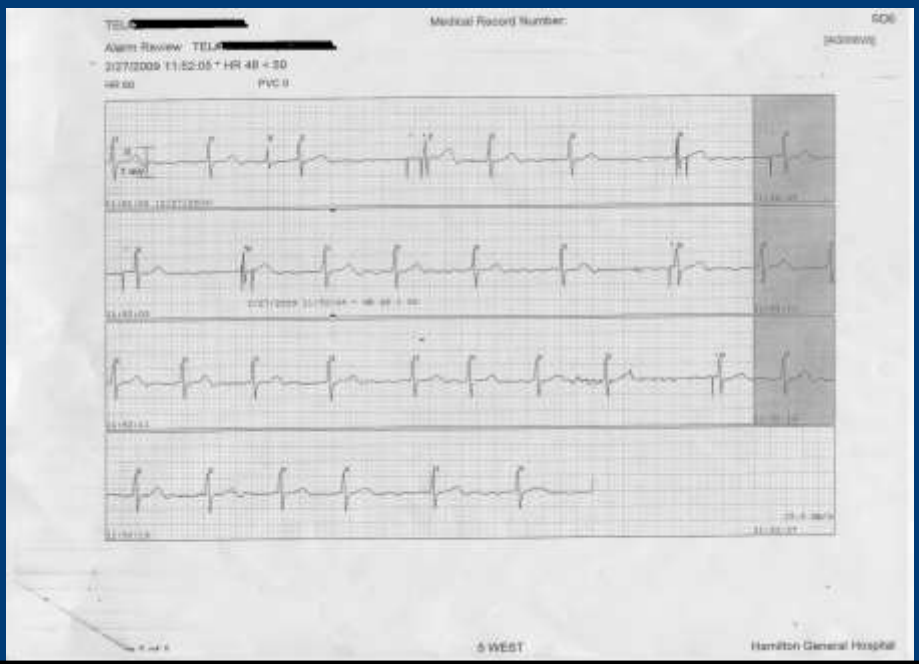
When Simple Becomes complex

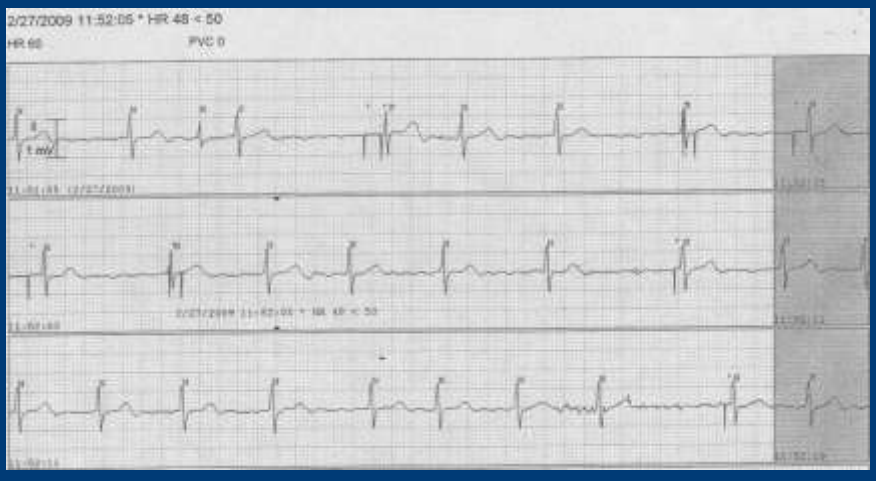
Mohammad Hassan Khedr
MD Cardiology
EP fellowship
McMaster University

