
Pacemaker Zaman Aralıkları

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Ege ÜTF Kardiyoloji AD

Plan



- Genel konular
- Pacing Modları
- Tek/ çift odacık pacemaker temel zaman aralıkları
- Refrakter periyotlar
- Refrakter periyodlarla ilişkili sorunlar, algoritmalar

Pacing EKG'si incelerken

- Pil hangi modda
 - Ventriküler pace/ sens
 - Atriyal pace/sens
 - AV ilişki
- Sorun var mı? Neden olmuş olabilir?
- Nasıl çözerim?

AS	Atrial Sense - After Refractory and AFR window
AS-Hy	Atrial Sense - In Hysteresis Offset
AS-FI	Atrial Sense - In AFR window
(AS)	Atrial Sense - During TARP
AP	Atrial Pace - Lower Rate
AP↓	Atrial Pace - Rate Smoothing Down
AP↑	Atrial Pace - Rate Smoothing Up
AP-FB	Atrial Pace - Fallback (in ATR)
AP-Hy	Atrial Pace - At Hysteresis Rate
AP-Sr	Atrial Pace - Sensor Rate
AP→	Atrial Pace - Inserted after AFR
AP-Ns	Atrial Pace - Noise (asynchronous pacing)
AP-Tr	Atrial Pace - Trigger Mode
RVS	Right Vent Sense - After Refractory
[RVS]	Right Vent Sense - During Blanking
RVP	Right Vent Pace - Lower Rate or Atrial Tracked
RVP↓	Right Vent Pace - Rate Smoothing Down
RVP↑	Right Vent Pace - Rate Smoothing Up
RVP-FB	Right Vent Pace - Fallback (in ATR)
RVP-Hy	Right Vent Pace - At Hysteresis Rate
RVP-Sr	Right Vent Pace - Sensor Rate
RVP-MT	Right Vent Pace - Atrial Tracked at MTR
RVP-Ns	Right Vent Pace - Atrial Tracked at MTR
RVP-Tr	Right Vent Pace - Trigger Mode
RVP-VRR	Right Vent Pace - Ventricular Rate Regulation
LVS	Left Vent Sense - After Refractory
[LVS]	Left Vent Sense - During Blanking
LVP	Left Vent Pace - Lower Rate or Atrial Tracked
LVP↓	Left Vent Pace - Rate Smoothing Down
LVP↑	Left Vent Pace - Rate Smoothing Up
LVP-Hy	Left Vent Pace - At Hysteresis Rate
LVP-Sr	Left Vent Pace - Sensor Rate
LVP-MT	Left Vent Pace - Atrial Tracked at MTR
LVP-Ns	Left Vent Pace - Noise (asynchronous pacing)
LVP-Tr	Left Vent Pace - Trigger Mode
LVP-VRR	Left Vent Pace - Ventricular Rate Regulation
Inh-LVP	Left Vent Pace - Inhibited Due to LVPP
PVC	PVC after Refractory

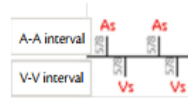
Biotronik

As/AP	Atrial sensing/pacing
Vs/Vp	Ventricular sensing/pacing
LVP/LVs	Left ventricular pacing/sensing
RVP/RVs	Right ventricular pacing/sensing
ArS	Atrial refractory sensing
ArS (FFP)	ArS in far-field protection window
Vrs	Ventricular refractory sensing
Aflut	Atrial flutter detected
Afib	Atrial fibrillation detected
Msw/DDI	Modeswitch to DDI
Det. VF	VF detected
Rdt.	Redetection criteria are fulfilled
1:1	1:1 A:V ratio
Charging of the capacitors	
Term.	Tachycardia episode has terminated

VT-1	VT-1 Zone Sense
VT	VT Zone Sense
VF	VF Zone Sense
AN	Atrial Rate Noise
RVN	Right Ventricular Rate Noise
LVN	Left Ventricular Rate Noise
ATR↓	Atrial Tachycardia Sense - Count Down
ATR↑	Atrial Tachycardia Sense - Count Up
ATR-Dur	ATR Duration Started
ATR-FB	ATR Fallback Started
ATR-End	ATR Fallback Ended
FB	ATR in Progress
RID-TU	Rhythm ID Template Update
RID+	Rhythm ID Correlated
RID-	Rhythm ID Uncorrelated
C--	RhythmMatch™ Correlated without percentage
U--	RhythmMatch™ Uncorrelated without percentage
PVP→	PVARP after PVC
PMT-B	PMT Termination
AF-Rhythm	AFib Rhythm
V-Epsd	Ventricular Tachy Start Episode
V-EpsdEnd	Ventricular Tachy End Episode
V>A	Ventricular Rate Faster than Atrial Rate
AFibV	V AFib Criteria Met
V-Dur	Duration Met
Ssb	Stable
Unsb	Unstable
Sudden	Sudden Onset
Gradl	Gradual Onset
V-Detect	Ventricular Detection Met
Chrg	Start/End Charge
Dvrt	Therapy Diverted
Shock	Shock Delivered
SRD	Sustained Rate Duration Expired

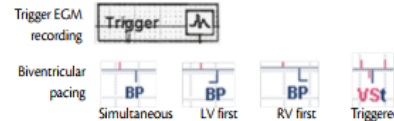
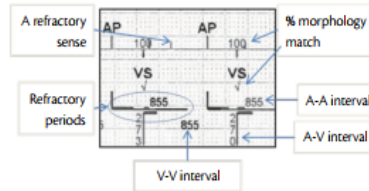
Medtronic

AS/AP	Atrial sensing/pacing
AR	Atrial refractory sense
Ab	Atrial event in blanking period
VS/Vp	Ventricular sensing/pacing
BV	Biventricular pace
VR	Ventricular refractory sense
TS	Sense in (slow) VT zone
T-F	Sense in fast VT zone via VT
TF-	Sense in fast VT zone via VF
FS	Sense in VF zone
TDI	VT detected
TFI	FVT detected
FDI	VF detected
TP	Tachy pace (ATP)
CE	Charge end



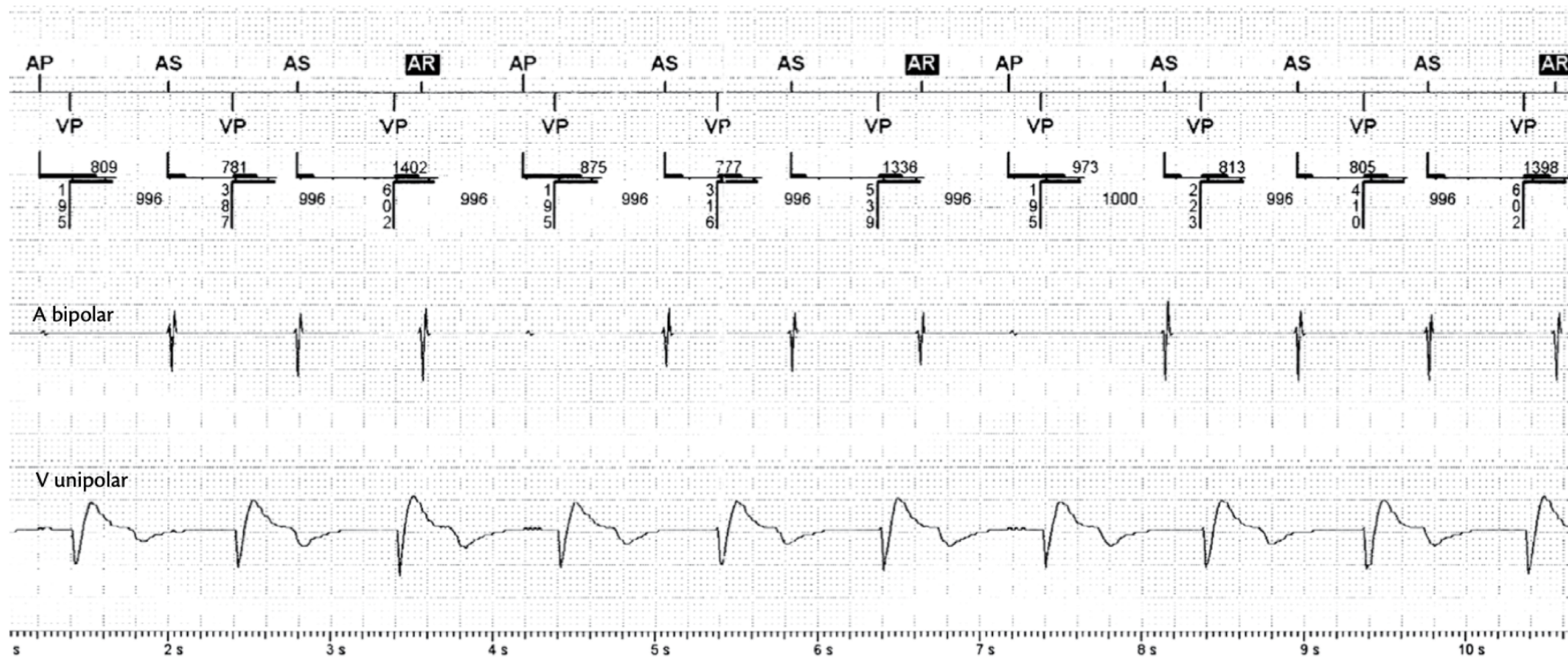
Ap/A	Atrial pacing
As/P	Atrial sensing
Ar	Atrial refractory sensing
Vs/R	Ventricular sensing
Vp	Ventricular pacing
Vr	Ventricular refractory sensing
bV	Biventricular pacing

St-Jude Medical



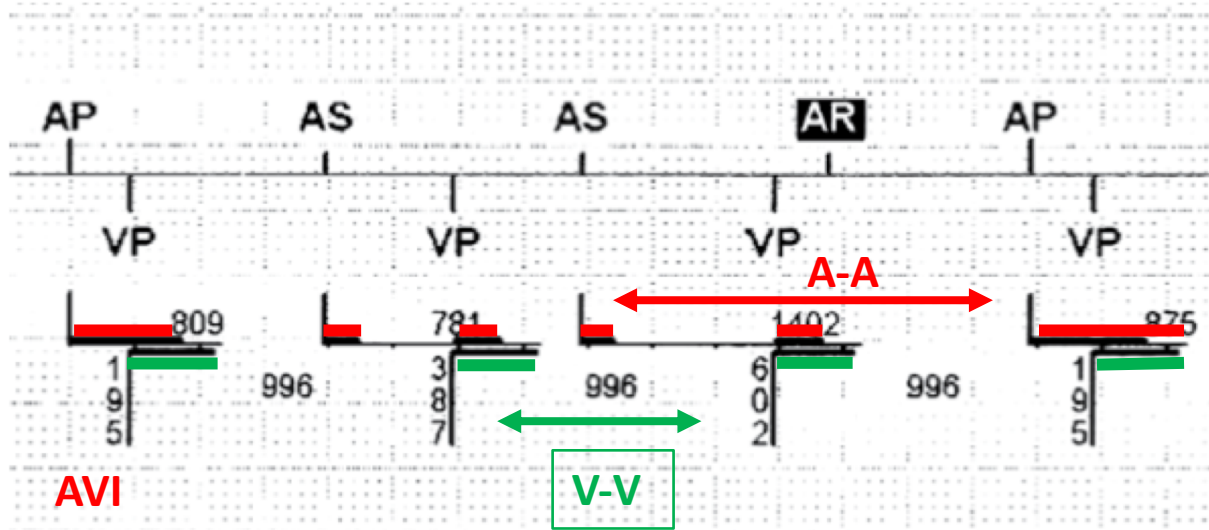
A/MS	Modeswitch
LOC	Loss of capture
VPP	Ventricular backup pacing
-	Interval that is not binned
VS	Binning of interval in Sinus zone
T1	Binning of interval in VT1 zone
T2	Binning of interval in VT2 zone
F	Binning of VF interval
E	Reconfirmation of VF

- VS: Sens
- VP: Pace
- VB: Blanking
- VR: Refrakter
- AS: Sens
- AP: Pace
- AB: Blanking
- AR: Refrakter



Sweep Speed: 25,0 mm/s Page 1A

Rhythm Strip Page 1B



Atrial refrakter dönem

Ventriküler refrakter dönem

$60.000 / \text{.....ms} = \text{.....vuru/dk}$

$60.000 / \text{.....vuru/dk} : \text{.....ms}$

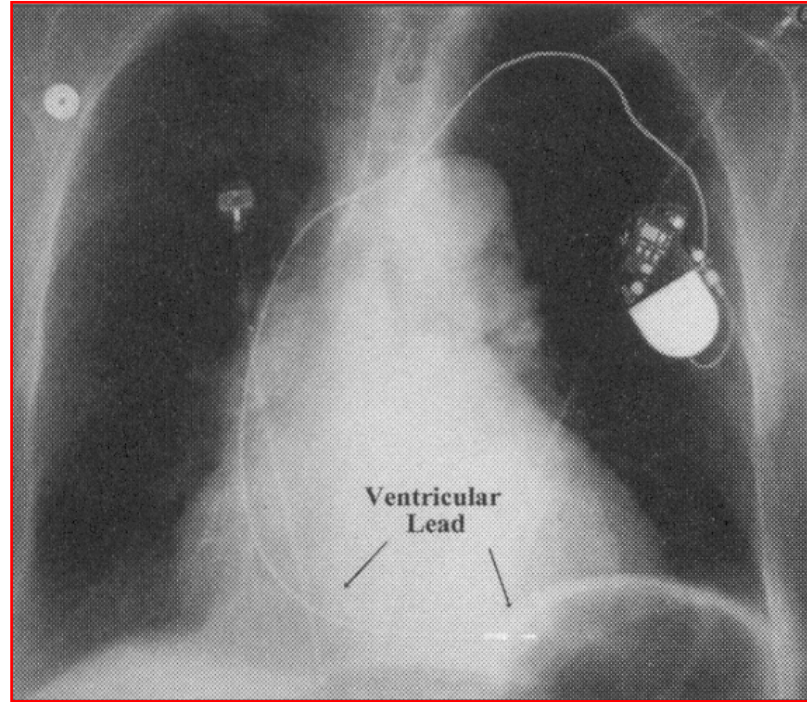
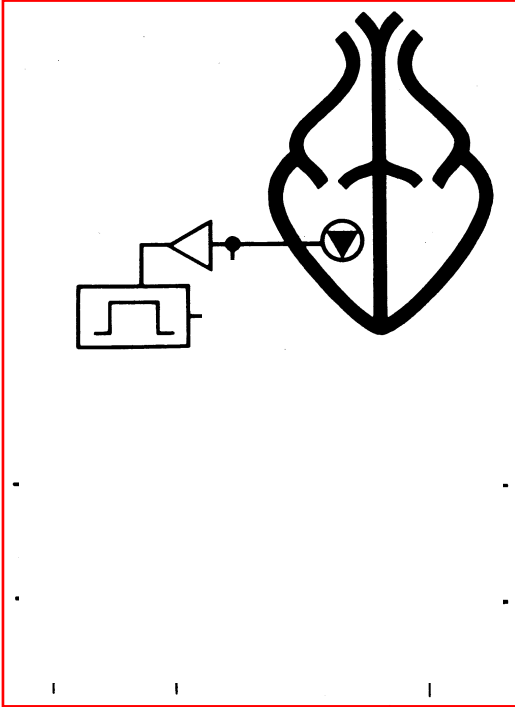
NBG (NASPE/BPEG) kodlama

Uyarı / Pace	Algılama / Sens	Algılama yanıtı	Hız yanıtı	Multiside Pace
A:Atriyum	A:Atriyum	I: İnhibe	-	A:Atriyum
V:Ventrikül	V:Ventrikül	T:Tetikleme - Ventrikül sens alırsa uyarı verme - Atriyal sens algılsa AV gecikme tetikleme	R: Hız yanıtı	V:Ventrikül
D: Dual	D: Dual	D: Dual		D: Dual
O: Yok	O: Yok	O: Yok		O: Yok

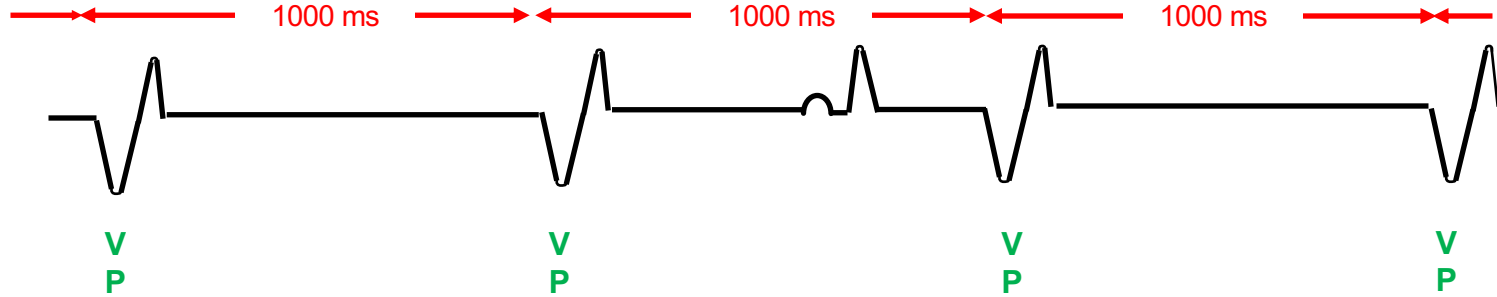
Temel zaman aralıkları-I

- Tek odacıklı kalp pilleri
 - Alt hız aralığı (Lower rate interval- LRI)
- Çift odacıklı kalp pilleri
 - Alt hız aralığı (Lower rate interval- LRI)
 - Atriyo ventriküler aralık (Atrioventricular interval- AVI)

