Response to Pacing at Sites of Isolated Diastolic Potentials During Ventricular Tachycardia in Patients With Previous Myocardial Infarction

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Objectives. The goal of this study was to determine whether isolated diastolic potentials (IDPs) recorded during ventricular tachycardia (VT) are generated in zones of slow conduction and whether the arcs of block that bound these zones of slow conduction are functional or anatomic in nature.

Background. No previous studies have systematically investigated the response to pacing during VT and sinus rhythm at sites where IDPs are recorded.

Methods. The study included 11 patients with a previous infarction who underwent radiofrequency catheter ablation of 15 hemodynamically stable, sustained VTs and in whom an IDP that could not be dissociated from the VT was detected during mapping.

Results. Pacing during VT at the site where the IDP was recorded resulted in concealed entrainment in each of the 15 VTs. In 10 of the 15 VTs, an IDP was present during sinus rhythm at the same site at which a diastolic potential was recorded during VT. In nine VTs, the isolated potential occurred early in diastole; in these cases, the QRS configuration during pacing in the setting of sinus rhythm was different from that during VT. In six VTs, the isolated potential occurred later in diastole, and in these cases, the QRS configuration during pacing in the setting of sinus rhythm was the same as that during VT.

Conclusions. Isolated diastolic potentials may often be generated in an area of slow conduction bounded by arcs of block that are anatomically determined and present during sinus rhythm.

Methods

Patient characteristics. The study included 11 patients with coronary artery disease who underwent a radiofrequency catheter ablation procedure for hemodynamically stable, sustained VT and in whom an IDP that could not be dissociated from the VT was detected during mapping. There were 10 men and one woman (mean \(\pm SD\) age 62 \(\pm 16\) years). Each patient had a history of myocardial infarction 2 to 12 years earlier (anterior in 3 patients, inferior in 5 patients and both anterior and inferior in 3 patients). The mean left ventricular ejection fraction was 0.26 \(\pm 0.08\). The clinical presentation consisted of frequent discharges from an implantable cardioverter-defibrillator (ICD) in five patients, incessant VT in four patients and sustained palpitations in two patients. At the time of the electrophysiologic procedure, nine patients were being treated with amiodarone and one patient with procainamide. Nine of the 11 patients in this study also were the subjects in a previous study that examined the value of concealed entrain-
ment as a guide for catheter ablation of VT (7). The 11 patients in this study were part of a pool of 34 patients with coronary artery disease who underwent an ablation procedure for VT during the period of this study.

Characteristics of VT (Table 1). An IDP that could not be dissociated from the VT was recorded in 15 different VTs induced in the 11 patients in this study. The mean cycle length of the VTs was 474 ± 96 ms. Eight of the 15 VTs had a left bundle branch block configuration and seven had a right bundle branch block configuration.

Electrophysiologic testing. The electrophysiologic procedures were performed in the fasting state after written, informed consent was obtained. An electrode catheter inserted into a femoral vein and positioned in the right ventricle was used for programmed ventricular stimulation with a protocol employing four extrastimuli (8). Left ventricular mapping and ablation were performed with a 7F quadripolar electrode catheter that had an interelectrode spacing of 2-5-2 mm, a deflectable tip and a 4-mm distal electrode (EP Technologies or Mansfield). The catheter was inserted into the left ventricle using a retrograde aortic approach from the femoral artery. A bolus of 5,000 U of heparin was administered intravenously at the beginning of the procedure, followed by 1,000 U of heparin every hour.

The intracardiac electrograms and leads V1, I, II and III were displayed on an oscilloscope and recorded using a Mingograph 7 recorder (Siemens, Solna, Sweden) at a paper speed of 100 mm/s. The left ventricular endocardial electrograms were recorded at filter settings of 50 to 500 Hz. Pacing was performed with a programmable stimulator (Bloom Associates). A 12-lead electrocardiogram was recorded whenever hemodynamically stable VT was induced. Sustained VT was defined as VT lasting at least 30 s or requiring termination because of loss of consciousness.