CASE

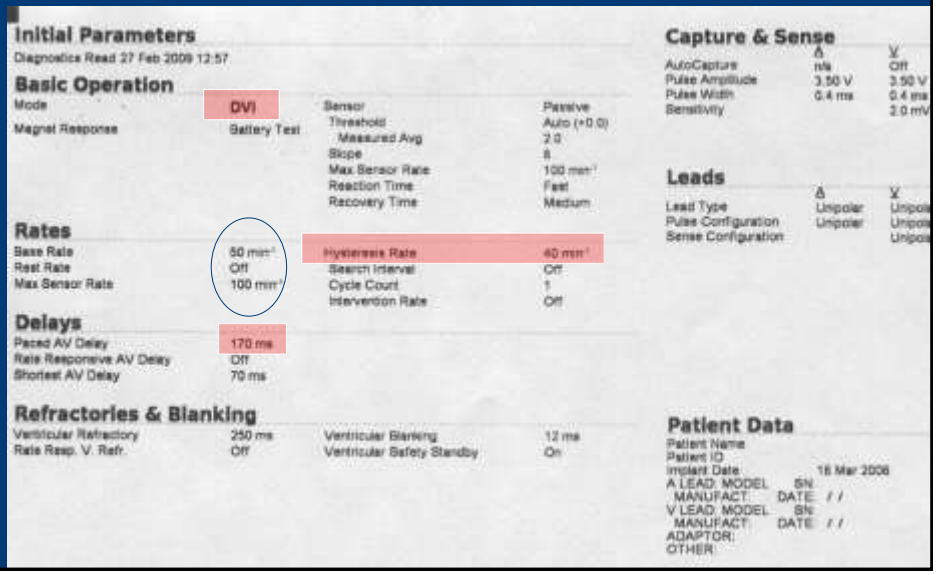
- 83 y old lady
- SSS with pacer in 1993,2006
- History of A FIB.
- CAD ,Hypercholesterolemia ,HTN
- Admitted for vascular surgery.
- Arrhythmia service was consulted because of suspected malfunction of the device .



Malfunction or not ?



Parameters



Initial Parameters

Diagnostics Read 27 Feb 2009 12:57

Basic Operation

Mode	DVI	Sensor	Passive
Magnet Response	Battery Test	Threshold	Auto (+0.0)
		Measured Avg	2.0
		Slope	8
		Max Sensor Rate	100 min⁻¹
		Reaction Time	Fast
		Recovery Time	Medium

Rates

Base Rate	50 min⁻¹	Hysteresis Rate	40 min⁻¹
Rest Rate	Off	Search Interval	Off
Max Sensor Rate	100 min⁻¹	Cycle Count	1
		Intervention Rate	Off

Delays

Paced AV Delay	170 ms
Rate Responsive AV Delay	Off
Shortest AV Delay	70 ms

Refractories & Blanking

Ventricular Refractory	250 ms	Ventricular Blanking	12 ms
Rate Resp. V. Refr.	Off	Ventricular Safety Standby	On

Capture & Sense

	A	V
AutoCapture	n/a	Off
Pulse Amplitude	3.50 V	3.50 V
Pulse Width	0.4 ms	0.4 ms
Sensitivity		2.0 mV

Leads

	A	V
Lead Type	Unipolar	Unipol
Pulse Configuration	Unipolar	Unipol
Sense Configuration		Unipol

Patient Data

Patient Name
Patient ID
Implant Date: 16 Mar 2006
A LEAD: MODEL SN:
MANUFACT: DATE: / /
V LEAD: MODEL SN:
MANUFACT: DATE: / /
ADAPTOR:
OTHER:

NASPE/ BPEG Generic (NBG) Pacemaker Code

I. Chamber Paced	II. Chamber Sensed	III. Response to Sensing	IV. Programmability Rate Modulation	V. Antitachy arrhythmia funct.
O= none	O= none	O= none	O= none	O= none
A=atrium	A= atrium	T= triggered	P= simple	P= pacing
V= ventricle	V= ventricle	I= inhibited	M= multi	S= shock
D= dual (A+V)	D= dual (A+V)	D= dual (T+I)	C= communication	D= dual
			R= Rate Modulation	

Manufacturers' Designation only:

S= single (A or V)	S= single (A or V)