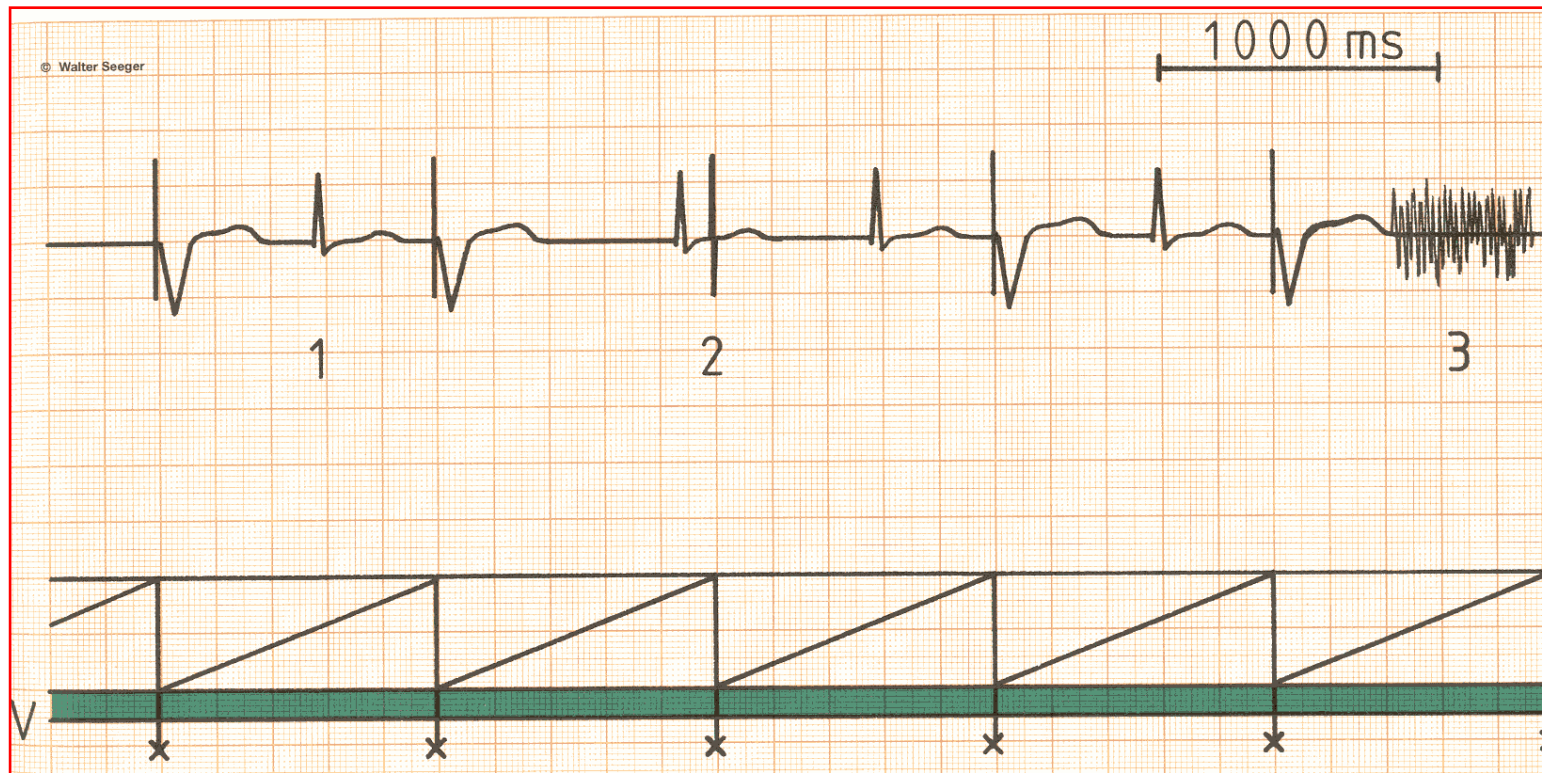
V00 Pacing



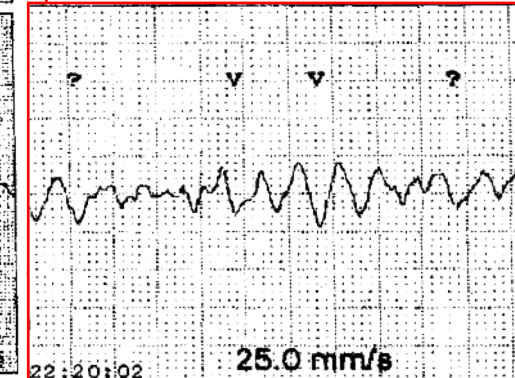
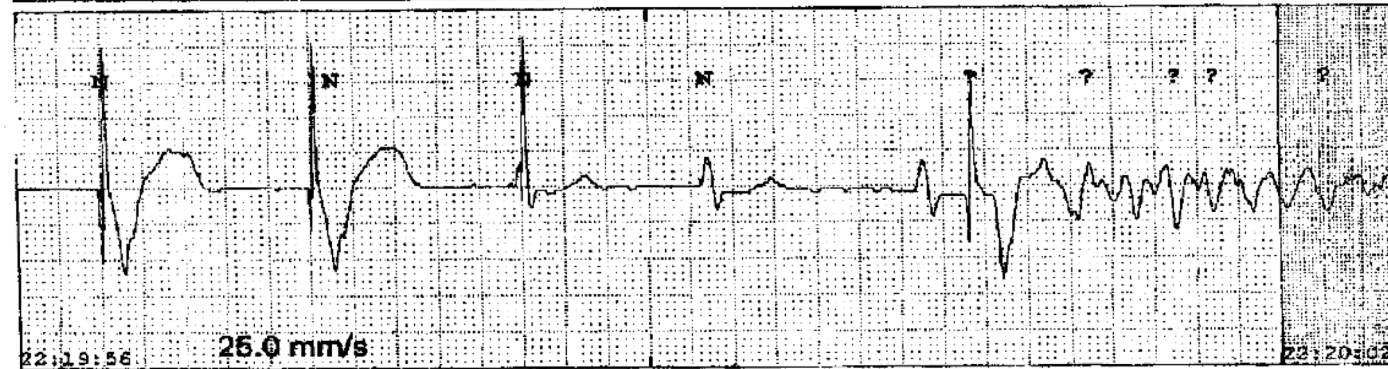
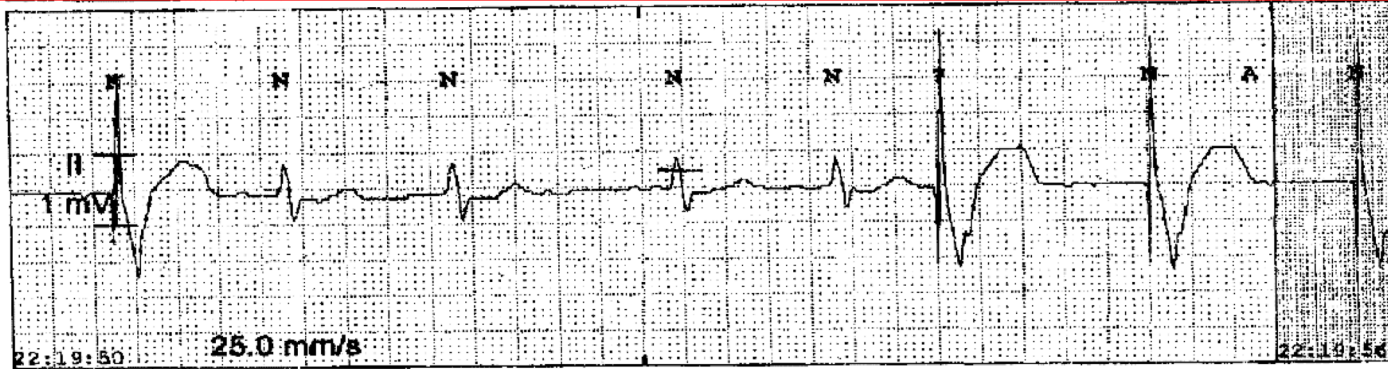
VOO Pacing



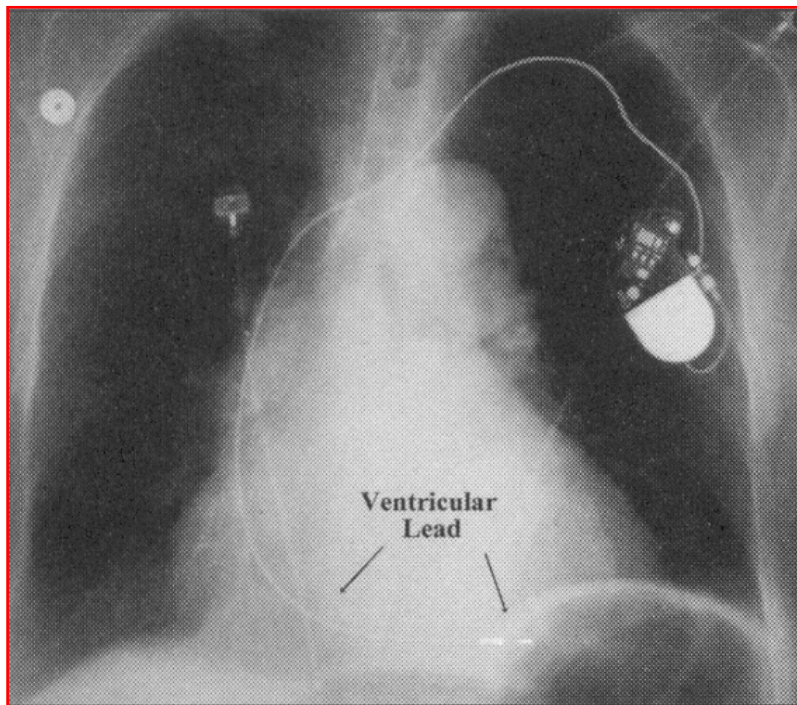
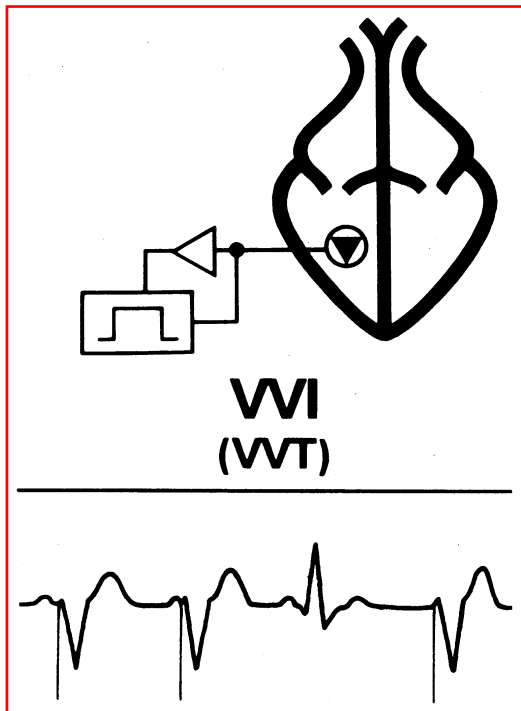
VOO Pacing



