LETTERS TO THE EDITOR

Ventricular Premature Beats and Sympathetic Nerve Activity

Welch et al. (1) reported that provoked ventricular premature beats led to bursts of efferent sympathetic discharge that had greater amplitude, duration and area than those that occur during sinus rhythm. Spontaneous (unprovoked) premature ventricular beats were also followed by unusually large bursts of sympathetic nerve activity. Postextrasystolic beats were followed by nearly complete neural silence. The concern they raised was that cardiac sympathetic activity may parallel discharge to the muscle sympathetic nerves in the leg and, if so, ventricular premature beats could modify cardiac sympathetic nerve activity and could be an important factor in the pathophysiology of sudden cardiac death in patients with heart failure.

Is it appropriate to conclude from these studies in normal subjects that the neural response to ventricular ectopic beats is similar in patients with congestive heart failure? As demonstrated by Leimbach et al. (2), sympathetic traffic to muscle is markedly elevated in patients with congestive heart failure—in some patients, virtually all cardiac cycles are associated with a burst of sympathetic discharge. Patients with cirrhosis and ascites also display increased sympathetic discharge to muscle: in our own series, sympathetic activity appears to be higher in such patients than in patients with congestive heart failure. In one of these patients we had the opportunity to record the sympathetic neurogram during periods of spontaneous, closely coupled ventricular ectopic beats. As may be seen in Figure 1, maximal burst amplitude was recorded during sinus rhythm and not after a ventricular premature beat, ventricular ectopic beats did not consistently augment subsequent sympathetic discharge and there was no neural silence after postextrasystolic beats. These recordings, in a patient with extremely high sympathetic discharge, suggest that the observation made by Welch et al. (1) may be restricted to normal subjects. Do these authors have data on the effects of ventricular ectopic beats on sympathetic activity in patients with congestive heart failure and, if so, do they provide support for their concern?

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References

Reply

We appreciate Floras’s interest in our report. Five patients with heart disease were included in our study, and two of these had compensated congestive heart failure. Consistent with the observations of Leimbach et al., baseline sympathetic nerve activity in the patients with heart failure was increased (recordings from one of these patients constituted Figure 2 of our report). All of our subjects, including the two with heart failure, manifested increased sympathetic nerve activity after ventricular premature beats with coupling intervals <60% of the preceding RR interval, and manifested neural silence after corresponding postextrasystolic beats. The neural silence was frequently most apparent in the patients with heart failure because of the increased baseline activity.

Floras’s recording from a patient with ascites is intriguing. Baseline sympathetic nerve activity is increased. There are two spontaneous ventricular premature beats. Consistent with our results, the first premature beat appears to be followed by a sympathetic burst of increased duration and area. However, other features differ from our findings: the second premature beat does not appear to be followed by increased sympathetic activity, and neither postextrasystolic beat is followed by neural silence.

There are several possible explanations for the differences between our results and Floras’s recording. First, his spontaneous premature beats are rather late coupled, occurring at approximately 80% of the preceding RR interval. Our study suggested that a coupling interval of 80% lies near the threshold of prematurity required to provoke sympathetic changes, and that coupling intervals <60% are generally needed to provoke maximal changes. Second, his second premature beat fell just three beats after the first. Our study employed single premature beats provoked after 8 to 10
sinus beats and did not address sympathetic responses to more frequent or complex ectopic beats. Finally, it is possible that sympathetic responses vary among patient groups. Perhaps, when sympathetic drive is intense, it is difficult to either further increase or suppress sympathetic nerve activity.

We thank Floras for sharing his recording and thoughts with us. Clearly, further study is needed to fully characterize sympathetic responses to cardiac arrhythmias.

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What Is the Role of Vagal Tone in the Genesis of Life-Threatening Ventricular Tachyarrhythmias in Humans?

Our recent clinical experience (1) is in agreement with the conclusions of Waxman et al. (2) in their study of the role of vagal tone in idioventricular rhythm, a benign ventricular arrhythmia. We (1) found that vagal tone may indeed play a substantial role even in life-threatening ventricular tachyarrhythmias in humans. At present, the effect of vagal activity on ventricular tachyarrhythmias is controversial. Although very limited clinical observations regarding the role of the vagus on ventricular instability are available, some data exist from experimental studies. In our experience (1), atropine administration (1 mg) in a stable patient and in the absence of acute myocardial ischemia induced a prolonged unusual dramatic ventricular rhythm necessitating direct current shock for termination. In particular, the rate of the arrhythmia was irregular and the QRS configuration varied continuously, which suggests that enhanced automaticity was probably the arrhythmia mechanism. In patients with marked vagal overactivity, the immediate vagal tone removal may result in a parasympathetic-sympathetic imbalance; as a consequence, the increased sympathetic activation may induce ventricular instability leading to this unusual ventricular tachyarrhythmia. We concluded that vagal tone per se may indeed be considered an important factor in the protection from malignant ventricular tachyarrhythmias in both animals and humans. A major limitation of all the experimental studies indicating a protective vagal effect on ventricular instability is that they have been performed in anesthetized animals. However, recent experimental studies in conscious dogs (3) have confirmed that manipulations of the autonomic nervous system may indeed decrease susceptibility to ventricular fibrillation; our clinical experience and that of Waxman et al. (2) clearly support these experimental observations.

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References


Reply

In the case described by Santinelli et al., intravenous atropine induced polymorphic ventricular tachycardia. The tachycardia developed before an increase in background atrial rate. Atrial pacing up to 110 beats/min did not induce any arrhythmias. Thus it appears that the ventricular tachycardia was not secondary to a rise in atrial rate induced by atropine. In Figure 3 of the article by Santinelli et al., there is a considerable amount of ST segment depression in lead V, after restoration of sinus rhythm. This finding, coupled with the patient's significant triple vessel coronary disease, raises the possibility that atropine induced myocardial ischemia, which in turn started the ventricular tachycardia. Atropine could induce myocardial ischemia by increasing the effects of background sympathetic tone on the heart secondary to blockade of muscarinic receptors in the region of sympathetic nerve terminals.


Correction

In Gillebert et al. (J Am Coll Cardiol 1989;13:483-90), the first line of the abstract should read: 'To analyze the influence of loading patterns on cardiac pump performance and cardiac relaxation, the effects of preload on peak length-tension relation and of systolic load clamps on peak length-tension relation and on relaxation were analyzed in isolated cat papillary muscles.'