DVI MODE

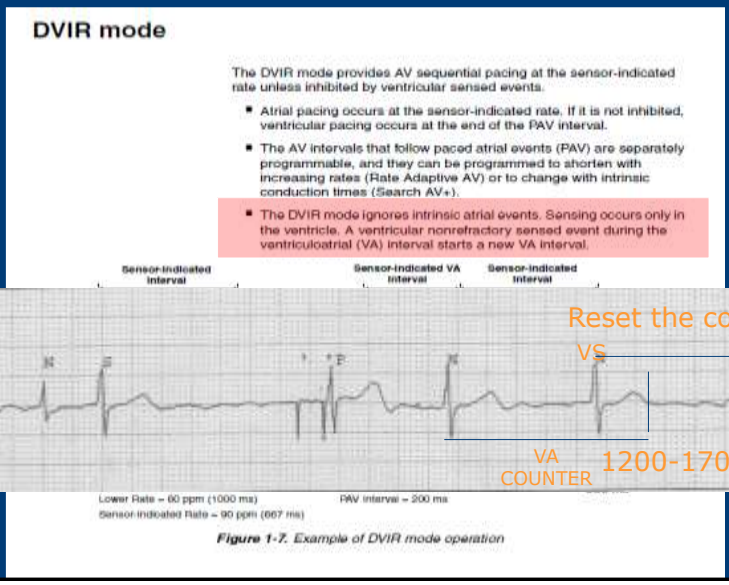


Figure 1-7. Example of DVIR mode operation

D VI pacing

- The purpose of this mode of pacing is to add a atrial pacing but not sensing circuit to standard VVI circuit, thus providing a normal A-V sequence in case of atrial bradycardia.

- Two types of DVI pacing modes are available:

The non-committed mode, originally designed by Berkovitz. Atrial pacing is followed by ventricular stimulation in the absence of spontaneous QRS sensed during the preset or programmed A-V delay.

The committed mode:

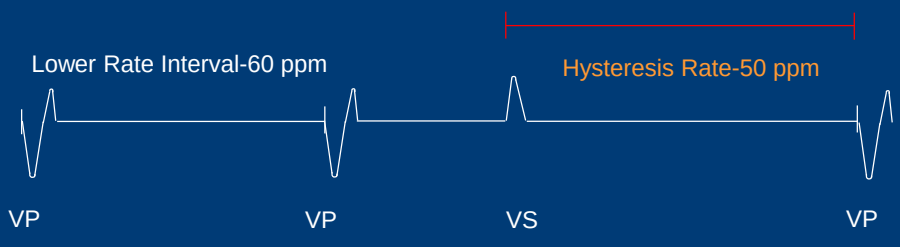
- Every atrial stimulus is always followed by a ventricular stimulus; the ventricular refractory period includes the entire A-V delay which cannot be over 150 ms to minimize the risk of "T" wave stimulation.
- The only advantage of committed DVI pacing is the elimination of possible inhibition by cross talk.
- In 1983, DVI pacing is generally considered as a 2nd choice mode of DC pacing which can be selected when DDD pacing cannot be safely achieved. This was too frequently the case in 1982

- In DVI mode, sensing of an intrinsic ventricular depolarization (following either an atrial pacing spike or intrinsic atrial depolarization), inhibits ventricular pacing.
- In the absence of any intrinsic cardiac depolarization, the pacemaker behaves like a DOO. Since there is no atrial sensing, there is a possibility that the atrial pacing stimulus will not be inhibited even though there is an intrinsic atrial rhythm. This may lead to competition if the atrium is beating at a faster rate, and can precipitate atrial arrhythmias.
- For this reason, DDI or DDD are preferable to DVI in patients with atrial rates high enough to compete with the pacing rate.

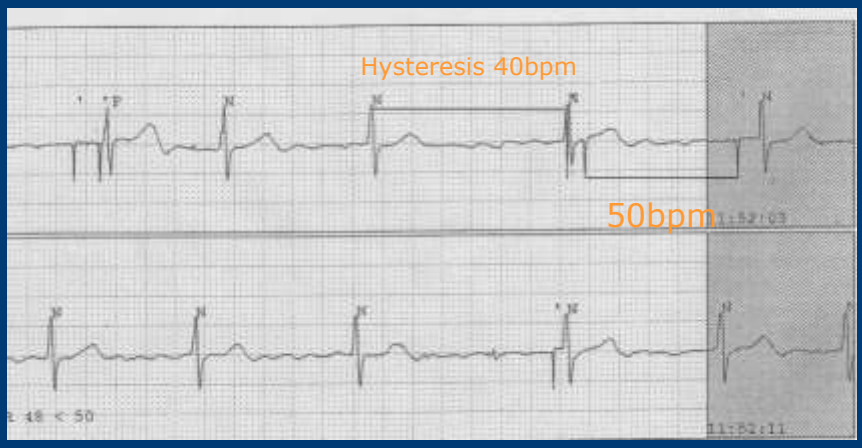
- DVI is primarily used for immediate treatment of pacemaker-mediated tachycardia. If a ventricular paced beat is conducted retrograde to the atria, atrial sensing might interpret this as intrinsic atrial activity, which in DDI and DDD modes would precipitate a release of a ventricular stimulus creating a 'loop' pacemaker-mediated tachycardia