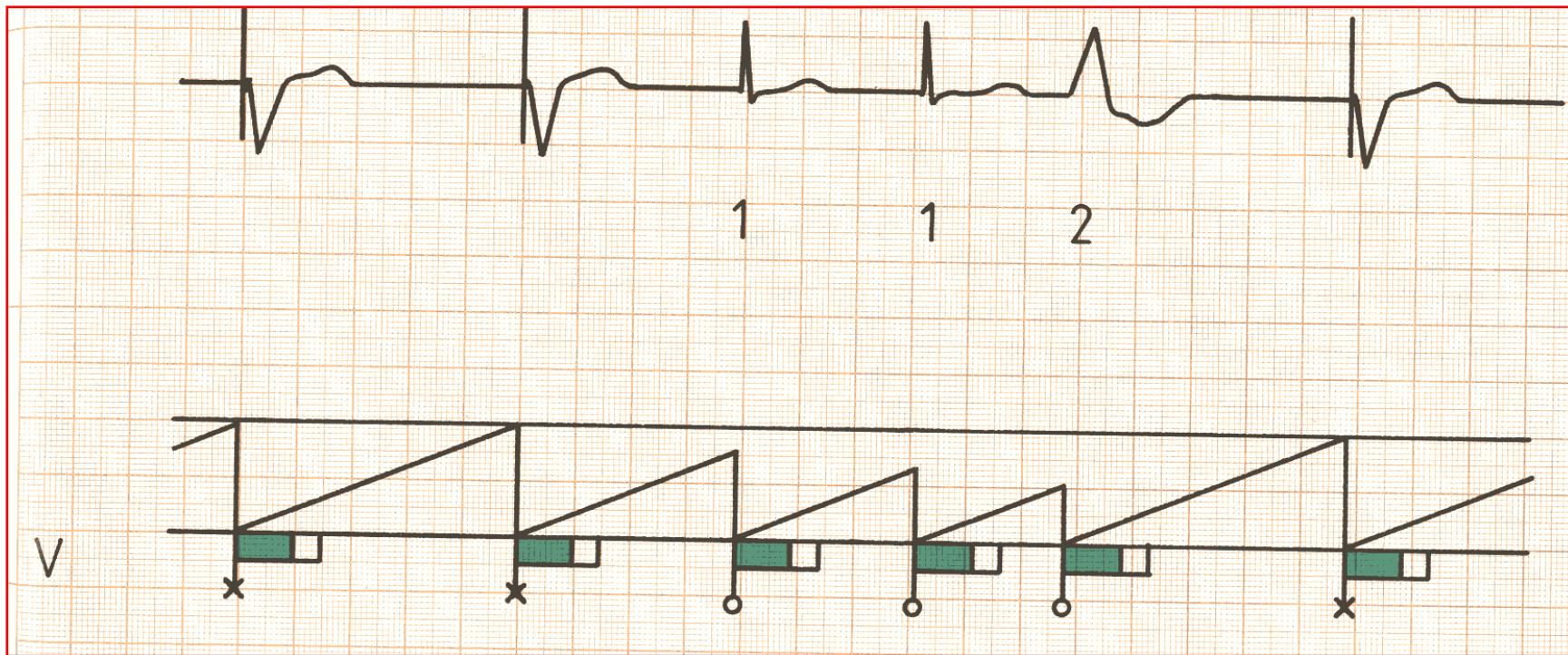
VOO Pacing- Magnet modu



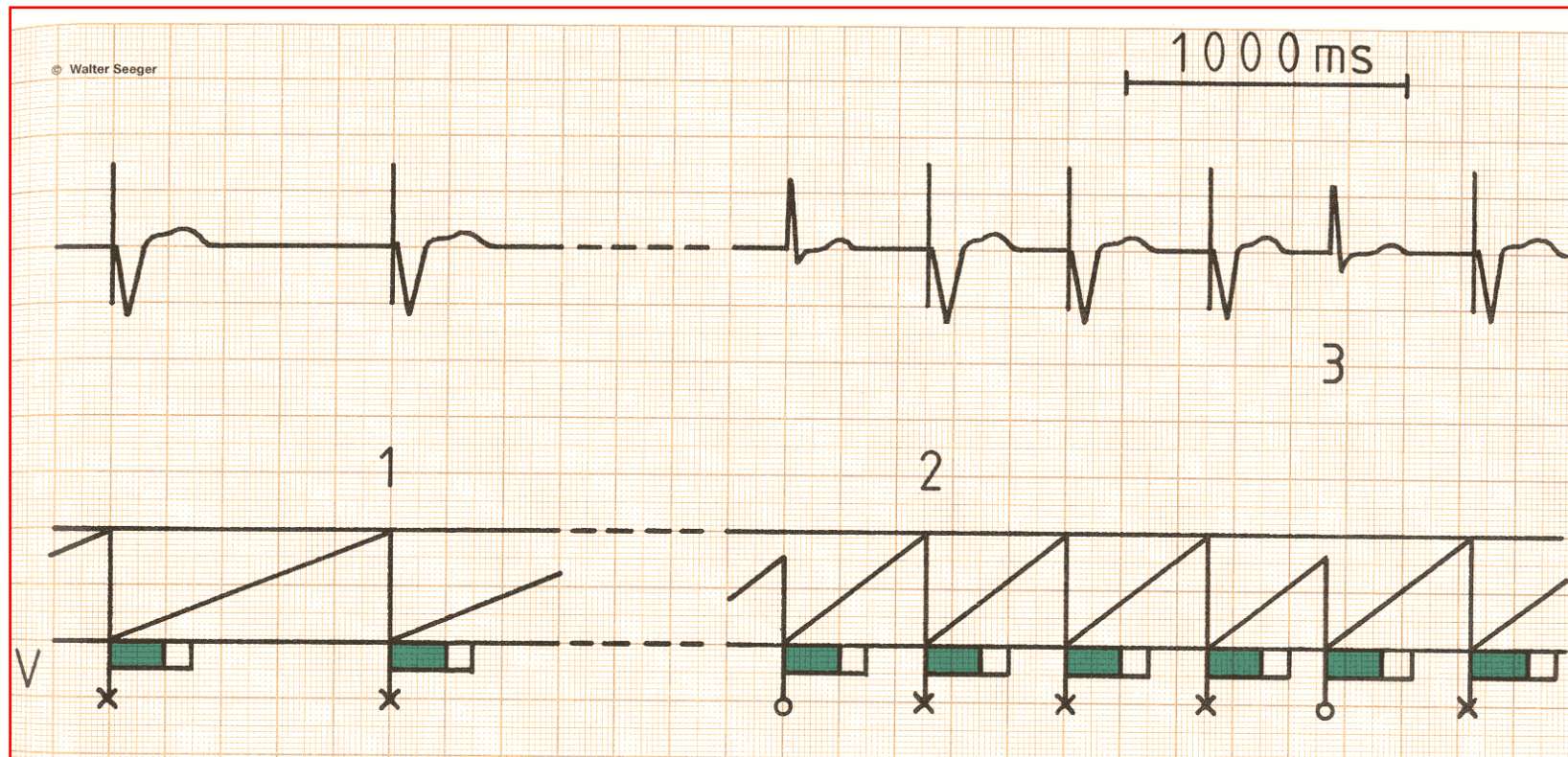
VVI Pacing



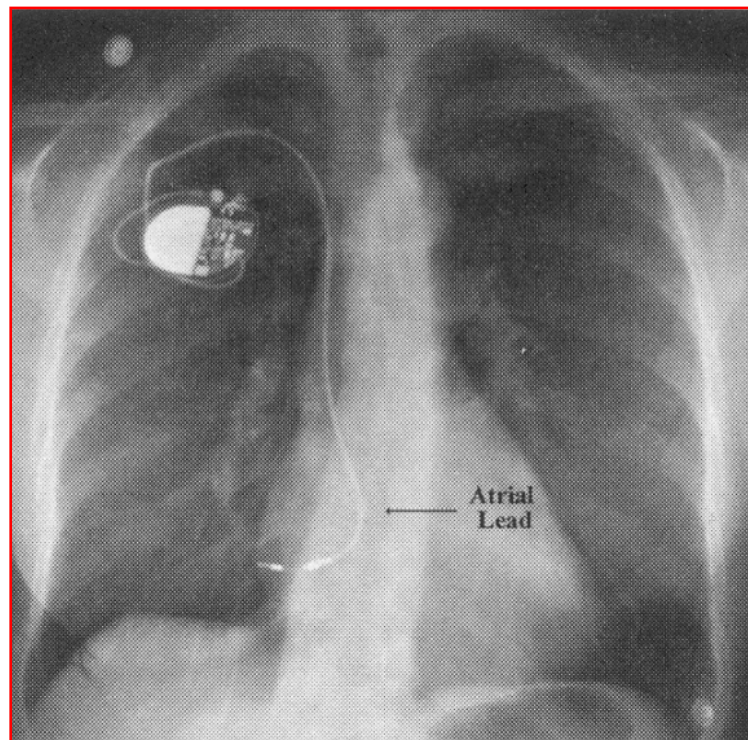
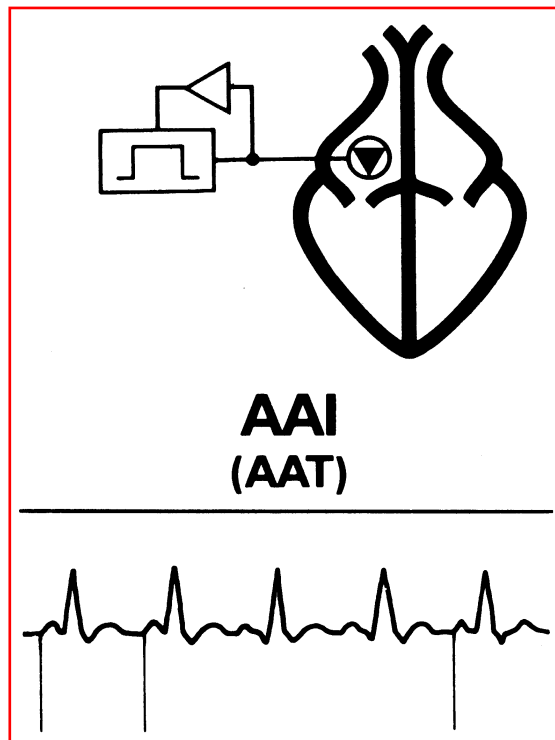
VVI Pacing



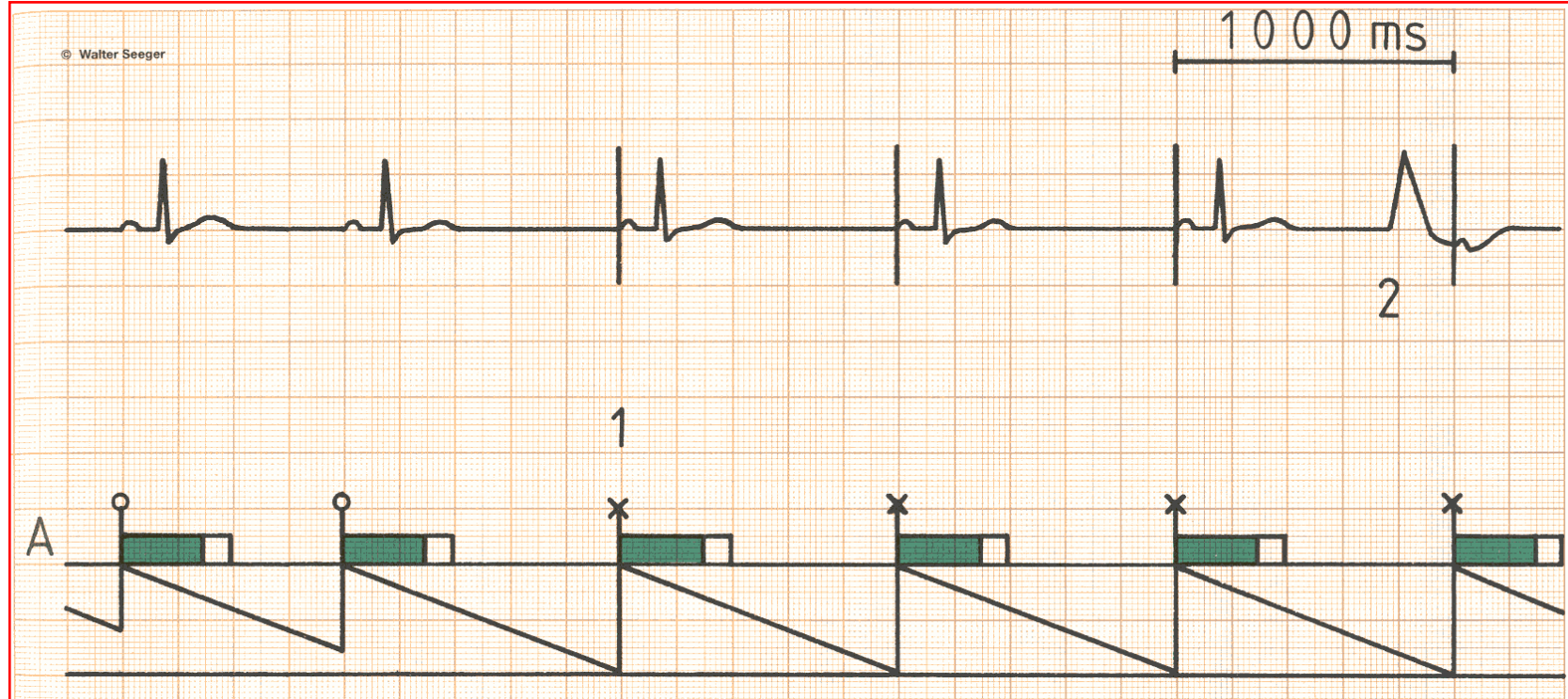
VVIR Pacing



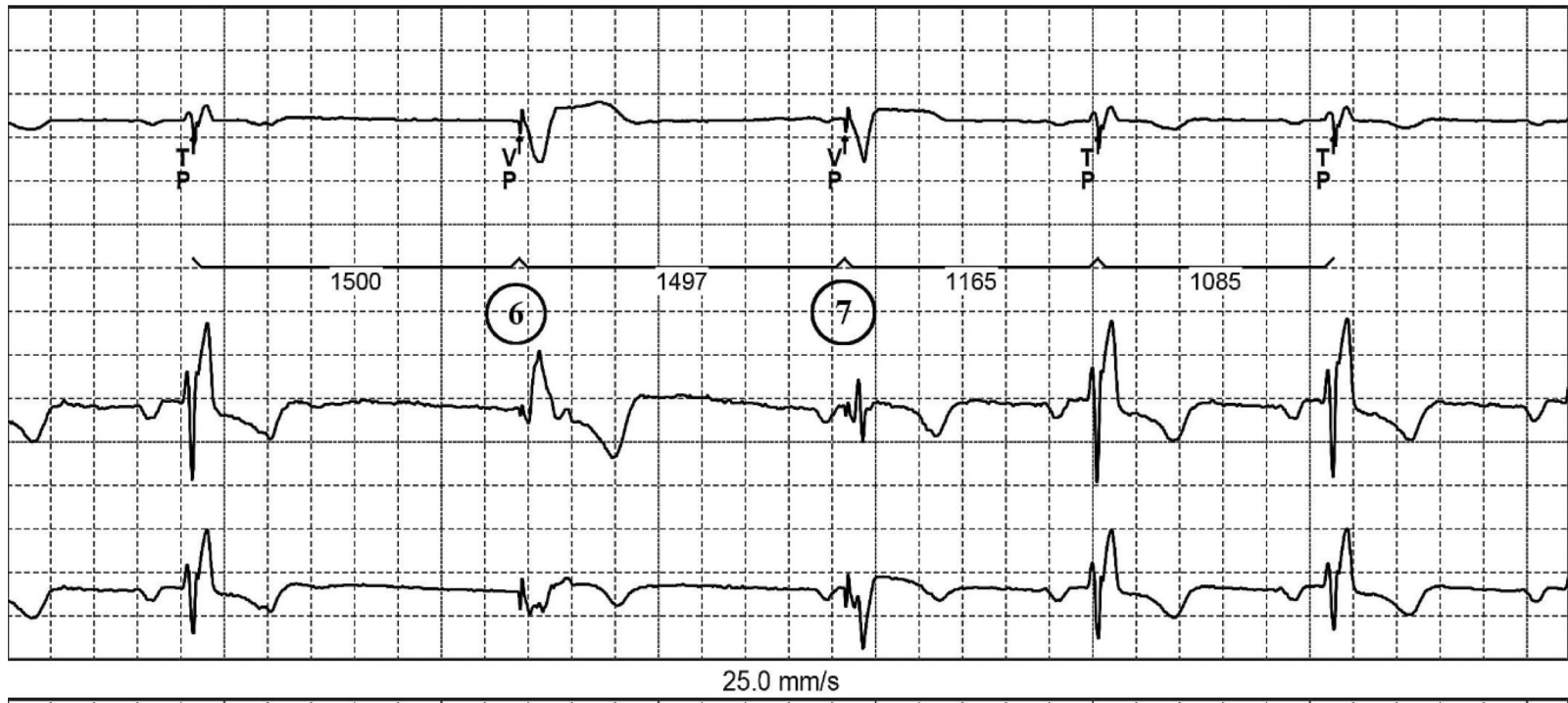
AAI Pacing



AAI Pacing



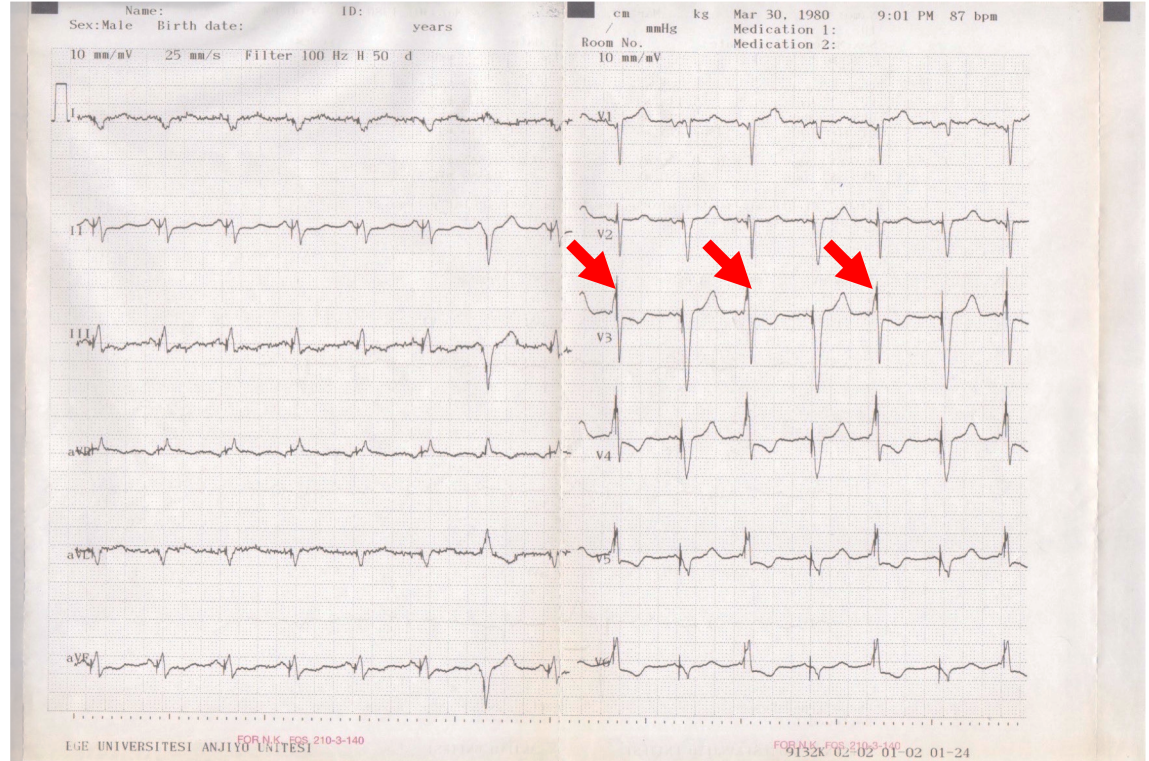
VVT Pacing



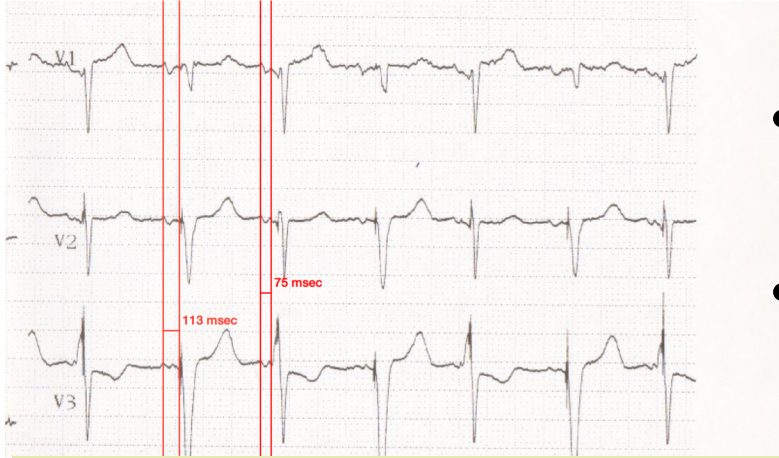
VVT Pacing



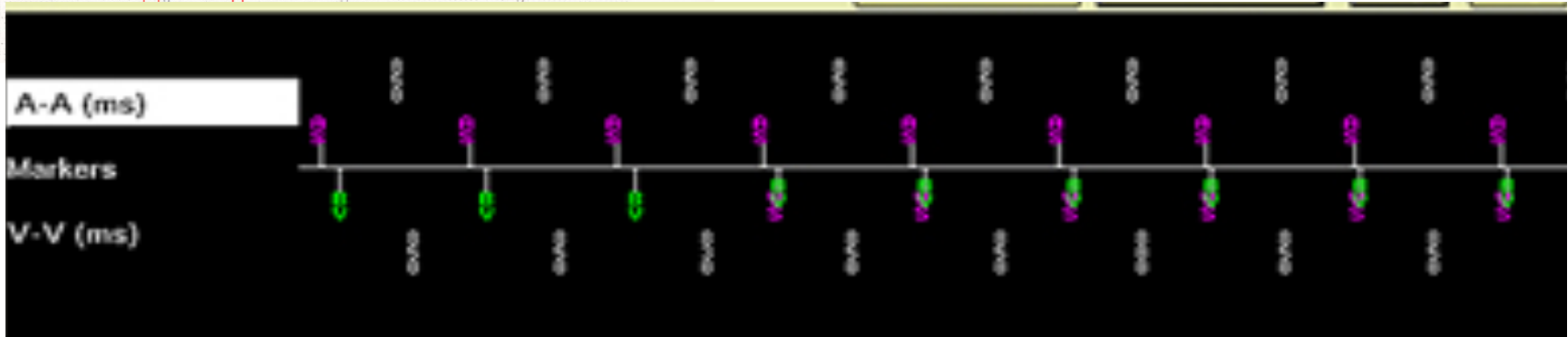
- KRT-D hastası



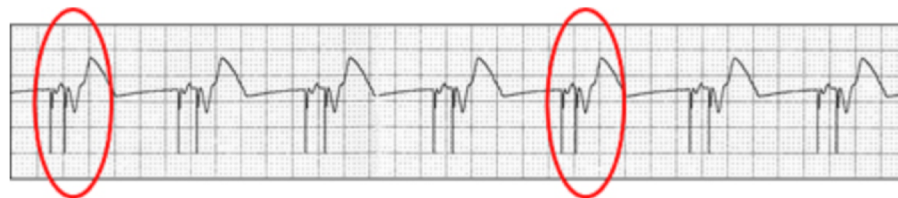
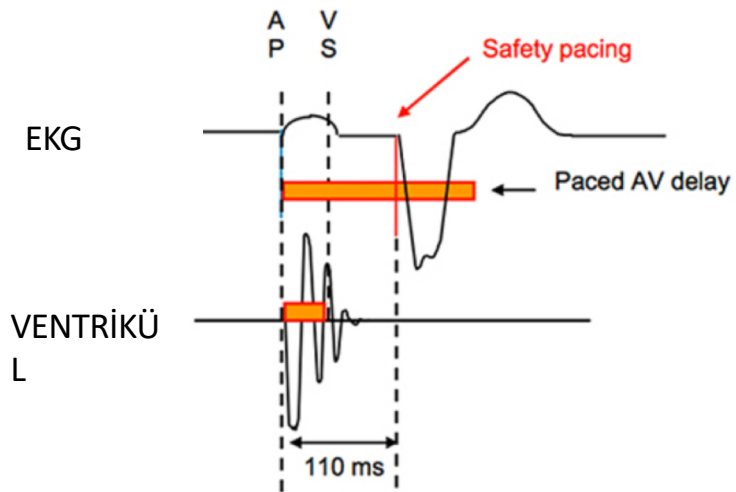
VVT Pacing



