Committed DVI Pacing

The article by Luceri et al. (1) implies that it was the committed design of the atrioventricular (AV) sequential pacemaker used in their patient that led to the repetitive induction of rapid polymorphous ventricular tachycardia, and from this single case suggest caution in the use of these devices. While I know of no therapy that is totally free of adverse affects in at least a small number of individuals even though benefitting the majority, I would submit that the case against committed DVI pacing is not unequivocally established in this report. Based upon a review of their published rhythms, there are a couple of additional explanations that warrant consideration. One was suggested by the authors. By my measurements, the QT interval in Figures 1 and 2 as measured from the ventricular pacing artifact to the end of the T wave is approximately 540 ms. When corrected for a pacing interval of 830 ms, the QT is 590 ms. This along with the morphology of the ventricular tachycardia as shown in Figure 3 favors a diagnosis of “torsade de pointes” arising from a relatively late cycle native ventricular beat (2,3). Torsade, while usually associated with an electrolyte imbalance or the type I antiarrhythmic drugs, may be triggered by a multiplicity of factors. The fact that the electrolytes were normal in this patient does not exclude the diagnosis.

The authors do state that the ventricular tachycardia only occurred after insertion of the pacemaker suggesting a cause and effect relation. The presence of the ventricular lead alone could have mechanically induced sufficient ventricular ectopic rhythm leading to the ventricular tachycardia as has been reported (4). In addition, they state that the arrhythmias were only observed when induced by an asynchronous ventricular stimulus; however, at least in their published rhythms, this was not a consistent phenomenon as shown in the bottom tracing of Figure 3.

I should also like to take issue with two statements in the body of the author’s text. They state that the “fixed refractory period is intended to avoid the potential hazzard of ventricular capture during the vulnerable period.” The fixed refractory period is intended to avoid cross-talk, a phenomenon whereby the ventricular output is inhibited by sensing of the far-field atrial stimulus (5). Limiting the AV interval to 150 ms or less is intended to avoid ventricular capture during the vulnerable period. This brings me to the second statement with which I disagree. They state that the “beginning of the ST segment” falls “within the so-called vulnerable period.” The early portion of the ST segment comprises the effective refractory period corresponding to phase II of the cardiac action potential while the vulnerable period tends to occur around the apex of the T wave or phase III of the cardiac action potential (6,7). The design of the committed DVI system reduces the AV interval to minimize its occurrence on the vulnerable period and thus limits the likelihood that it will directly induce ventricular tachycardia. The newer generation of modified committed DVI and DDD pacing systems, however, carry a much greater chance of problems. This is due to ability to program the AV interval, which makes it more likely to place the ventricular artifact in the vulnerable zone when the atrial stimulus otherwise coincides with the QRS and the blanking period in these units precludes appropriate sensing of the native ventricular signal (8).

Although I remain unconvinced that it was the committed design of this system that predisposed to this patient’s problems, I agree with the author’s conclusion concerning “the ability of a dual chamber pacing system to monitor ventricular events after atrial emission (that is, absence of committed stimulation and blanking).” Unfortunately the two truly noncommitted pacing systems that do this are no longer generally available. All the commercial and investigational systems result in a greater or lesser degree of ventricular refractoriness during the AV interval predisposing to some degree of competition. The value of AV sequential pacing over ventricular demand pacing has been now well established (9) and should not be discarded because noncommitted systems are no longer available. Problems will continue to occur and it is only from a careful evaluation of these spontaneous clinical events that we will learn how the design of the next generation of devices should be further modified. I would urge a return to dual bipolar dual chamber systems that will allow for truly noncommitted pacing systems.

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References

Reply

The comments made by Levine may indeed be applicable, but they stray from the main point and scope of the article. The exact mechanism of propagation of the ventricular tachycardia is irrelevant to the case, whether it is torsade de pointes, vulnerability, latency or local reentry. What does matter is the fact that in this patient, every episode of ventricular tachycardia followed a committed ventricular stimulus; none occurred either spontaneously or when the pacer was inhibited. Therefore, they must be viewed as provoked episodes. Second, the period of vulnerability to stimulation varies considerably and is dependent upon the myocardial
substrate, humoral and neural factors among others. While generally occurring near the T wave, repetitive response may be seen as early as 145 ms after onset of ventricular depolarization as reported by Brooks et al. (1) in 1955. Furthermore, most paced patients suffer from some type of myocardial disease and usually take cardioactive medications, factors which may modify general physiologic characteristics derived from study of normal tissue. Most importantly, however, this single case report is presented to highlight the problems that may occur with any asynchronous (that is, nonphysiologic) pacing stimulus, and the need to intervene appropriately. Finally, in regard to future design, I wholeheartedly support Levine’s plea for “truly noncommitted pacing systems.”

The race to release new technology must be tempered by concerns for patient needs and physician understanding.

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