Study protocol. To simultaneously pace and record in bipolar fashion at endocardial sites as close together as possible, electrodes 1 and 3 of the mapping catheter were used for bipolar pacing and electrodes 2 and 4 were used for recording. Left ventricular sites were paced using stimuli that had a pulse width of 2 ms and a current strength 1 to 2 mA higher than the capture threshold, up to 10 mA. If there was not reliable capture at an output of 10 mA, the pulse width was increased as necessary to a maximum of 9 ms. Pacing was performed during VT and sinus rhythm at all sites where there was an IDP that could not be dissociated from the VT by pacing maneuvers (2,3). Because IDPs that can be dissociated from the VT probably are generated in dead-end pathways that are not part of the reentrant circuit (2,3,9), these types of diastolic potentials were excluded from consideration in this study. When VT was incessant, pacing during sinus rhythm was performed after ablation of the tachycardia.

An IDP was defined as a discrete depolarization separated by an isoelectric segment from the main component of the ventricular electrogram associated with the QRS complex. A segment of an electrogram recording was considered to be isoelectric if it was a straight line at a gain setting of 20 to 40 mm/mV. The location of the IDP within diastole was characterized using the diastolic potential index, defined as the interval from the end of the QRS complex to the onset of the IDP, divided by the interval between the end of the QRS complex and the onset of the next QRS complex. A diastolic potential index <0.5 was indicative of a potential within the first half of electrical diastole, and an index of ≥0.5 was indicative of a potential within the second half of diastole (Fig. 1).

**Abbreviations and Acronyms**

ICD = implantable cardioverter-defibrillator
IDP = isolated diastolic potential
VT = ventricular tachycardia

**Figure 1.** Examples of IDPs recorded during VT. A, An IDP (arrows) that occurs early in diastole during VT no. 1. The diastolic potential index is 0.15. Shown are leads V1, I and II; the intracardiac electrograms recorded at the right ventricular apex (RVA) and the inferobasal left ventricle (Inf-basal LV) at gain settings of 10 and 40 mm/mV; and lead III. B, An IDP (arrows) that occurs late in diastole during VT no. 3. The diastolic potential index is 0.76. Shown are leads V1, I and II; the intracardiac electrograms recorded at the right ventricular apex and anterobasal left ventricle (Ant-basal LV) at gain settings of 40 and 80 mm/mV; and lead III.
Concealed entrainment was defined as entrainment of VT at two or more pacing cycle lengths, with no change in the QRS configuration during pacing as compared with the VT, and with a stimulus-QRS interval of at least 60 ms (4,5). The pacing trains consisted of 10 to 15 stimuli at cycle lengths 10 to 130 ms shorter than the VT cycle length. Pacing during sinus rhythm was performed at cycle lengths similar to the pacing cycle lengths used to demonstrate concealed entrainment.

Delivery of radiofrequency energy. Radiofrequency energy was delivered during VT at sites where there was an IDP that could not be dissociated from the VT. The radiofrequency energy was delivered as a continuous, unmodulated sine wave at a frequency of 500 kHz (EP Technologies). The initial power setting was 10 W, and the power was titrated upwards, at a frequency of 500 kHz (EP Technologies). The initial power setting was 10 W, and the power was titrated upwards, as guided by temperature or impedance monitoring (10), to attain a temperature of 60°C. Once this end point was reached, the power setting was 10 W, and the power was titrated upwards, to a frequency of 500 kHz (EP Technologies). The initial power setting was 10 W, and the power was titrated upwards, to a frequency of 500 kHz (EP Technologies). The initial power setting was 10 W, and the power was titrated upwards, to a frequency of 500 kHz (EP Technologies). The initial power setting was 10 W, and the power was titrated upwards, to a frequency of 500 kHz (EP Technologies). The initial power setting was 10 W, and the power was titrated upwards, to a frequency of 500 kHz (EP Technologies).

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Programmed ventricular stimulation then was repeated to determine if the targeted VT was still inducible. For the purposes of this study, an effective target site was defined as a site at which radiofrequency energy terminated the VT and prevented the reinduction by programmed ventricular stimulation of the targeted VT.