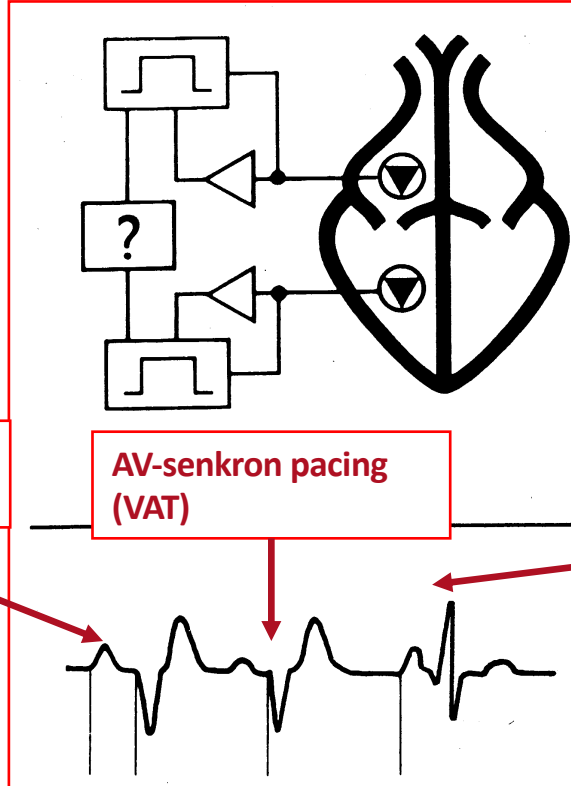
- Ventriküler sens yanıtı V pace tetiklemiş
- VVT modu



VVT Pacing



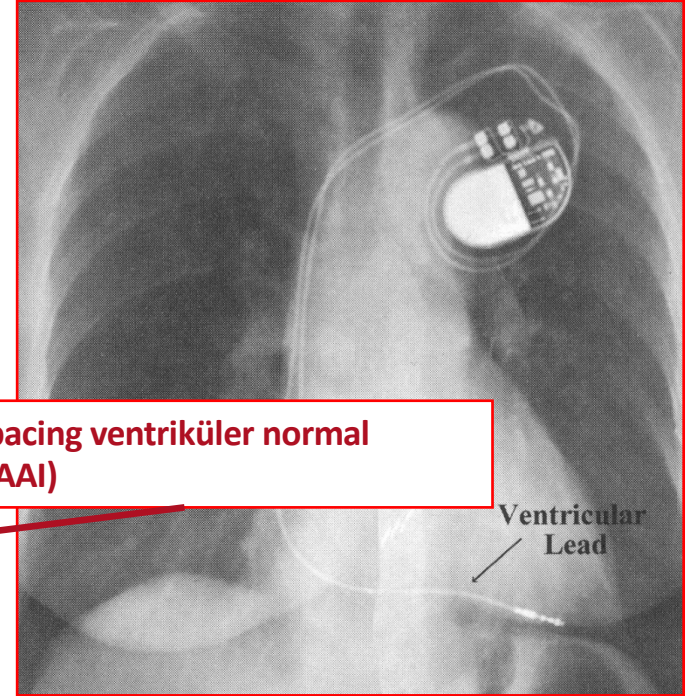
DDD Pacing



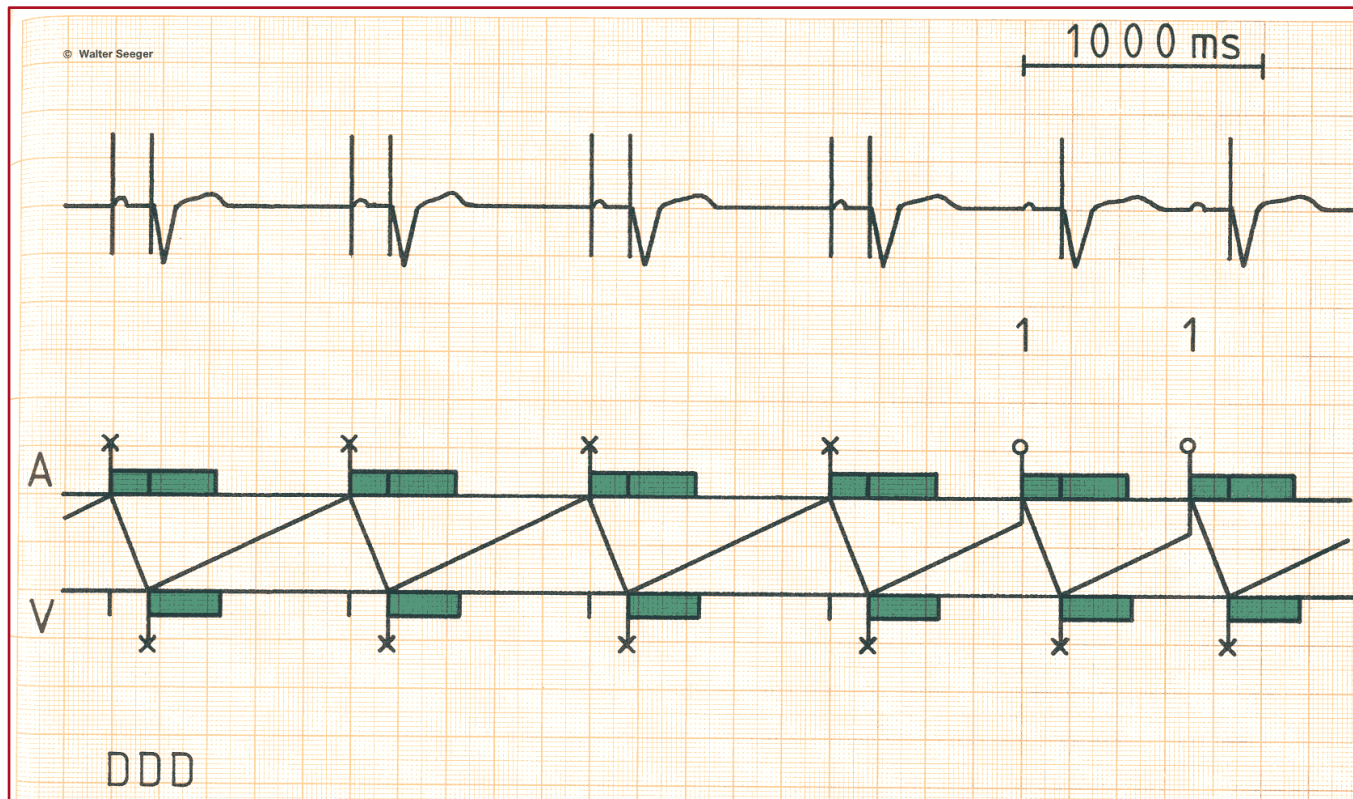
AV-eş zamanlı pacing
(DDI)

AV-senkron pacing
(VAT)

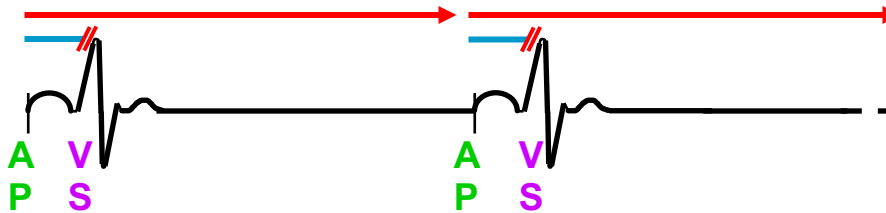
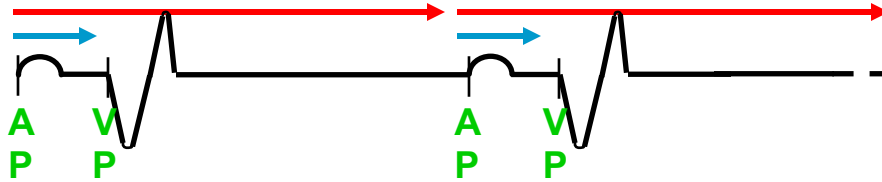
Atrial pacing ventriküler normal
iletim(AAI)



