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Clinical Application of Artificial Intelligence: Sustained Ventricular Tachycardia Termination Using Intrinsic Antitachycardia Pacing

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Background

- **iATP allows the device to analyze the post pacing interval to determine if the ATP failed to reach the circuit, reset but failed to terminate the VT, or had loss of capture. Based on the determined cause of failure to respond to ATP, subsequent sequences will either adjust the number of S1 stimuli, adjust the S2/S3 extra stimuli CL, or add additional S3 stimuli to the prior sequences in order to optimize the ATP for the patient's particular reentrant VT circuit (Figure 1).**
- To our knowledge, we present the first clinical case of a successful VT termination using iATP in the United States.

Case description

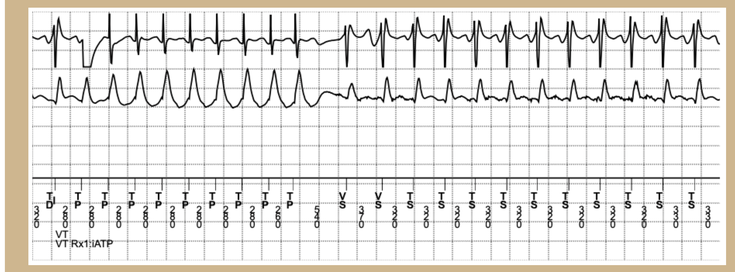
- 73-year-old F presented with **sustained monomorphic VT**, HR 230/min.
- Cardiac MRI showed severe asymmetric hypertrophy of the LV and systolic anterior motion of the anterior mitral leaflet with flow acceleration consistent with **hypertrophic obstructive cardiomyopathy (HOCM).**
- A **single chamber ICD (Medtronic Cobalt XT VR DVPA2D4)** was implanted
- 3 months after discharge: ICD interrogation showed 2 arrhythmic episodes falling into the VF zone (> 188/min) each successfully terminated by single shock and 2 episodes of fast VT with CL 320 ms (188/min) successfully terminated after 6 sequences of iATP.

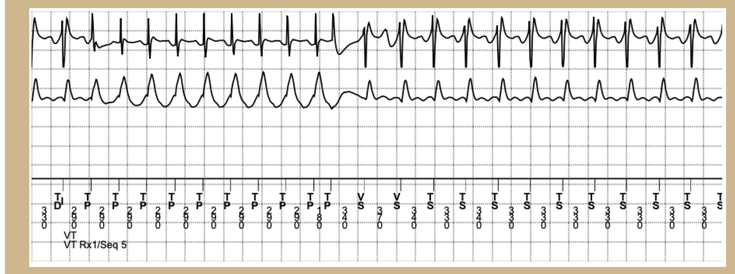
Conclusions

- Current ATP algorithms are effective at reducing unnecessary ICD shocks that provide discomfort to patients, however, they are limited to the preprogrammed parameters that determine the cycle length and type of antitachycardia pacing sequences delivered.
- The machine-based artificial intelligence of the iATP program permits the device to adjust subsequent therapies and to learn from each failed pacing attempt so subsequent pacing sequences approach the cycle length needed to terminated VT episodes.
- While more studies are required to compare the iATP algorithm with current ATP algorithms, this case illustrates the adaptability of iATP gives it an advantage in terminating VT episodes compared to standard ATP.

Figure 1: iATP algorithm

		Failed to Reach VT Circuit	Reset	Loss of Capture
Learns		ATP did not reach circuit. Not enough S1 pulses to reach VT circuit	Enough S1 to reach VT circuit, but S2 was not fast enough to terminate VT	ATP pulse paced into refractory period and lost capture at the electrode
Adapts Next Sequence	S1	• Pulse Interval: Always 88% of VTCL • Number of Pulses: Calculates using VTCL and distance (varies by type of unsuccessful ATP		
	Distance:	Adds 100 ms to assumed 150 ms to increase number of S1 pulses needed to reach VT circuit	Calculates the PPI. If distance is closer, iATP decreased number of S1 pulses	Uses distance from sequence that lost capture
	S2/S3	Uses same extra stimulus from previous sequence	Decrements last extra stimulus (either S2 or S3) by 20-30 ms	• Sets S2 pulse based on previously captured S2 • Adds S3 (sets S3 interval same as S2 interval that did not capture)
	Main Adjustment	+ S1	↓S2/S3	↑S2+S3





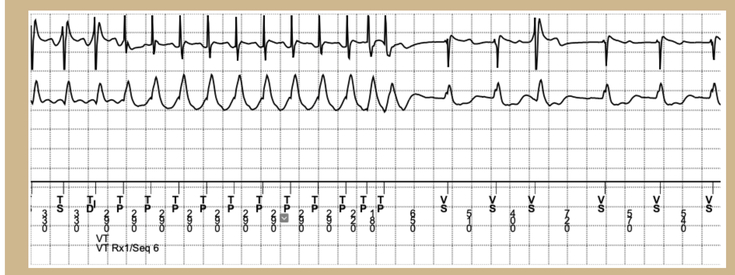


Figure 2:, 3 and 4 : **the initial iATP sequence with a default S1 of 88% VT cycle length gave S1/S2 of 280/260 ms which captured and reset the tachycardia as evidenced by a post pacing interval of 540 ms (Figure 2). Subsequent iATP sequences appropriately decreased the S2 interval for a reset but failure to terminate VT until loss of capture occurred during the fifth iATP with an S2 of 180 ms (Figure 3). For the sixth sequence of iATP the S2 was increased back to 200 ms and an additional S3 at 180 ms was added, which successfully terminated the VT (Figure 4).**