Hysteresis

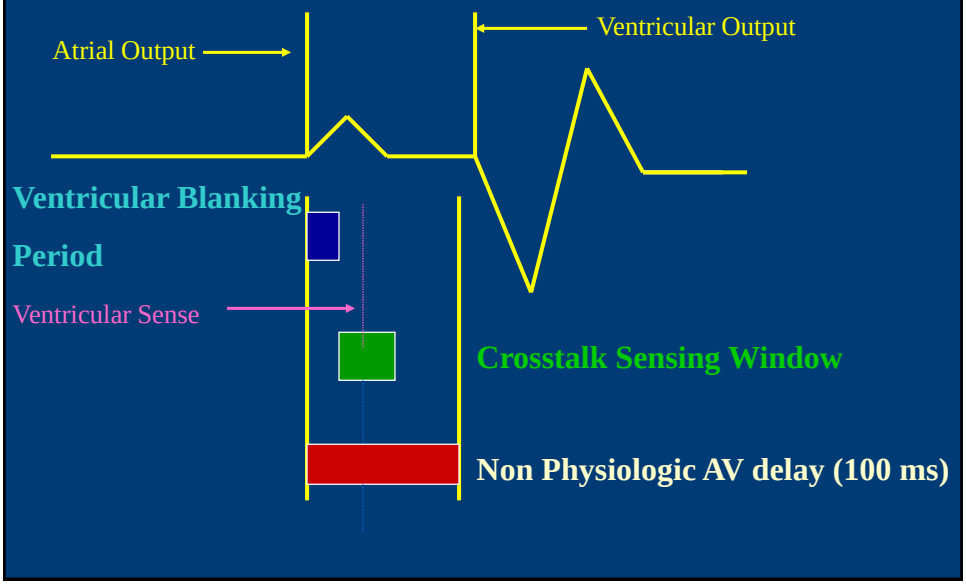
- Allows the rate to fall below the programmed lower rate following an intrinsic beat



Hysteresis

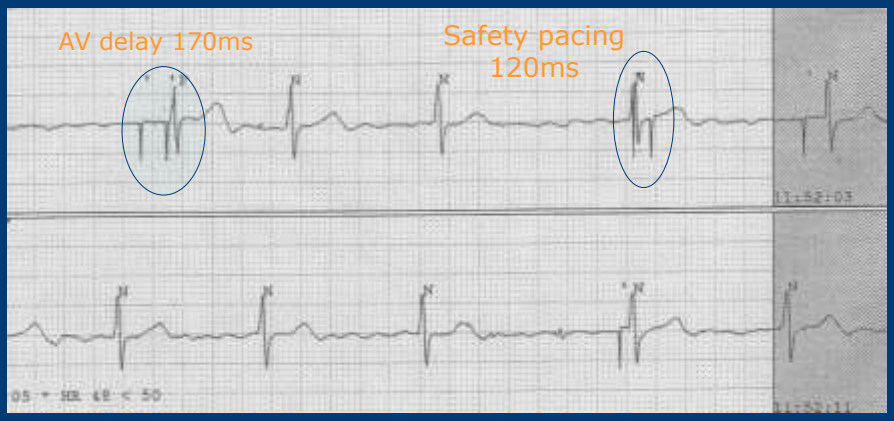


Safety Pacing



Crosstalk Sensing Window

- **A short (25-40ms) period of time that starts at the end of the ventricular blanking period**
- **If during this time interval the ventricular lead senses an event (may be crosstalk, may also be a PVC), a ventricular output pulse is delivered after 100 ms = SAFETY PACING**
- **This 100 ms time period = Non Physiologic AV delay**



Notes

- Programming the device to DVI was inappropriate and confusing.
- Safety pacing and hysteresis can disturb the normal excepted pattern
- Programmig of the device to VVI mode was our option