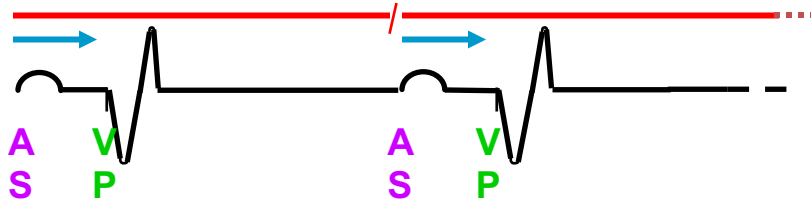
DDD Pacing



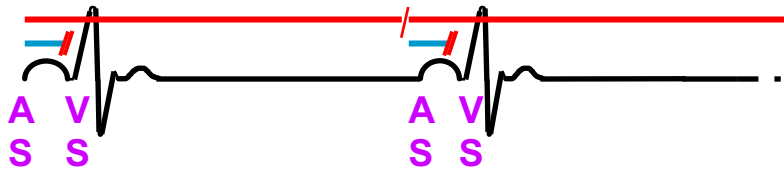
DDD Pacing



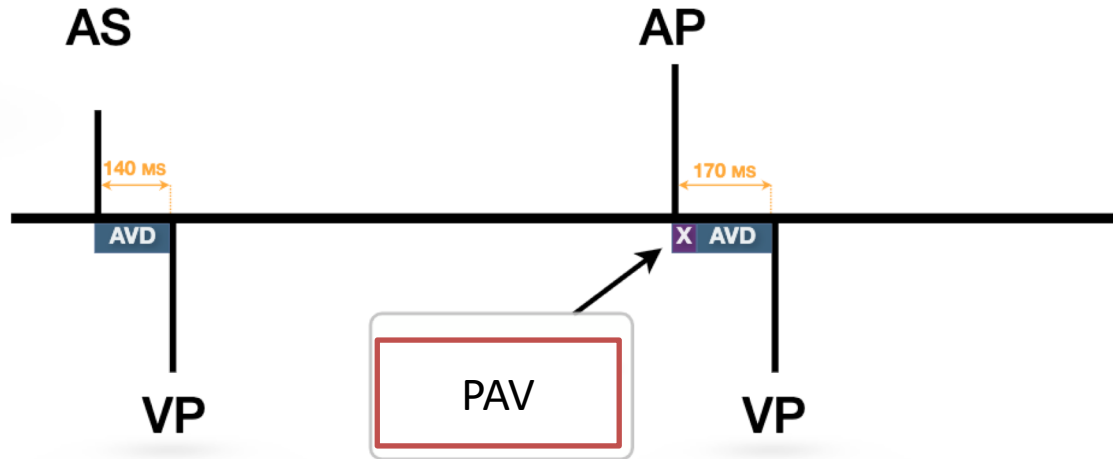
DDD Pacing



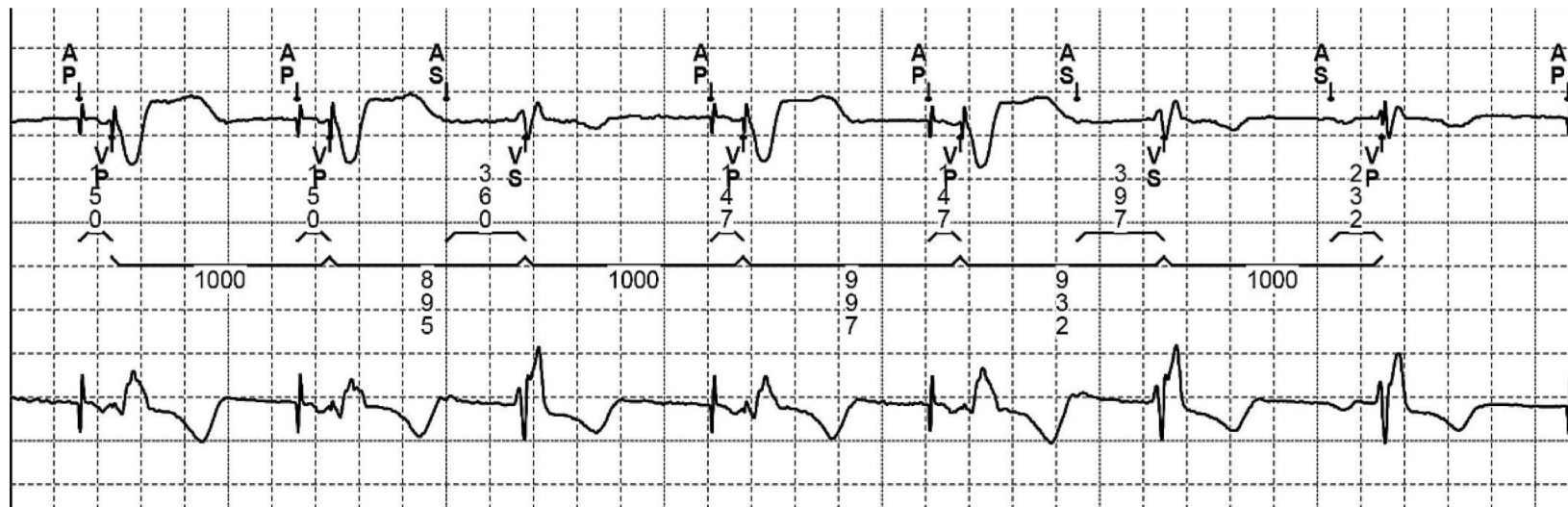
4. Atrial and ventricular sensing



DDD pacing AV gecikme



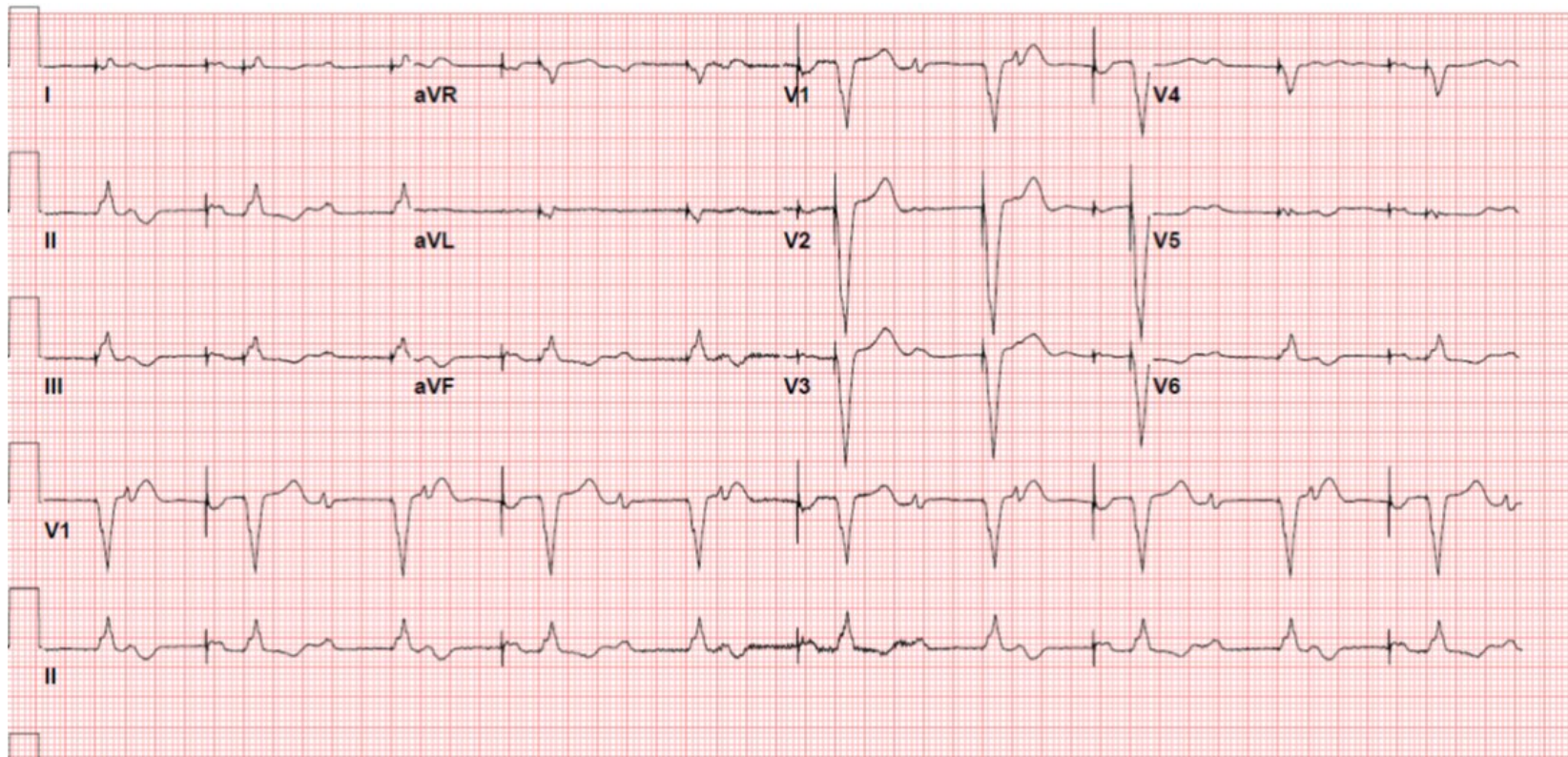
DDI pacing



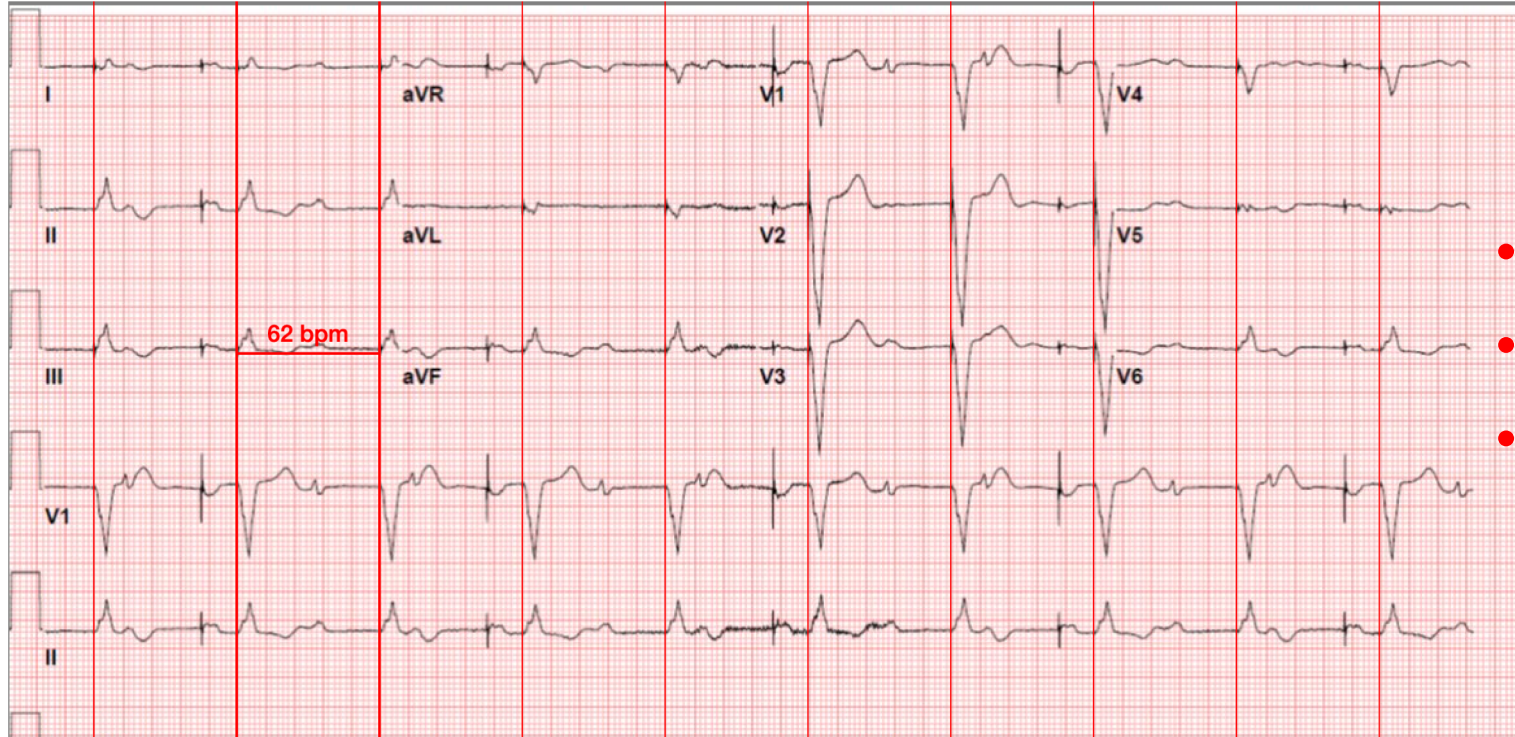
DDI pacing

- A ya da V sens edildiği sürece AV sekronisite yok
- A sens AVI tetiklemez
- AP olursa AVI tetiklenir
- AV senkron görünüm sadece AP-VP edince olur
- Atriyum kendi LRI'sında, ventrikül kendi LRI'sında hareket eder
- VS yada VP olursa VA tetiklenir ama AS gelirse AV senkron gene olmaz

DDI pacing

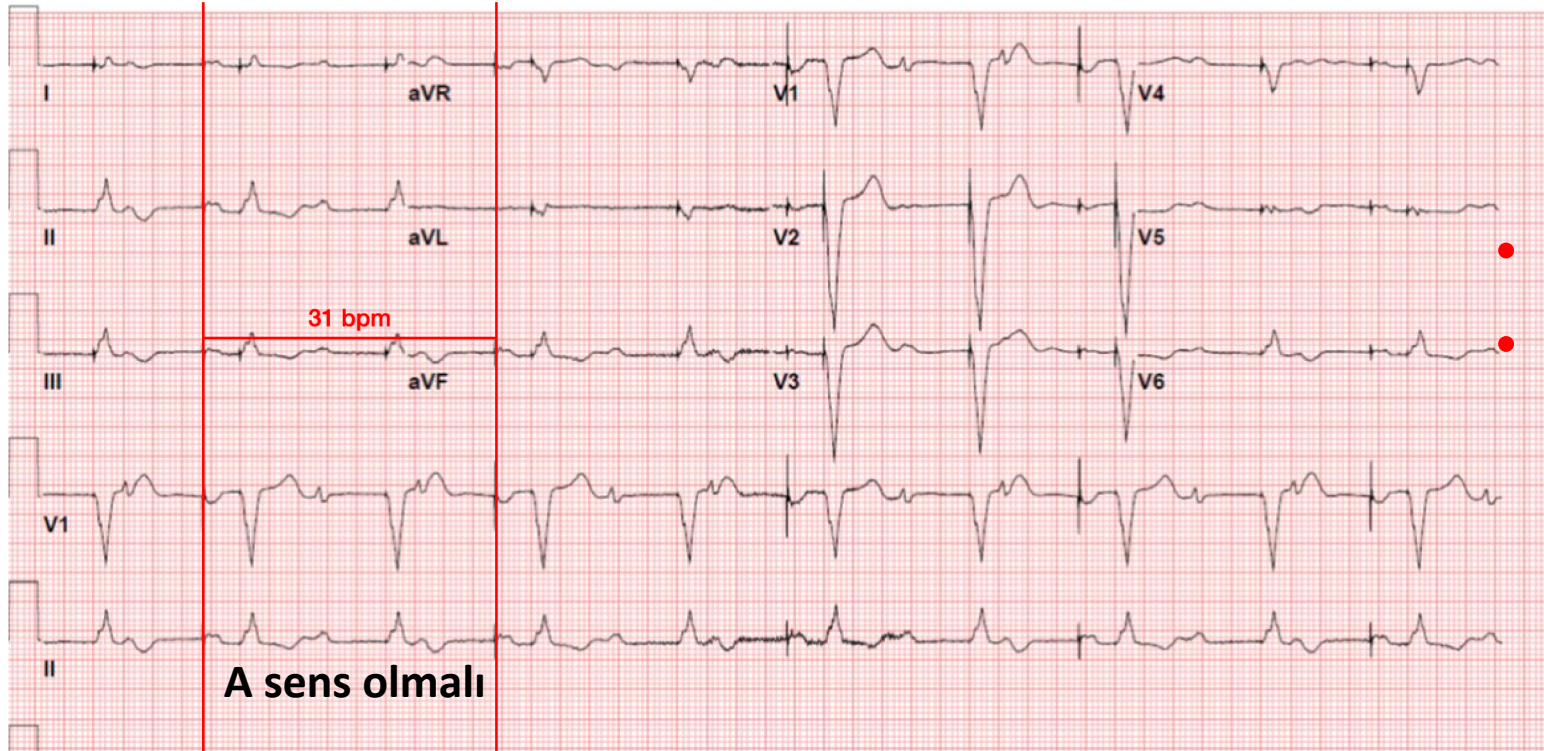


Ventrikül sens –pace?



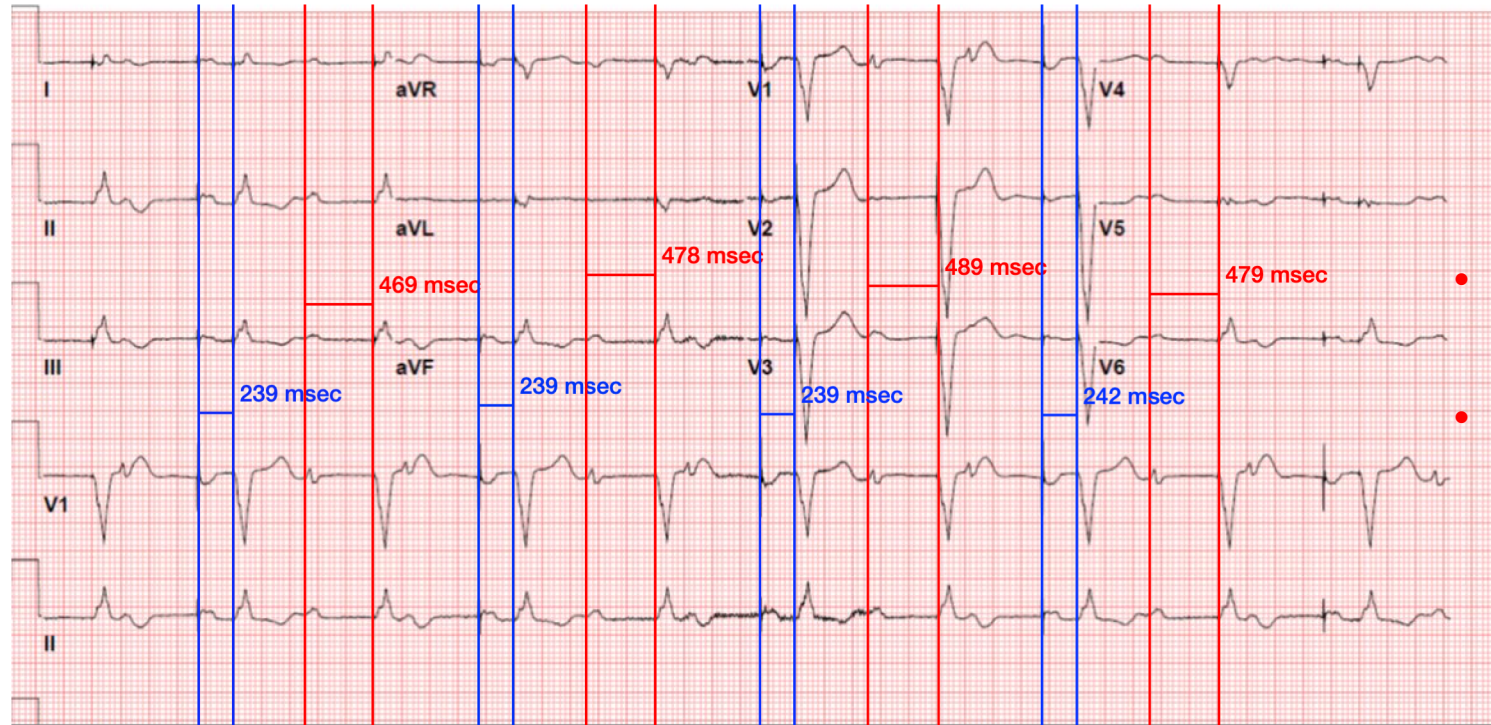
- V pace +
- V sens ?
- V alt hız:60

Atrial sens –pace?



- A pace +
- A sens +

A-V ilişkisi



• AP-VP + (240ms)

• AS- VP -

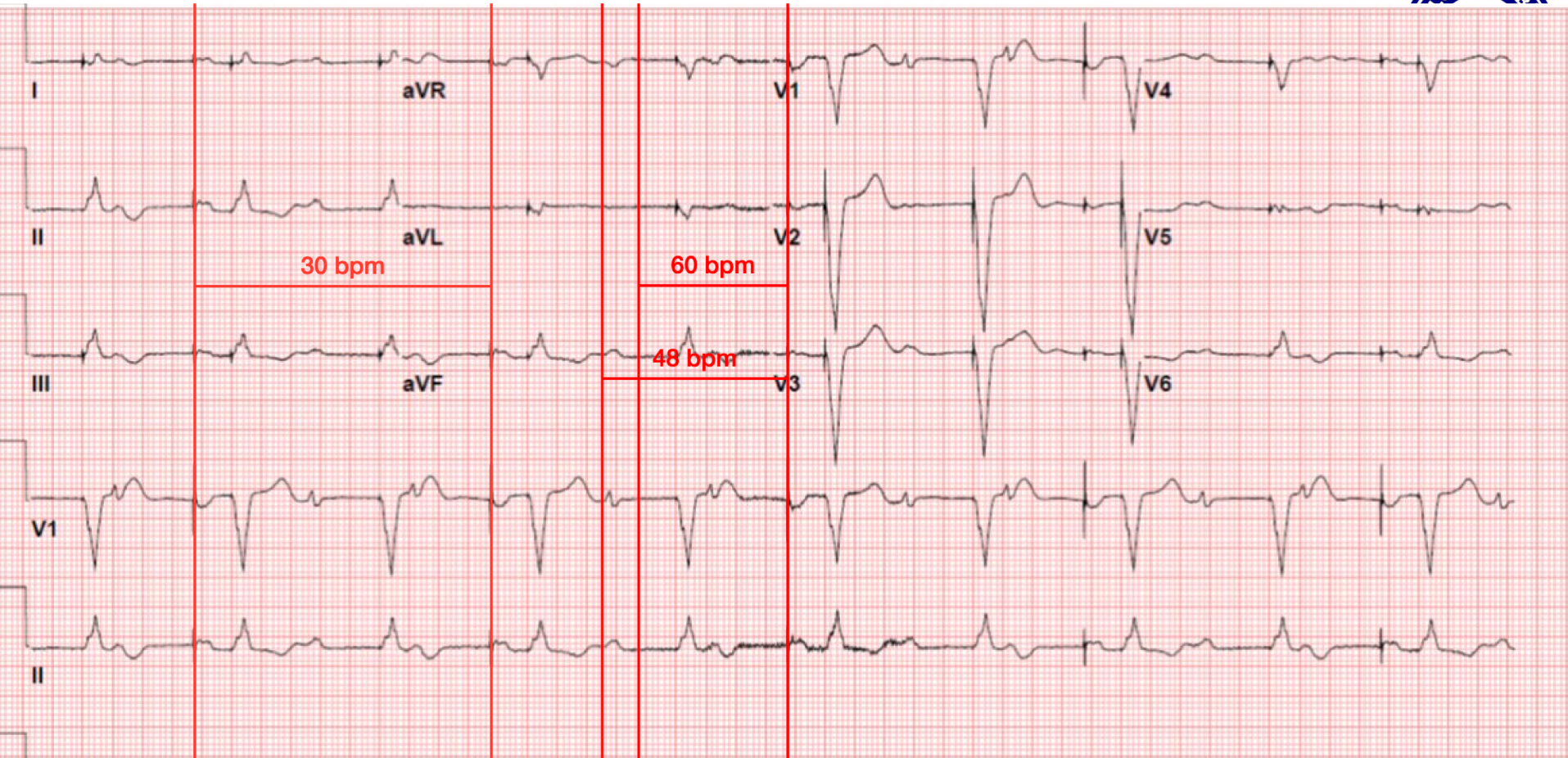
UYARI	ALGILAMA	ALGILAMAYA YANIT	HIZ YANITI
A:Atriyum V:Ventrikül D:Her ikisi	A:Atriyum V:Ventrikül D:Her ikisi O: Yok	I: İnhibe T:Tetikleme • Ventrikül sens alırsa uyarı verme • Atriyal sens algılsa AV gecikme tetikleme D:Her ikisi O: Yok	R: Hız yanıtı var