Follow-up. After the ablation procedure, therapy was continued with the same antiarrhythmic medications that the patients were being treated with at the time of the procedure. Patients were seen in an outpatient clinic every 3 months by one of the authors or by the referring physician.

Statistical analysis. Continuous variables are expressed as mean value ± SD. Continuous variables were compared using the Student t test or by analysis of variance with repeated measures. Discrete variables were compared with the Fisher exact test or by chi-square analysis. Correlations between continuous variables were determined by regression analysis. A p value <0.05 was considered significant.

Results

Isolated diastolic potentials during VT (Tables 1 and 2). The mean diastolic potential index was 0.34 ± 0.2 (range 0.12 to 0.76). In 12 of the VTs, the IDP was located within the first half of diastole, and in three VTs, the IDP was located within the second half of diastole.

Response to pacing during VT (Table 2). Pacing during VT at the site where the IDP was recorded resulted in concealed entrainment in each of the 15 VTs in this study. The mean stimulus-QRS interval during concealed entrainment was 215 ± 76 ms (range 70 to 320). This did not differ significantly from the mean diastolic potential-QRS interval during undisturbed VT of 201 ± 74 ms (range 70 to 330, p = 0.15). There was a significant correlation between the diastolic potential-QRS interval during undisturbed VT and the stimulus-QRS interval during concealed entrainment (r = 0.88, p < 0.001).

Isolated diastolic potentials during sinus rhythm. In 10 of the 15 VTs, an IDP was present during sinus rhythm at the same site at which a diastolic potential was recorded during VT (Table 2). In five cases, the IDP recorded during sinus rhythm had the same configuration as that of the IDP recorded during VT (Fig. 2). When an IDP was present during sinus rhythm, the mean diastolic potential index during VT was 0.31 ± 0.19; this did not differ significantly from the mean diastolic potential index of 0.41 ± 0.21 in the VTs in which a diastolic potential was not present during sinus rhythm (p = 0.4).

Response to pacing during sinus rhythm (Table 2). In no instance did overdrive pacing in the setting of sinus rhythm induce VT during the study protocol. With five of the VTs, pacing during sinus rhythm at the same site at which the IDP was recorded during VT resulted in QRS complexes that had

Table 1. Characteristics of Ventricular Tachycardias

<table>
<thead>
<tr>
<th>Patient</th>
<th>Infarct Site</th>
<th>VT No.</th>
<th>VT CL (ms)</th>
<th>VT Configuration</th>
<th>IDP Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inferior</td>
<td>1</td>
<td>400</td>
<td>RBBB, sup.</td>
<td>Inferobasal</td>
</tr>
<tr>
<td>2</td>
<td>Inferior, anterior</td>
<td>2</td>
<td>480</td>
<td>LBBB, sup.</td>
<td>Midseptum</td>
</tr>
<tr>
<td>3</td>
<td>Anterior</td>
<td>3</td>
<td>490–620</td>
<td>RBBB, inf.</td>
<td>Anterobasal</td>
</tr>
<tr>
<td>4</td>
<td>Anterior</td>
<td>4</td>
<td>450</td>
<td>LBBB, sup.</td>
<td>Anterobasal</td>
</tr>
<tr>
<td>5</td>
<td>Anterior</td>
<td>5</td>
<td>670</td>
<td>LBBB, sup.</td>
<td>Midseptum</td>
</tr>
<tr>
<td>6</td>
<td>Inferior</td>
<td>6</td>
<td>490</td>
<td>RBBB, sup.</td>
<td>Anteropical</td>
</tr>
<tr>
<td>7</td>
<td>Inferior, anterior</td>
<td>7</td>
<td>410</td>
<td>RBBB, sup.</td>
<td>Inferopical</td>
</tr>
<tr>
<td>8</td>
<td>Inferior</td>
<td>8</td>
<td>370</td>
<td>RBBB, sup.</td>
<td>Midinferior wall</td>
</tr>
<tr>
<td>9</td>
<td>Inferior</td>
<td>9</td>
<td>400</td>
<td>RBBB, inf.</td>
<td>Anterobasal</td>
</tr>
<tr>
<td>10</td>
<td>Inferior</td>
<td>10</td>
<td>510</td>
<td>LBBB, inf.</td>
<td>Midseptum</td>
</tr>
<tr>
<td>11</td>
<td>Anterior</td>
<td>11</td>
<td>550</td>
<td>LBBB, sup.</td>
<td>Infereobasal sept</td>
</tr>
<tr>
<td>12</td>
<td>Inferior</td>
<td>12</td>
<td>480</td>
<td>RBBB, inf.</td>
<td>Inferobasal sept</td>
</tr>
<tr>
<td>13</td>
<td>Inferior</td>
<td>13</td>
<td>520</td>
<td>LBBB, inf.</td>
<td>Midinferior wall</td>
</tr>
<tr>
<td>14</td>
<td>Inferior</td>
<td>14</td>
<td>285</td>
<td>LBBB, sup.</td>
<td>Inferobasal</td>
</tr>
<tr>
<td>15</td>
<td>Anterior</td>
<td>15</td>
<td>610</td>
<td>LBBB, inf.</td>
<td>Inferobasal sept</td>
</tr>
</tbody>
</table>

