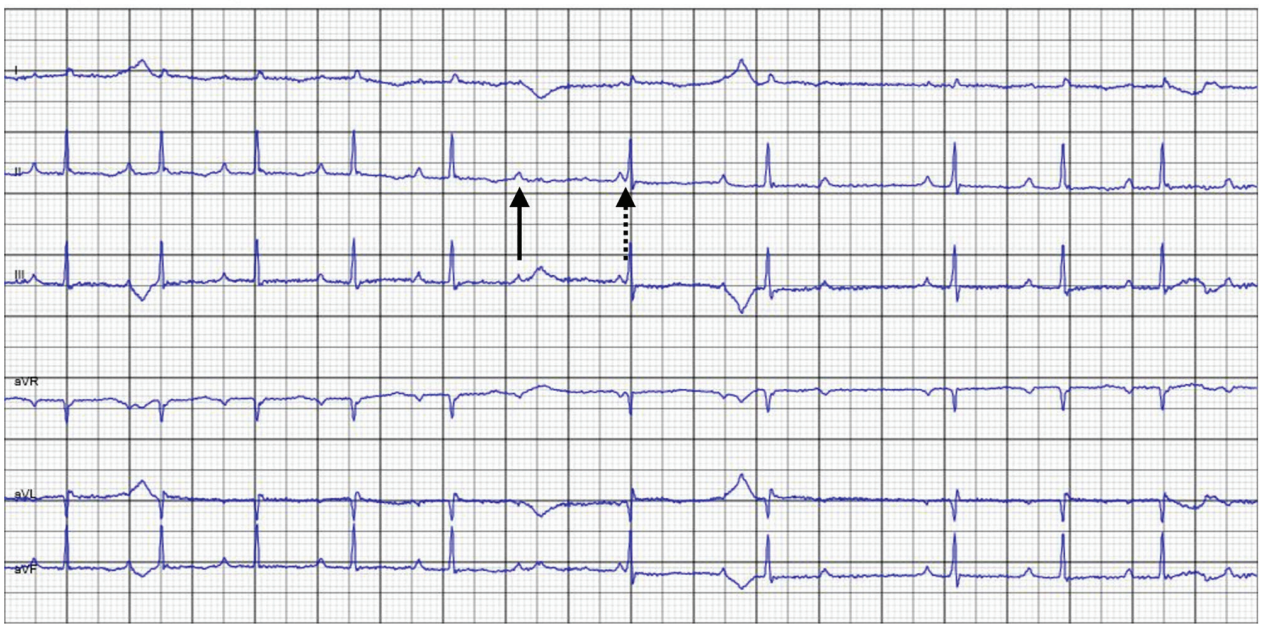

Figure 1—Six-lead ECG recording obtained from a 17-year-old cat with a previous history of third-degree atrioventricular block and congestive heart failure. The P waves initially have an apparently consistent relationship with the subsequent QRS complexes. However, the sixth P wave (solid arrow) does not have a following QRS complex, and the seventh P wave (dashed arrow) occurs just before a QRS complex that remains morphologically identical to the previous QRS complexes, suggesting that the atria and ventricles are depolarizing independently of each other. The P-P intervals are consistent throughout the tracings. When the atria and ventricles are depolarizing independently of each other yet at similar rates, the condition is termed isorhythmic atrioventricular dissociation. Paper speed = 50 mm/s; 5 mm = 1 mV.

associated clinical signs even without pacemaker implantation as a consequence of their relatively high ventricular escape rate.[2]

Isorhythmic atrioventricular dissociation is a rhythm disturbance that is uncommon in dogs and rare in cats.[3–7] It occurs when the atria and ventricles are discharging at similar rates but functioning independently of each other.[8,9] It is believed that the initiating event for IAVD may be the slowing of the sinoatrial node that results in bradycardia followed by a shift of the control of depolarization of the ventricles to an independent pacemaker. This independent pacemaker can be junctional, resulting in a normal or near-normal QRS complex appearance on ECG traces, or can be idioventricular with more bizarre, wide QRS complexes. As long as the sinoatrial rate remains bradycardic, the 2 pacemakers remain independent.

The IAVD phenomenon was first noted by Segers[8] who found that when 2 segments of frog myocardium were placed in contact, they would contract simultaneously at equivalent rates and tended to assume the rate of the more rapidly beating segment. This would consistently occur if the initial individual depolarization rates were within 25% of each other.[8] There are 2 patterns of IAVD.[3,8] Type I IAVD is characterized by a fluctuation in the P-QRS complex as the P wave oscillates across the QRS complex, thereby creating a variable PQ interval; usually the P wave does not move through the ST segment. In type II IAVD, the P wave and QRS complex are in a fixed position respective to one another.[9] On the basis of the relatively consistent relationship of the P waves to the QRS complexes, the cat of the present report likely had type II synchronization.[9] The underlying mechanism for type II synchronization is not known.[9] Theoretically, in type I IAVD, hemodynamic changes including hypotension can develop because the occurrence of the P wave after the QRS complex could reduce the contribution of atrial contraction to ventricular filling. In contrast, in type II IAVD, the beginning of atrial activation occurs simultaneously or later than the beginning of ventricular excitation; therefore, small changes in the PR interval are unlikely to have any major effects on arterial blood pressure.[9]

The cat of the present report had no clinical signs; thus, no antiarrhythmic treatment was instituted. The cat was reported to be doing well 6 weeks after the diagnosis was made.

References

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