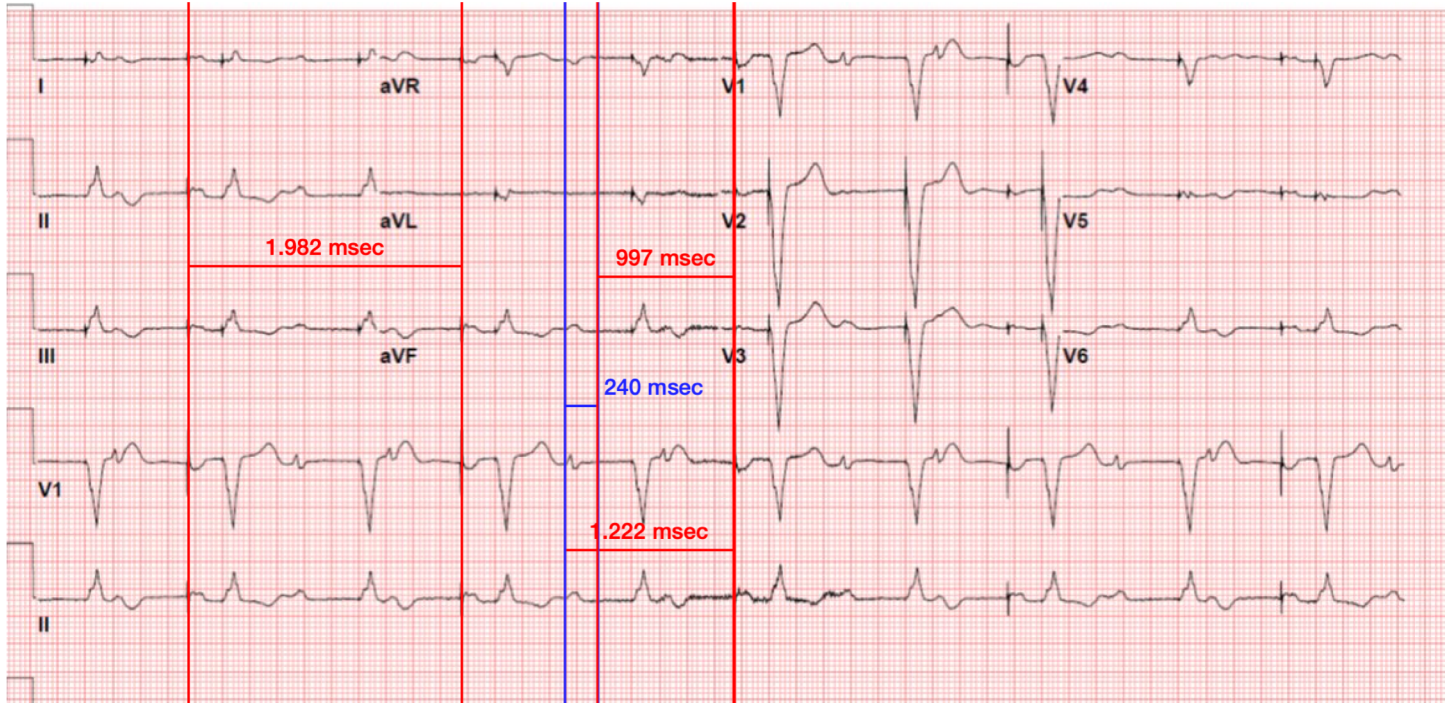
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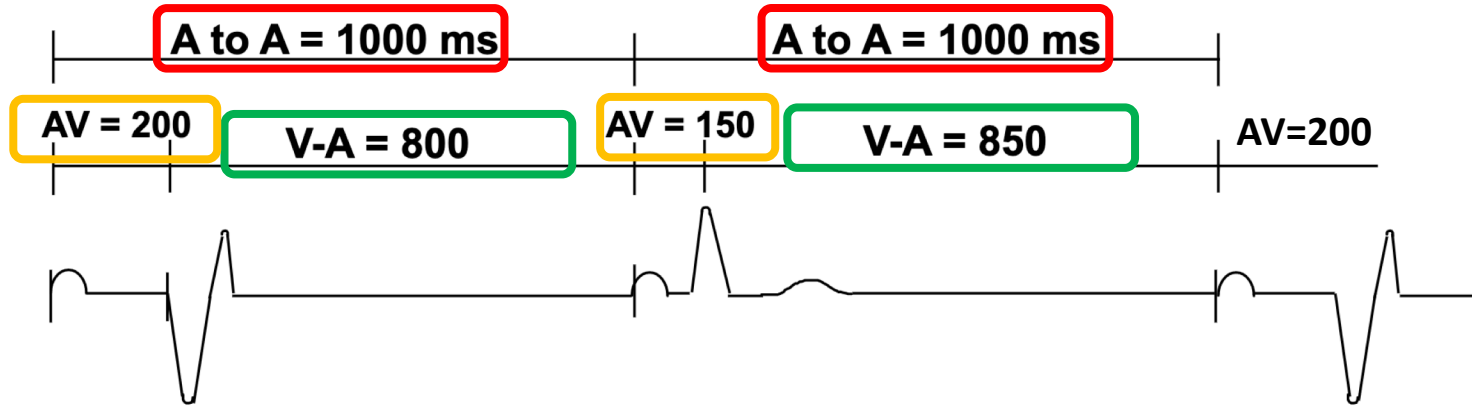
?



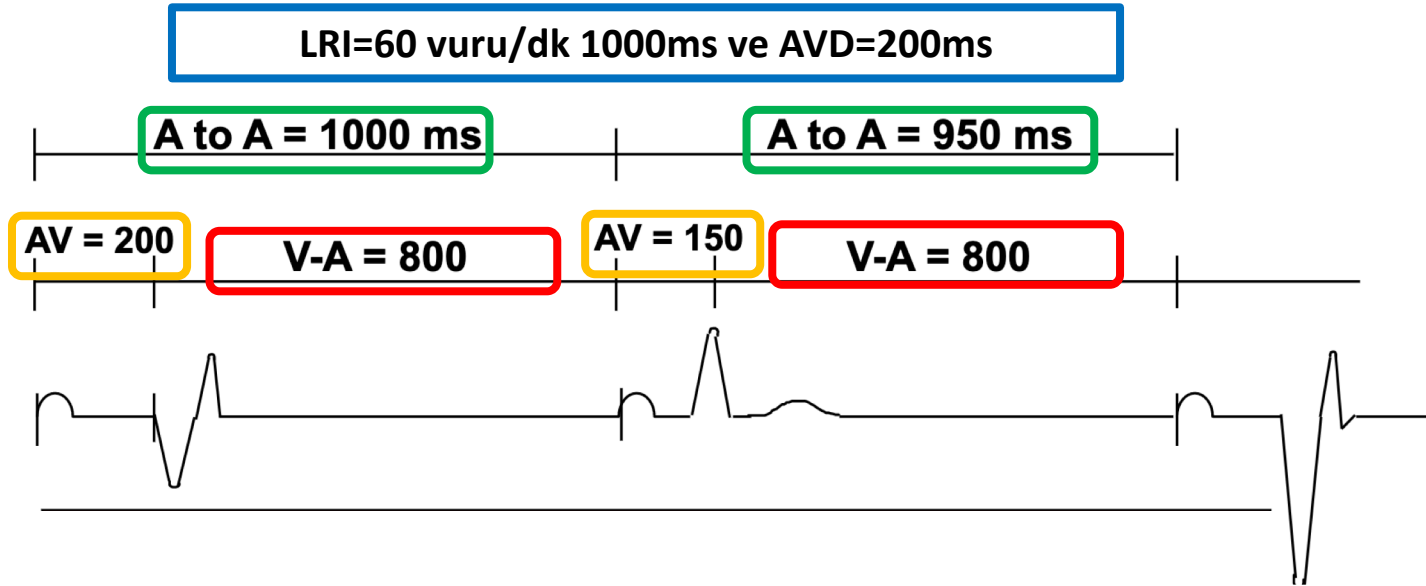


Atrial temelli zamanlama

LRI=60 vuru/dk 1000ms

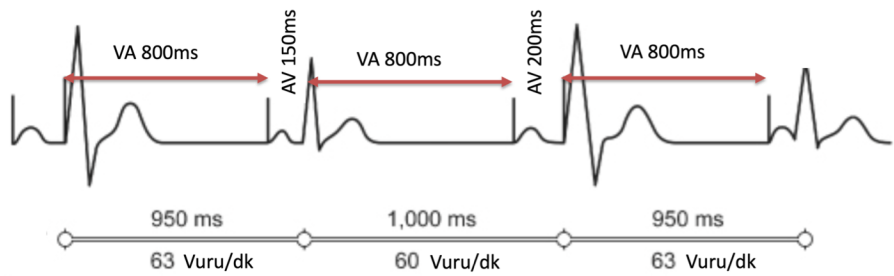


Ventriküler temelli zamanlama



Ventrikül temelli zamanlama

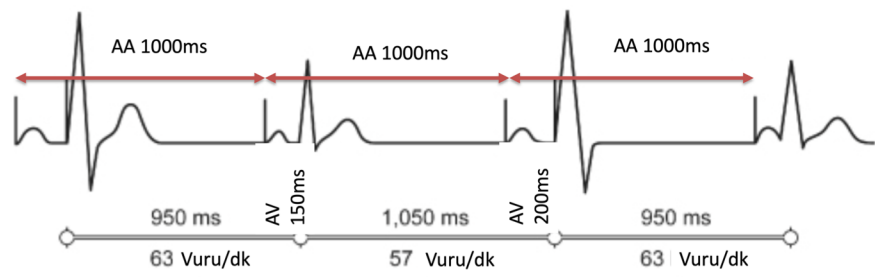
VA sabittir (LR-AV gecikme)



Alt hız:60 Vuru/dk (1000ms)
Paced AV:200 ms (Hız değişken AV)

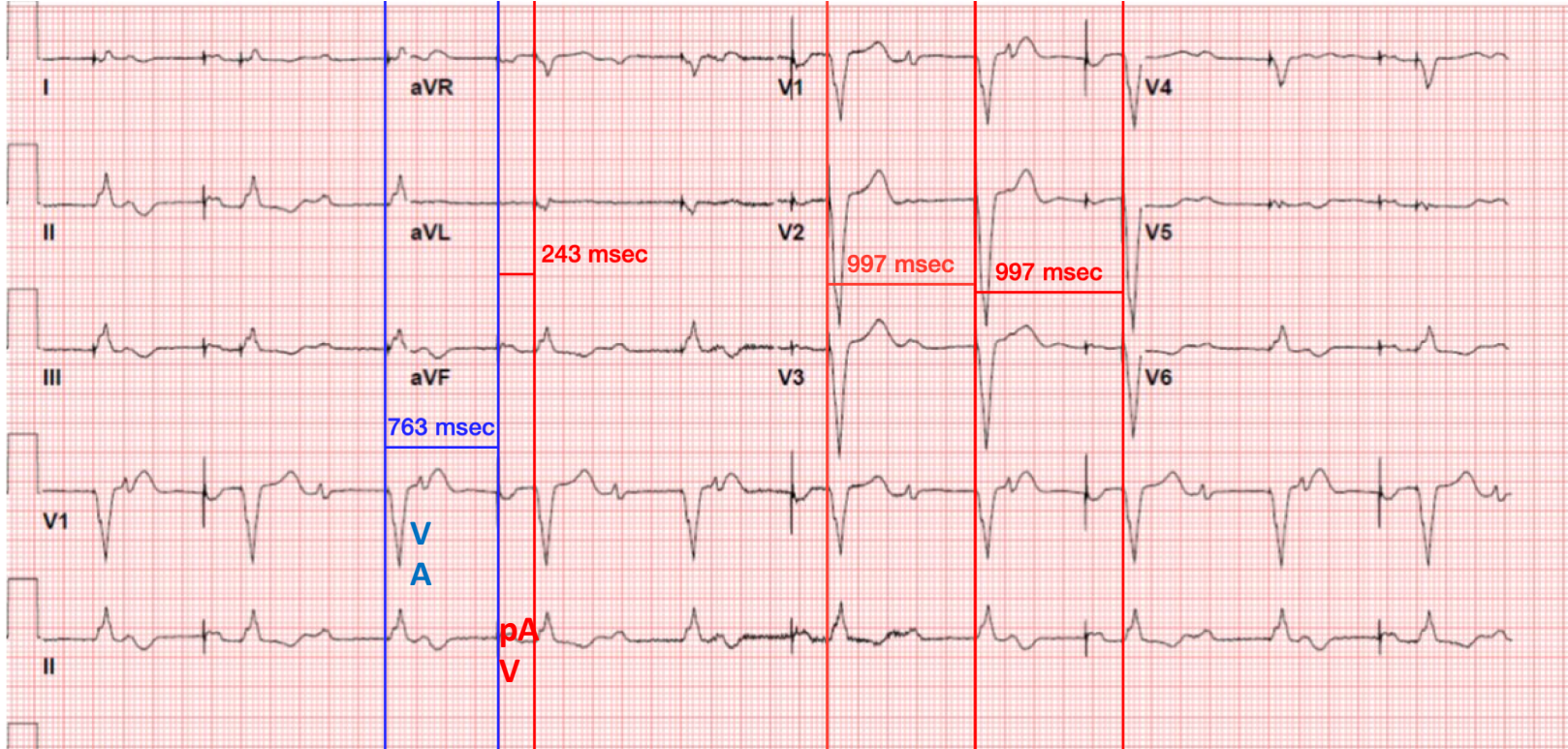
Atrial temelli zamanlama

AA sabittir

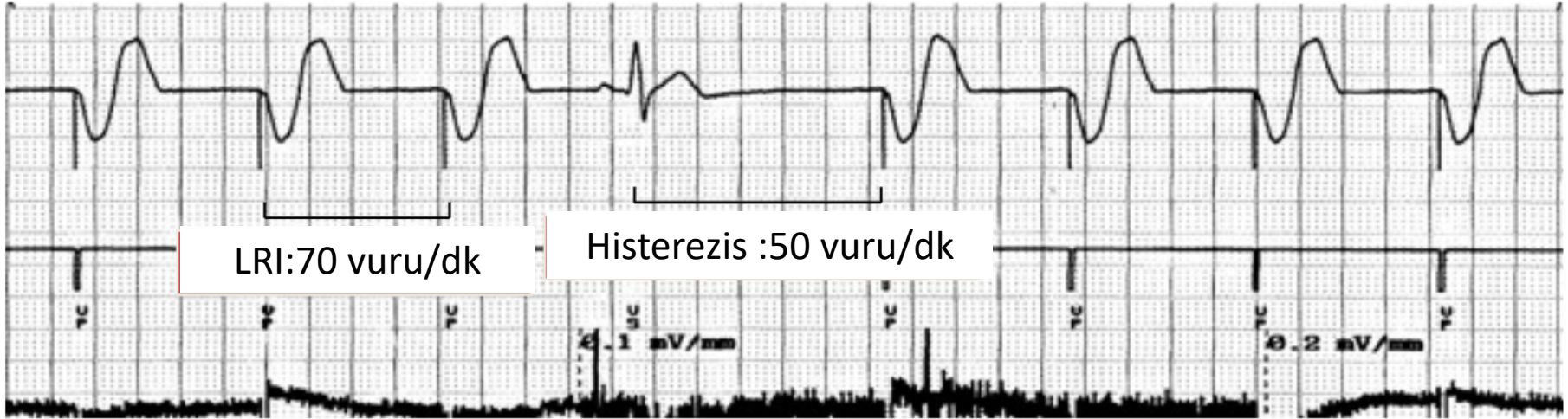


Alt hız:60 Vuru/dk (1000ms)
Paced AV:200 ms (Hız değişken AV)

- Alt hız:60 vuru/dk (1000ms)
- Paced AV:240ms
- Sabit VA intervali: $1000-240=760\text{ms}$



Histerezis



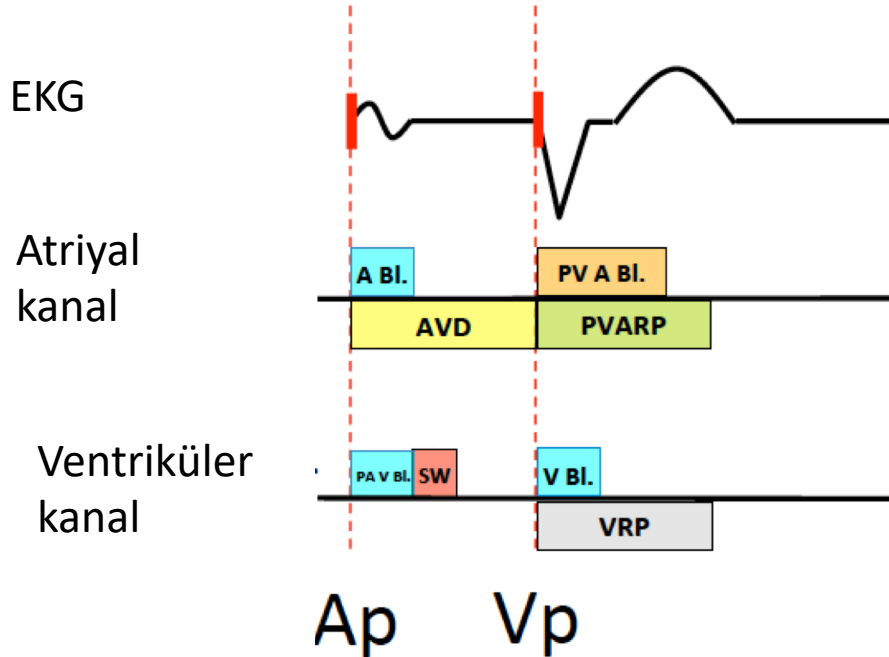
Temel zaman aralıkları-II

- Tek odacıklı kalp pilleri
 - Alt hız aralığı (Lower rate interval- LRI)
 - **Ventriküler blanking period**
 - **Ventriküler rölatif refrakter period**
- Çift odacıklı kalp pilleri
 - Alt hız aralığı (Lower rate interval- LRI)
 - Atriyo ventriküler aralık (Atrioventricular interval- AVI)

Temel zaman aralıkları-II

- Tek odacıklı kalp pilleri
- Çift odacıklı kalp pilleri
 - Alt hız aralığı (Lower rate interval- LRI)
 - Atriyo ventriküler aralık (Atrioventricular interval- AVI)
 - **Atriyal/Ventriküler blanking period**
 - **Atriyal/Ventriküler rölatif refrakter period**
 - **Post atriyal ventriküler blanking period**
 - **Post ventriküler atriyal blanking/rölatif refrakter period**

Temel zaman aralıkları-II



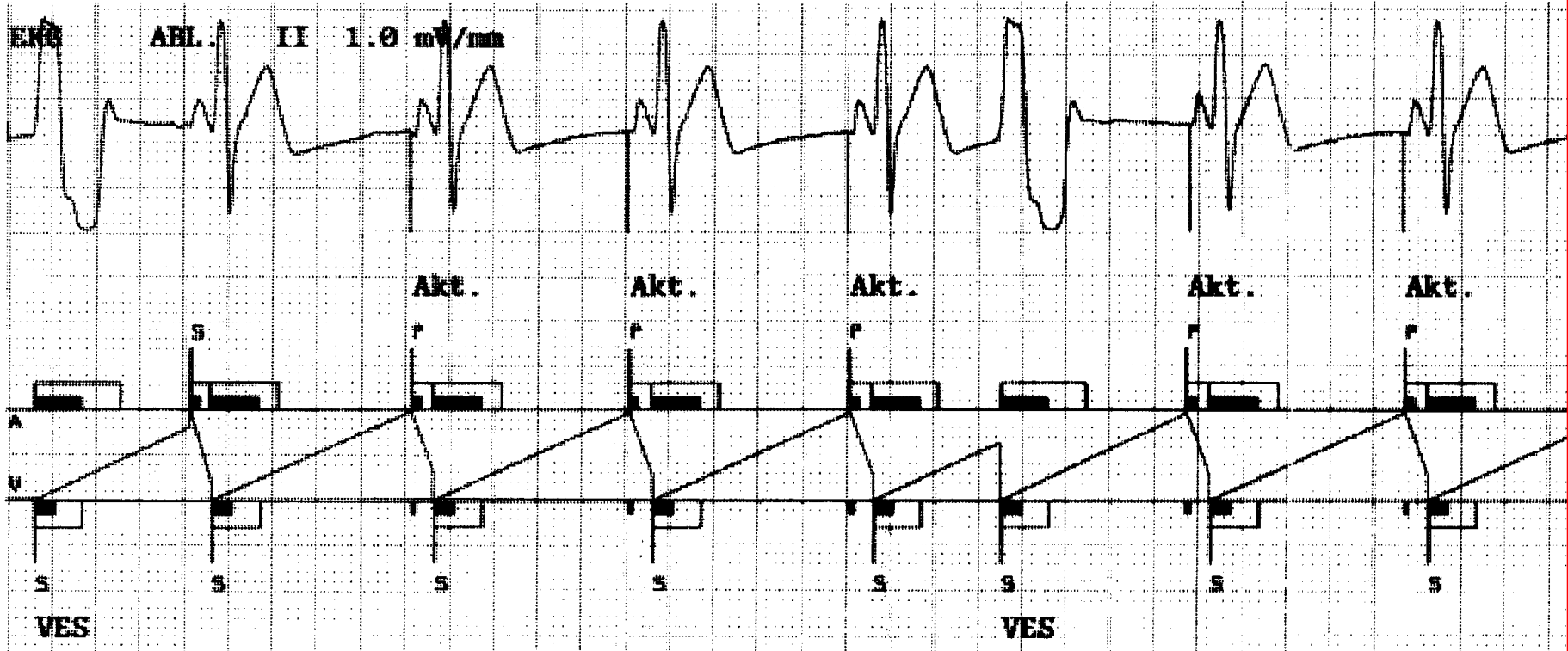
Blanking vs. rölatif refrakter dönem ?