CL = cycle length; IDP = isolated diastolic potential; inf = inferior axis; LBBB = left bundle branch block; RBBB = right bundle branch block; sup. = superior axis; VT = ventricular tachycardia.
the same configuration as the VT (Fig. 3). With nine VTs, the QRS configuration during pacing in the setting of sinus rhythm was different from that during VT (Fig. 4). With one of the VTs, pacing during sinus rhythm at the site where an IDP was recorded during VT resulted in QRS complexes that had a variable configuration, one of which was the same as that of the VT (Fig. 5).

An IDP was recorded during sinus rhythm in three of the six VTs (50%) in which some or all of the QRS complexes had the same configuration when pacing in the setting of sinus rhythm as that during VT. In comparison, an IDP was recorded during sinus rhythm in seven of the nine VTs (78%) in which the QRS configuration when pacing in the setting of sinus rhythm was different from that during VT (p = 0.3).

When there was an identical QRS configuration during VT and during pacing in the setting of sinus rhythm, the mean stimulus–QRS interval during concealed entrainment (144 \pm 62 ms) and the mean stimulus–QRS interval during pacing in the setting of sinus rhythm (153 \pm 60 ms) did not differ significantly (p = 0.2). In contrast, when the QRS configuration during VT was different from that during pacing in the setting of sinus rhythm, the mean stimulus–QRS interval during concealed entrainment (262 \pm 39 ms) was significantly longer than the mean stimulus–QRS interval when pacing during sinus rhythm (103 \pm 27 ms) (p < 0.001).

**Diastolic potential index and response to pacing in sinus rhythm.** When the QRS complexes had the same configuration in response to pacing in the setting of sinus rhythm as that during VT, the mean diastolic potential index during VT was 0.54 \pm 0.14. This was significantly greater than the mean diastolic potential index of 0.21 \pm 0.08 in the cases in which pacing in the setting of sinus rhythm resulted in QRS complexes that had a different configuration from that during VT (p < 0.001) (Fig. 6).

Whenever the diastolic potential index during VT was \( \geq 0.43 \), the QRS configuration during pacing in the setting of sinus rhythm was the same as that during VT. In contrast, whenever the diastolic potential index was \( \leq 0.37 \), the QRS configuration during pacing in the setting of sinus rhythm was different from that during VT (Fig. 6). In the one instance in which pacing in the setting of sinus rhythm resulted in QRS complexes of variable configuration, the diastolic potential index had an intermediate value of 0.39.