Neden var ?

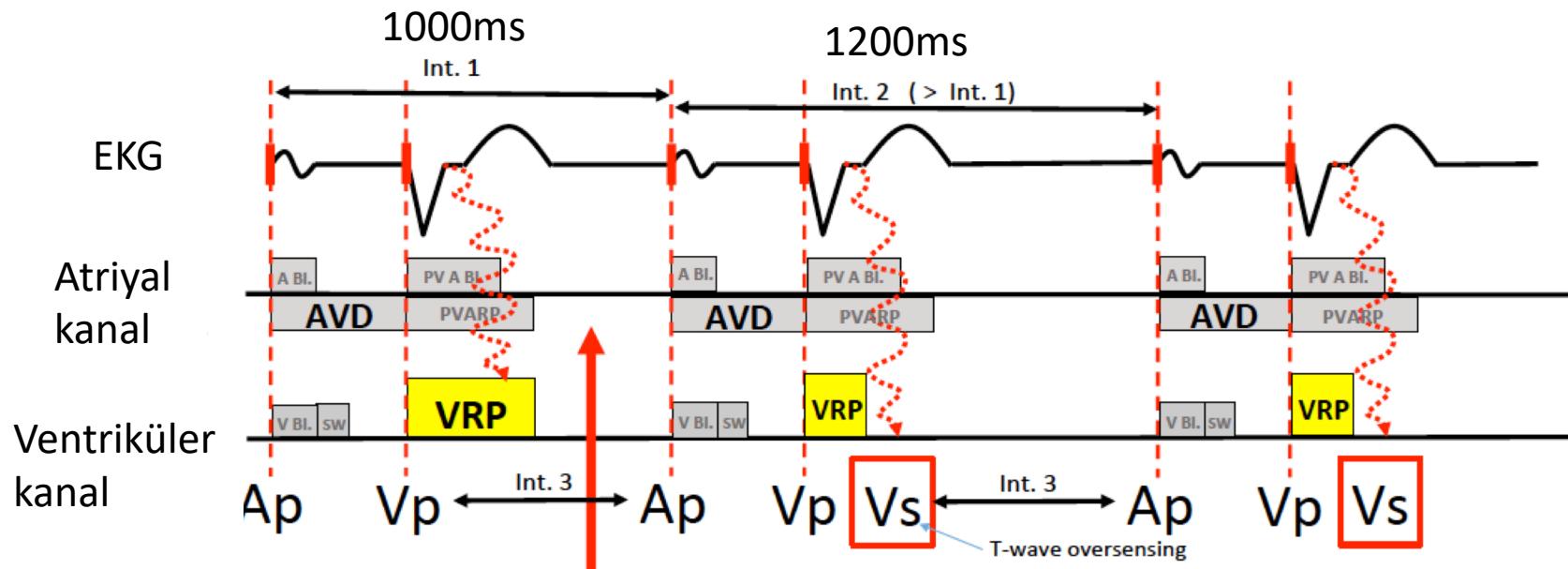
- Yanlış algılamaları önlemek
- Uygun hızda pace etmek
- Crosstalk önlemek
- Pacemaker mediated / endless loop taşikardilerini (ELT) önlemek

Merdiven Diagramlar

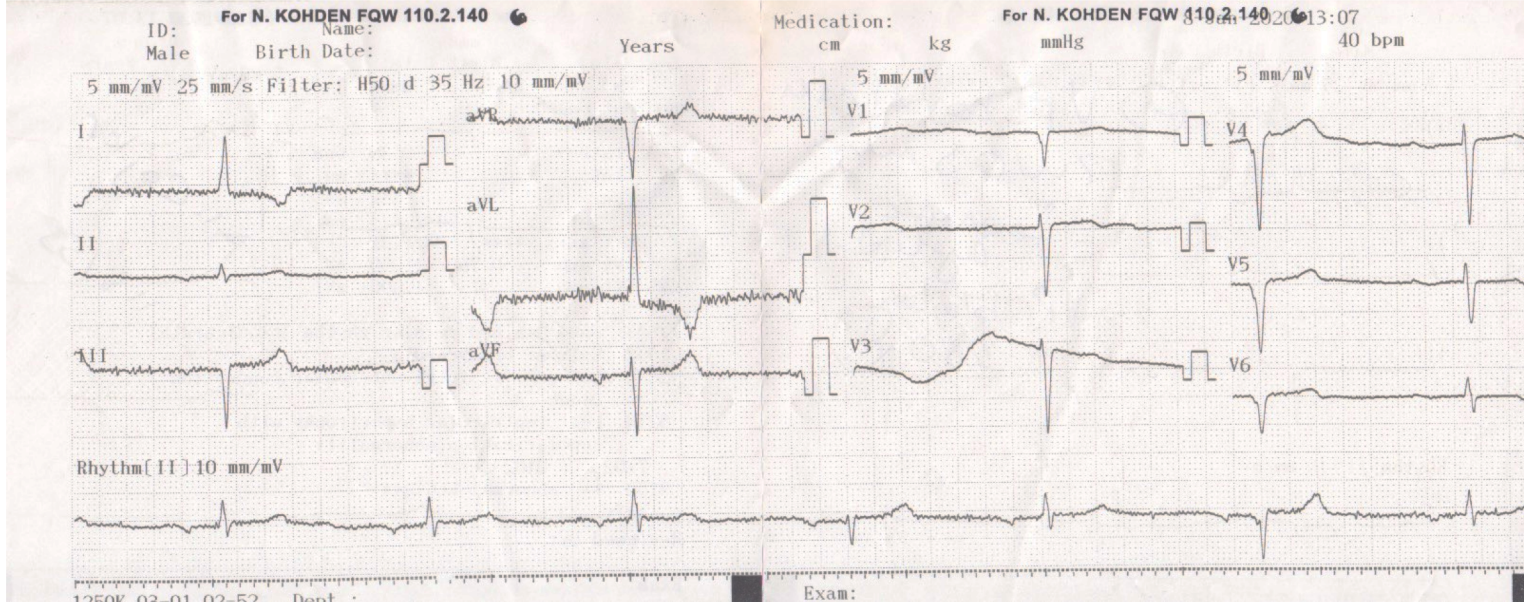
DDDR



T dalgası oversensing (TWOS)

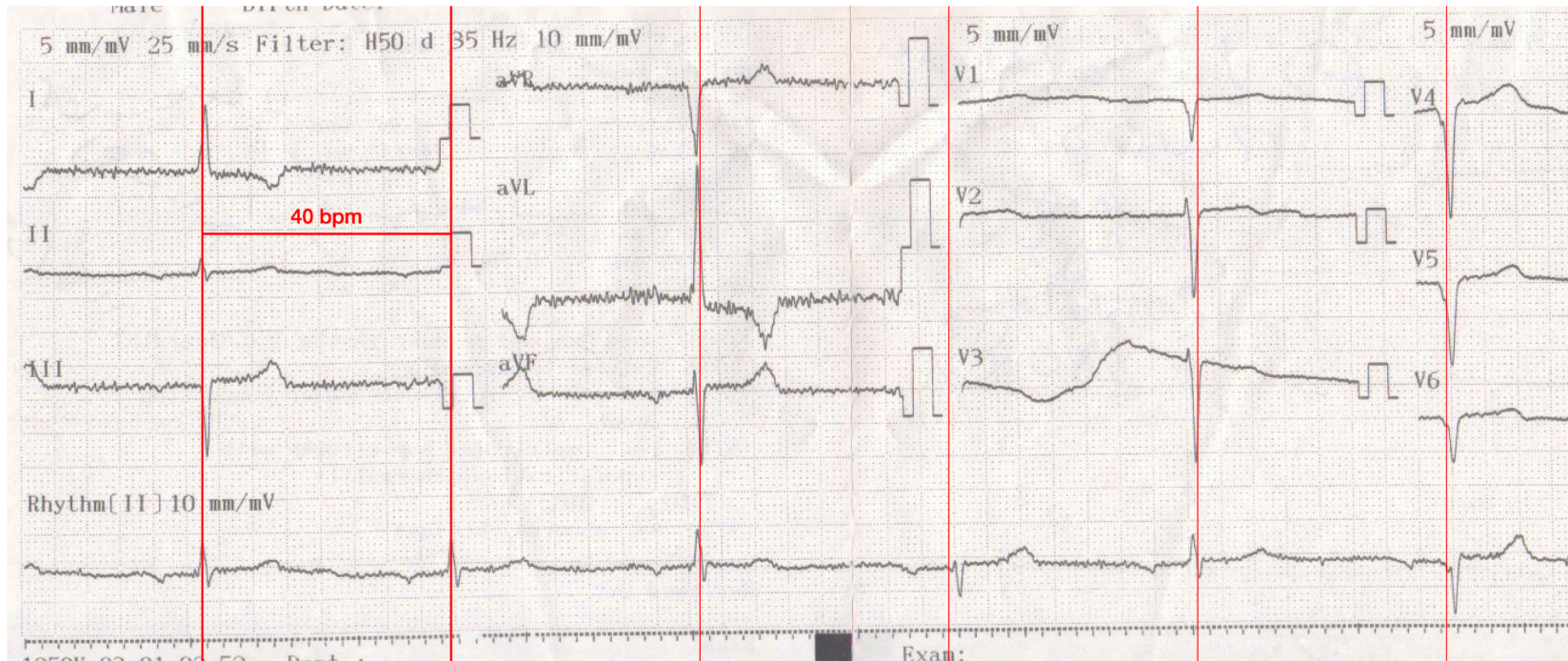


TWOS

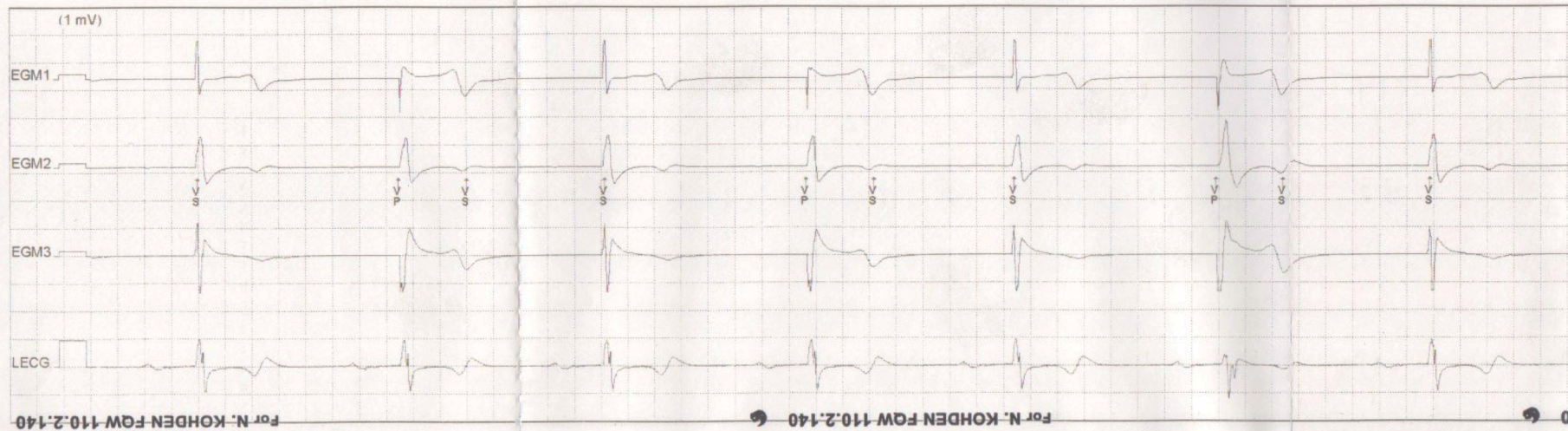


- İskemik KMP hastası
- Primer profilaksi için VVI-ICD (Alt hız: 40 vuru/dk)

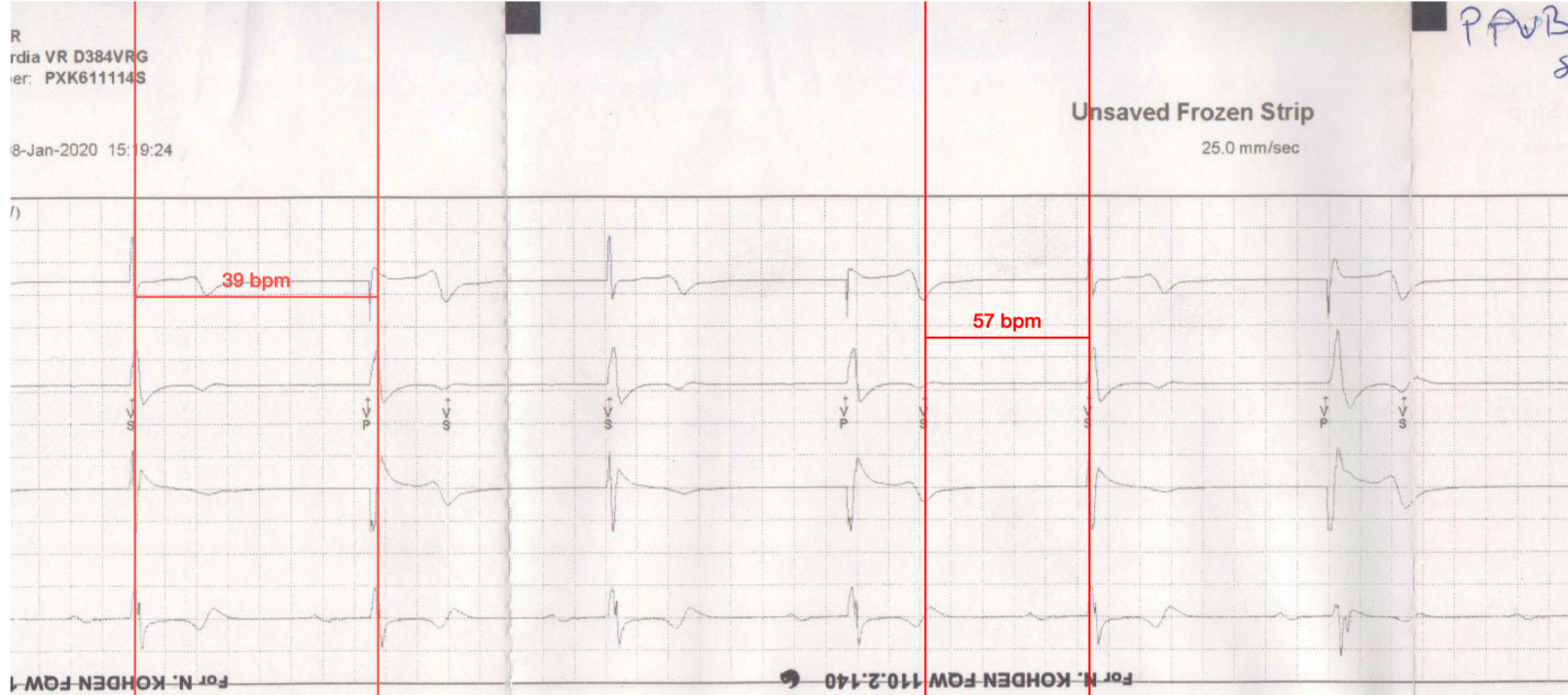
TWOS



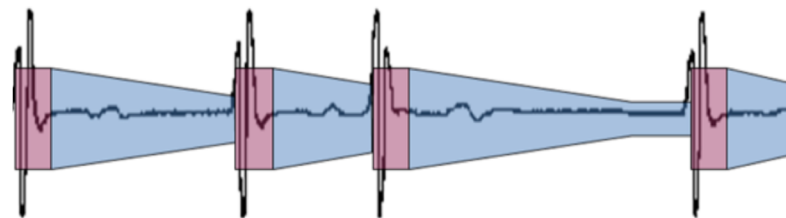
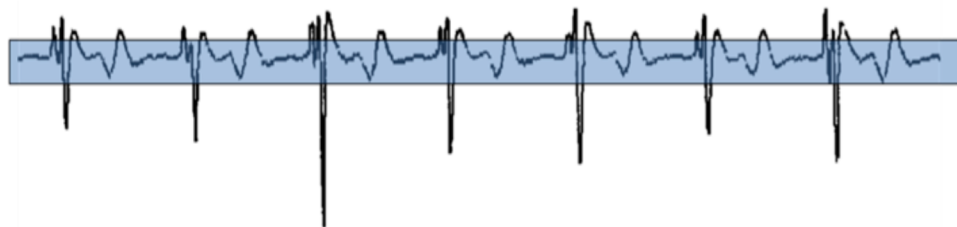
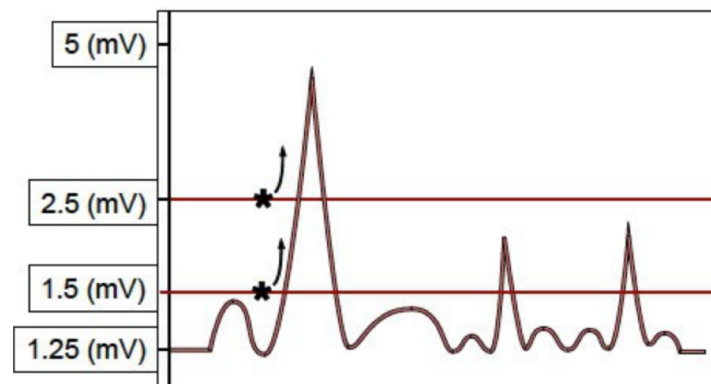
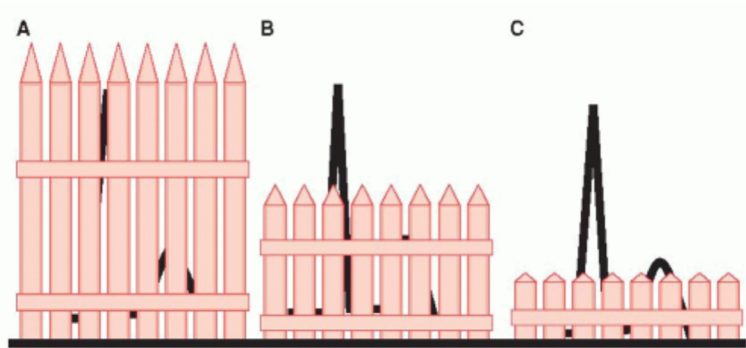
TWOS