**Results of ablation.** Thirteen (87%) of the 15 VTs were successfully ablated by application of radiofrequency energy at

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**Table 2.** Intervals Measured During Ventricular Tachycardia, Responses to Pacing During Ventricular Tachycardia and Sinus Rhythm and Presence of Isolated Diastolic Potential During Sinus Rhythm

<table>
<thead>
<tr>
<th>VT No.</th>
<th>DPI</th>
<th>IDP-QRS During VT (ms)</th>
<th>S-QRS During CE (ms)</th>
<th>S-QRS When Pacing During SR (ms)</th>
<th>Same QRS Complexes When Pacing During VT and SR</th>
<th>IDP in SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.15</td>
<td>220</td>
<td>300</td>
<td>100</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>0.43</td>
<td>220</td>
<td>220</td>
<td>230</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>0.76</td>
<td>120</td>
<td>210</td>
<td>140</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>0.21</td>
<td>210</td>
<td>300</td>
<td>70</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>5</td>
<td>0.55</td>
<td>225</td>
<td>215</td>
<td>220</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>6</td>
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<td>250</td>
<td>220</td>
<td>100</td>
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<td>Yes</td>
</tr>
<tr>
<td>7</td>
<td>0.12</td>
<td>150</td>
<td>150</td>
<td>70</td>
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</tr>
<tr>
<td>8</td>
<td>0.45</td>
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<td>150</td>
<td>140</td>
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<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>0.22</td>
<td>285</td>
<td>300</td>
<td>120</td>
<td>No</td>
<td>Yes</td>
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<tr>
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<td>70</td>
<td>70</td>
<td>80</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>11</td>
<td>0.23</td>
<td>230</td>
<td>230</td>
<td>108</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>12</td>
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<td>240</td>
<td>240</td>
<td>80</td>
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<td>Yes</td>
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<tr>
<td>13</td>
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<td>270</td>
<td>260</td>
<td>140</td>
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<td>15</td>
<td>0.14</td>
<td>330</td>
<td>320</td>
<td>140</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

CE = concealed entrainment; DPI = diastolic potential index; IDP-QRS = isolated diastolic potential–QRS interval; IDP = isolated diastolic potential; S-QRS = stimulus–QRS interval; SR = sinus rhythm; VT = ventricular tachycardia.

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**Figure 2.** An example of an IDP (arrows) recorded during sinus rhythm at the same inferobasal left ventricular (Inf-basal LV) site as during VT no. 1 (see Fig. 1A). Note that the IDPs recorded during sinus rhythm and during VT have very similar configurations. RVA = right ventricular apex.
the sites where the IDPs were recorded. Among 10 sites where a diastolic potential was present during sinus rhythm, the diastolic potential was no longer present at six sites after successful ablation. The ablation was unsuccessful in Patients 7 and 8. Patient 7, who underwent the ablation procedure because of incessant VT, was treated with a combination of amiodarone and mexiletine. Patient 8, who underwent the ablation procedure because of frequent ICD discharges, underwent a second ablation procedure that was successful; an IDP was not present at the effective target site.

During a mean follow-up interval of 14 ± 21 months (range 2 to 60), none of the patients died. Among the four patients with incessant VT at the time of the ablation procedure, none had any further episodes of incessant VT. Among the five patients who underwent the ablation procedure because of frequent ICD discharges, there were no further instances of frequent discharges. The two patients who underwent the ablation procedure because of recurrent episodes of VT associated with palpitations experienced no further episodes of symptomatic VT.

**Discussion**

**Main findings.** The results of this study demonstrate the following new findings relating to IDPs that cannot be dissociated from monomorphic VT in patients with previous myocardial infarction: 1) pacing during VT at sites at which IDPs are recorded consistently results in concealed entrainment; 2)
in a majority of cases, an IDP is present during sinus rhythm at the same site that demonstrates an IDP during VT, and the IDP recorded during sinus rhythm at times has the same configuration as the one recorded during VT; and 3) the response to pacing during sinus rhythm correlates with the relative timing of the IDP during VT. When an isolated potential occurs early in diastole during VT, pacing in the setting of sinus rhythm at the same site generates QRS complexes that do not have the same configuration as the VT. In contrast, when an isolated potential occurs relatively late in diastole during VT, pacing in the setting of sinus rhythm results in QRS complexes that have the same configuration as the VT. These findings suggest that IDPs that cannot be dissociated from VT may often be generated in an area of slow conduction that is bounded by arcs of block that are anatomically determined and present during sinus rhythm.

**Figure 4.** An example of different QRS configurations when pacing during VT (no. 1) and in the setting of sinus rhythm. The electrocardiogram was recorded six leads at a time. **A,** Pacing at a cycle length of 350 ms was performed during VT at the same inferobasal left ventricular site where the early IDP was recorded in Figure 1A. The last six stimuli (S) of the pacing train are shown. The VT cycle length was 400 ms. Pacing results in concealed entrainment, with a stimulus–QRS interval of 300 ms, and no change in the QRS configuration compared with that of VT. The last entrained QRS complexes are designated with an asterisk. **B,** Pacing at a cycle length of 350 ms, in the setting of sinus rhythm, at the same inferobasal site as that in **A.** The stimulus–QRS interval now has shortened to 100 ms, and the QRS complexes have a left bundle branch block configuration, compared with a right branch block configuration during VT.

**Concealed entrainment.** In previous clinical studies, the evidence that IDPs identify a critical zone of slow conduction in the reentry circuit of VT consisted of the inability to dissociate the diastolic potential from the VT, and the high success rate of catheter ablation of VT at sites where an IDP was recorded (2,3). By demonstrating the uniform concordance between the occurrence of concealed entrainment and the presence of an IDP, the present study provides additional, independent evidence that IDPs originate in a zone of slow conduction.

**Isolated diastolic potentials during sinus rhythm.** In two-thirds of cases, an IDP was recorded during sinus rhythm at the same site at which an isolated potential was present during VT. This finding indicates that the zone of slow conduction in which the IDP is generated during VT often is present during sinus rhythm also. The fact that the IDPs were present in the...
absence of VT and when the rate was much slower than during VT strongly suggests that they often originate in areas of slow conduction bounded by anatomic, and not functional, arcs of block. Furthermore, the observation that the IDP recorded during sinus rhythm often has the same configuration as the one recorded during VT suggests that the zone of slow conduction, at times, may be activated in the same fashion during sinus rhythm as during VT.

Pacing during sinus rhythm. When pacing is performed in the setting of sinus rhythm at a site that demonstrates concealed entrainment during VT, there is typically a different QRS configuration than during VT and a shorter stimulus–QRS interval than during concealed entrainment (5,13). In marked contrast to the typical disparity in the responses to pacing during VT and sinus rhythm, pacing during VT and sinus rhythm in several instances in the present study resulted in identical QRS complexes and very similar stimulus–QRS intervals. This observation provides additional evidence that the zone of slow conduction in these VTs was present during sinus rhythm and that its boundaries consisted of anatomic arcs of block.

In this study, a diastolic potential index ≤0.37 was always associated with disparate QRS configurations in response to

![Figure 5](image5.png)

**Figure 5.** A case in which pacing during sinus rhythm resulted in QRS complexes of varying configuration. **A,** An IDP (arrows) recorded at the inferobasal left ventricle (Inf-basal LV) in VT no. 14. The VT cycle length is 285 ms, and the diastolic potential–QRS interval is 100 ms. The IDP occurs near the middle of the diastolic interval, with a diastolic potential index of 0.39. Pacing at this site during VT resulted in concealed entrainment, with a stimulus–QRS interval of 100 ms (not shown). From top to bottom are leads V1, I and II; the intracardiac electrograms recorded at the right ventricular apex (RVA) and the inferobasal left ventricle at gain settings of 40 and 10 mm/mV; and lead III. **B,** Twelve-lead electrocardiograms recorded during the same VT as that shown in A and during pacing at a cycle length of 360 ms in the setting of sinus rhythm at the inferobasal site shown in A, where the IDP was recorded. Note that pacing results in QRS complexes of variable configuration, some of which are very similar to the QRS complexes during VT and some of which are different (asterisks). The stimulus–QRS intervals were 100 and 90 ms, respectively, for the QRS complexes that did and did not have the same configuration as the VT.

![Figure 6](image6.png)

**Figure 6.** A comparison of the diastolic potential indexes at sites at which the QRS complexes had the same or different configurations during VT and during pacing in the setting of sinus rhythm. Also shown is the mean value ± SD.
pacing in the setting of sinus rhythm and VT. This can be explained by pacing within a zone of slow conduction during sinus rhythm at a site that is closer to the entrance than to the exit of the slow pathway; in this case, the paced wave front would exit the zone of slow conduction in the antiodromic direction, through its entrance site, resulting in a different QRS configuration from that during VT. Consistent with this explanation is the observation that the stimulus–QRS interval during pacing in the setting of sinus rhythm was shorter than that when pacing during VT.

If pacing were performed during sinus rhythm at the midpoint of a zone of slow conduction whose borders were anatomically determined, the wave fronts propagating in the orthodromic and antidromic directions might reach the exit and entrance sites of the zone of slow conduction at approximately the same time. This may explain the response to pacing in the setting of sinus rhythm in Patient 10, in whom the diastolic potential index had an intermediate value of 0.39 and in whom pacing resulted in some QRS complexes that did and some that did not have the same configuration as the VT.

**Mechanism of anatomic block.** In the VTs in which IDPs were recorded at basal locations in the left ventricle, it is possible that the mitral or aortic annulus and the infract border served as the anatomically determined areas of block. Consistent with this possibility, previous studies in patients undergoing surgical ablation of VT have demonstrated that some patients with inferior infarction may have a critical isthmus between the mitral annulus and the border of the infract scar (14,15). Furthermore, a recent study demonstrated that in one-third of patients with VT and previous inferior infarction, this isthmus functions as an area of slow conduction critical to the maintenance of the VT (16).

Most of the sites at which IDPs were recorded in the present study were not basal in location. In these cases, it is likely that the anatomically determined arcs of block consisted of infract-related scar tissue. This possibility is consistent with the results of previous studies of surgically resected endocardium and subendocardium in patients with VT and previous infarction demonstrating that viable myocardial fibers may be embedded in or interdigitated with fibrous tissue (17–19).

**Comparisons with previous studies.** In a canine model of postinfarction VT, the arcs of conduction block were found to be either purely or partially functional in nature (1). Arcs of functional or both fixed and functional conduction block also have been demonstrated by high density intraprofate mapping of VT in several patients with previous infarction (20,21). Furthermore, the resetting response of VT in patients with previous myocardial infarction has provided evidence that the arcs of block are at least partially functional in nature (22). Although this may often be the case, the results of the present study suggest that an IDP that cannot be dissociated from the VT identifies a subgroup of VTs in which the arcs of block may be entirely anatomic in nature.

**Study limitations.** The first limitation of this study is that it does not provide information on how commonly IDPs are present during VT in patients with previous infarction. The subjects in this series represent a selected group of patients, all of whom had VTs in which IDPs were found. Concurrently, in other patients who underwent catheter ablation procedures in our laboratory, target sites were selected based on other criteria, including endocardial activation time, concealed entrainment or pace mapping, without searching for IDPs before ablation (23). A determination of the prevalence of IDPs will require a consecutive series of patients in whom complete mapping is performed before delivery of ablative lesions.

Second, ablation was performed at the first site that demonstrated an IDP that could not be dissociated from the VT. This approach did not allow for assessment of the relation between changes in the diastolic potential index and the response to pacing during sinus rhythm within individual patients. Finally, most of the patients in this study were being treated with an antiarrhythmic drug, and all of the VTs were hemodynamically stable. Therefore, the results of this study may not apply to unselected cases of VT.

**Conclusions.** Isolated diastolic potentials that cannot be dissociated from VT in patients with previous infarction are a reliable marker of a zone of slow conduction in the tachycardia reentry circuit. Although several different lines of evidence indicate that the borders of the area of slow conduction often consist of lines of block that are functional in nature (1,5,13,20–22), the results of this study suggest that IDPs that cannot be dissociated from the VT identify a subset of VTs in which the arcs of block may be anatomically determined and present during sinus rhythm. Perhaps because they identify areas of slow conduction whose border are fixed in nature, IDPs are an excellent guide for the selection of target sites for catheter ablation of VT. Their prevalence among patients with previous infarction and VT remains to be determined, as does the reason they may be generated in zones of slow conduction bounded by arcs of block more likely to be anatomic than functional in nature.

**References**