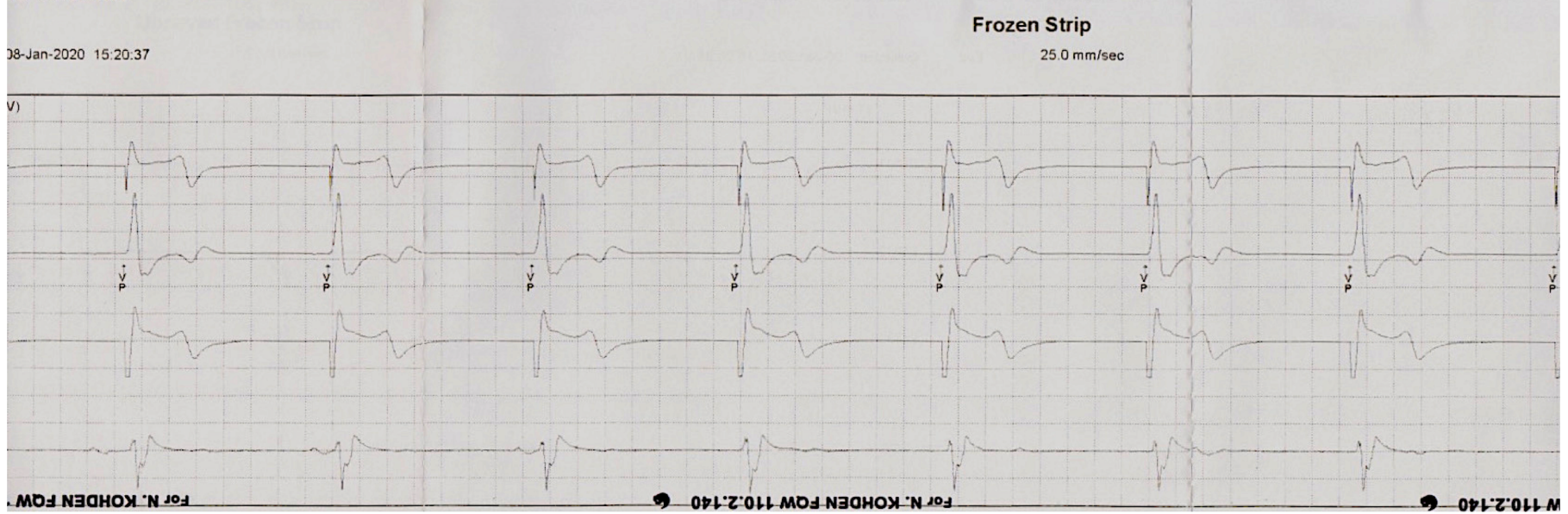
TWOS



TWOS

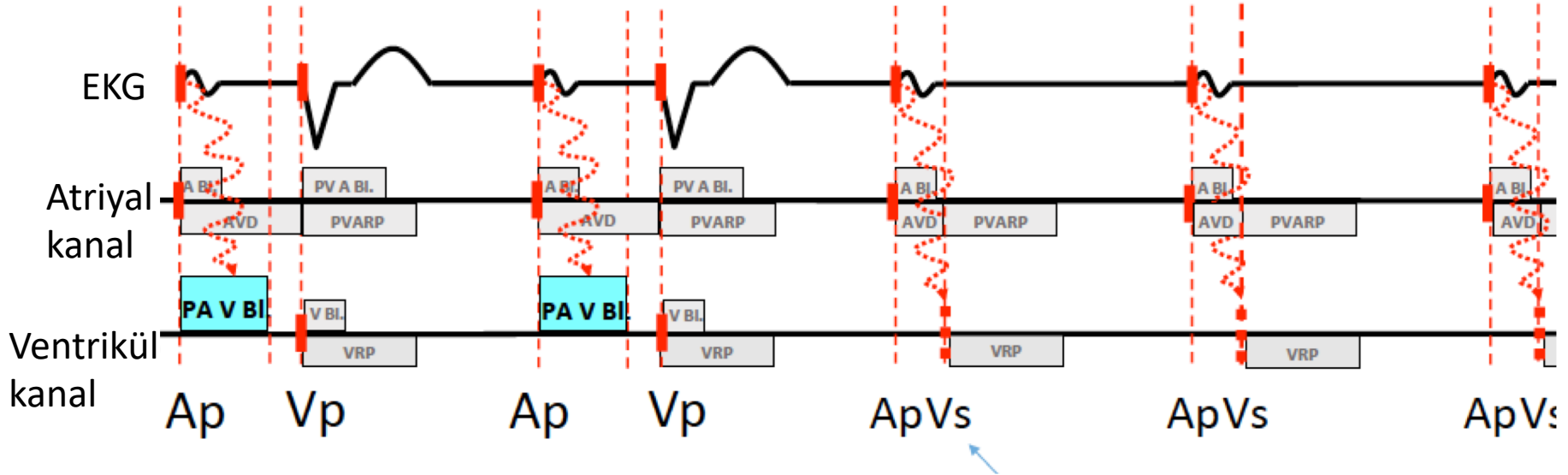


TWOS

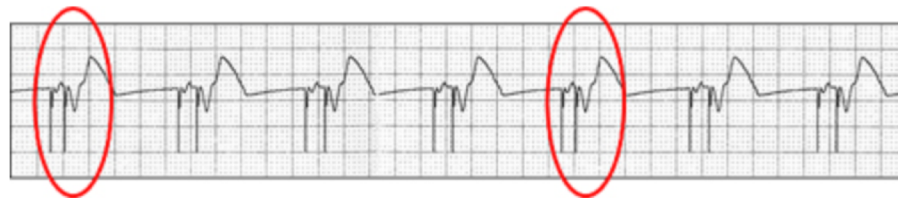
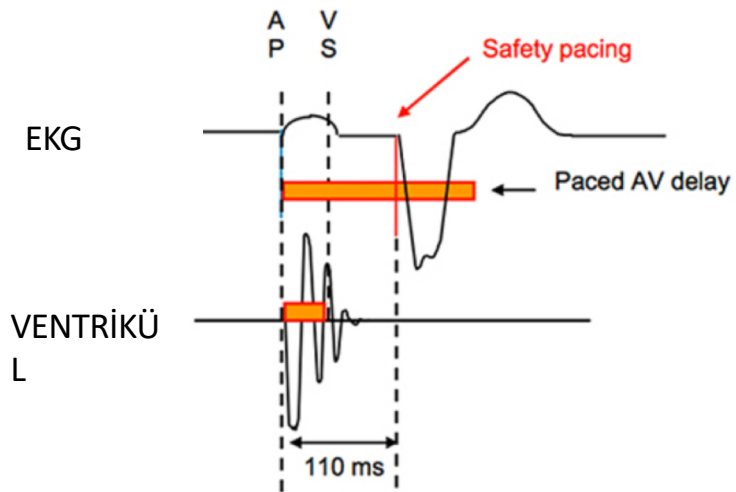


RV LEAD SENS:0.3MV 0.45MV YAPILDIKTAN SONRA EGM

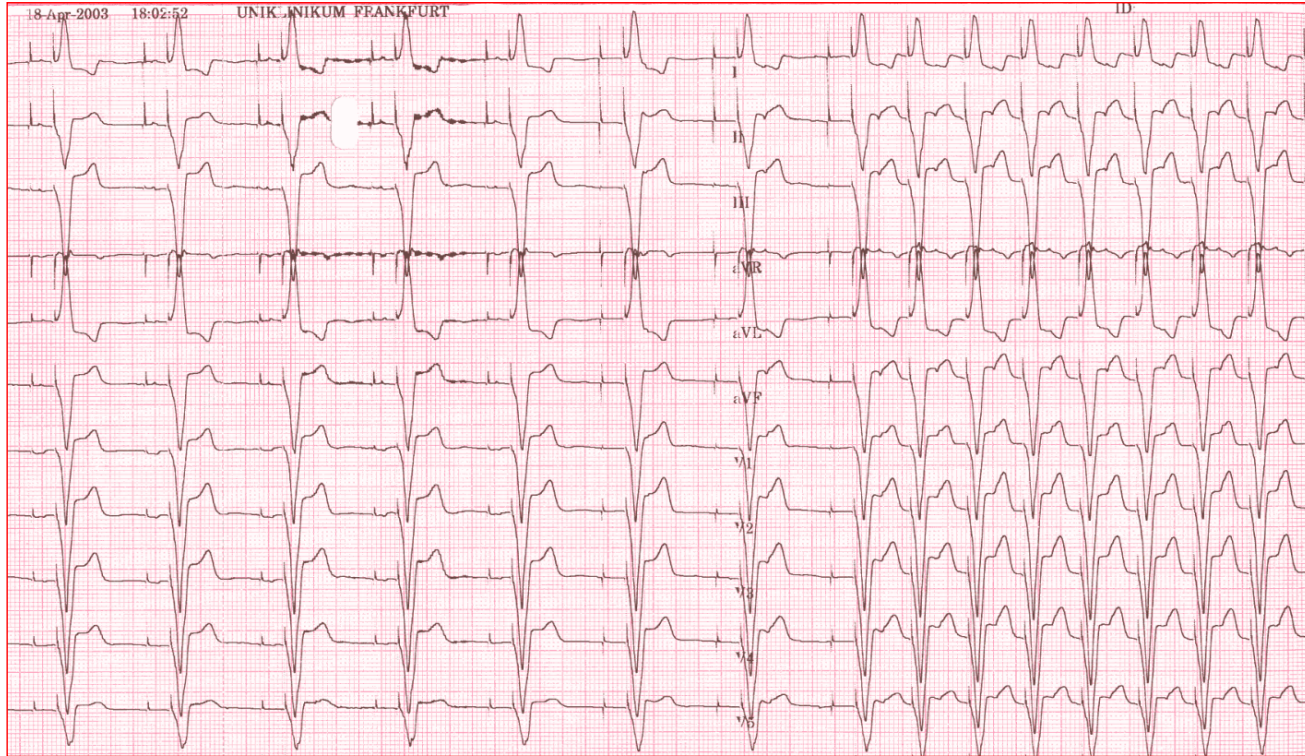
Crosstalk



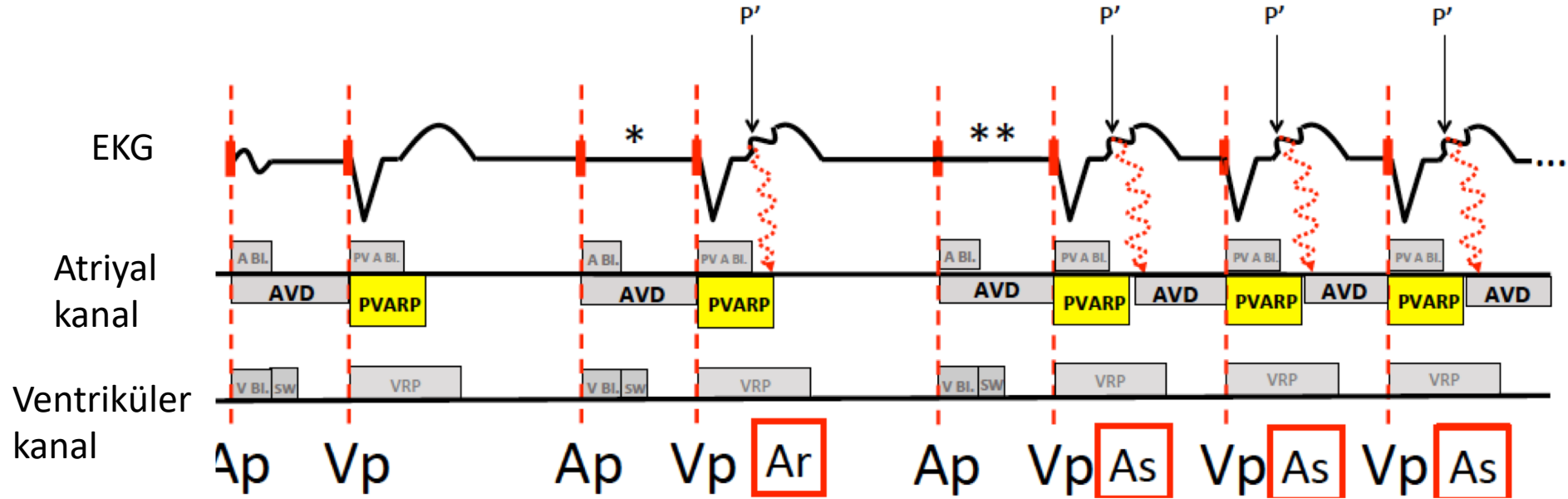
VVT Pacing



Endless loop taşikardi (ELT)

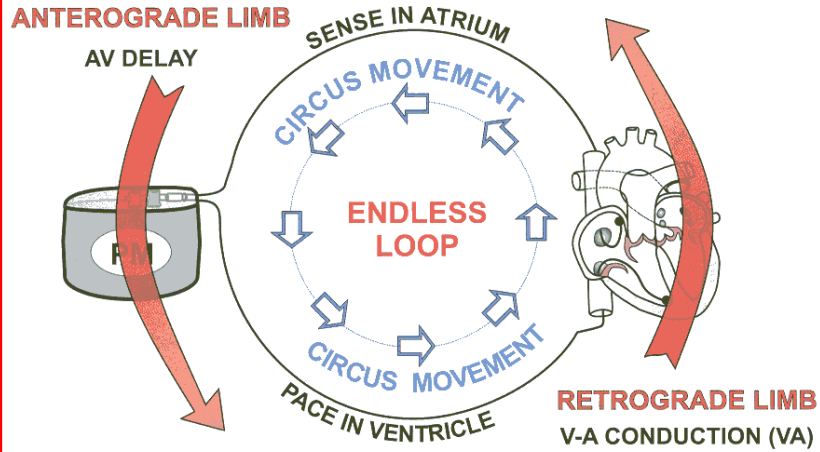


ELT

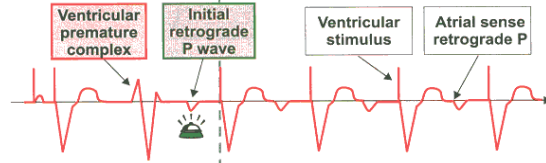


ELT

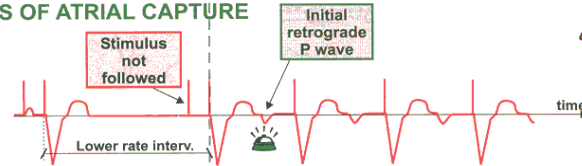
ENDLESS LOOP TACHYCARDIA (ELT)



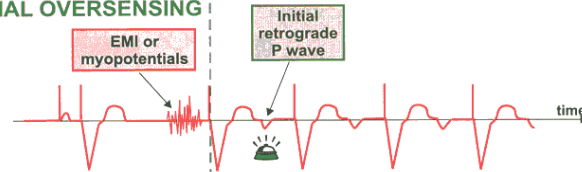
1 VENTRICULAR EXTRASYSTOLES



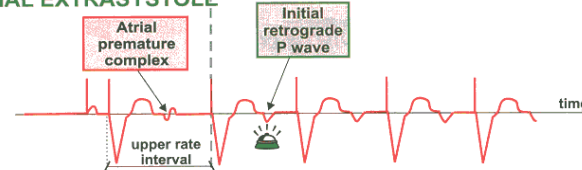
2 LOSS OF ATRIAL CAPTURE



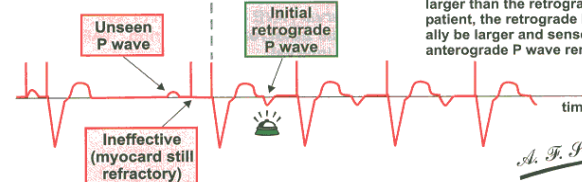
3 ATRIAL OVERSENSING



4 ATRIAL EXTRASYSTOLE



5 INTERMITTENT LOSS OF ATRIAL SENSING

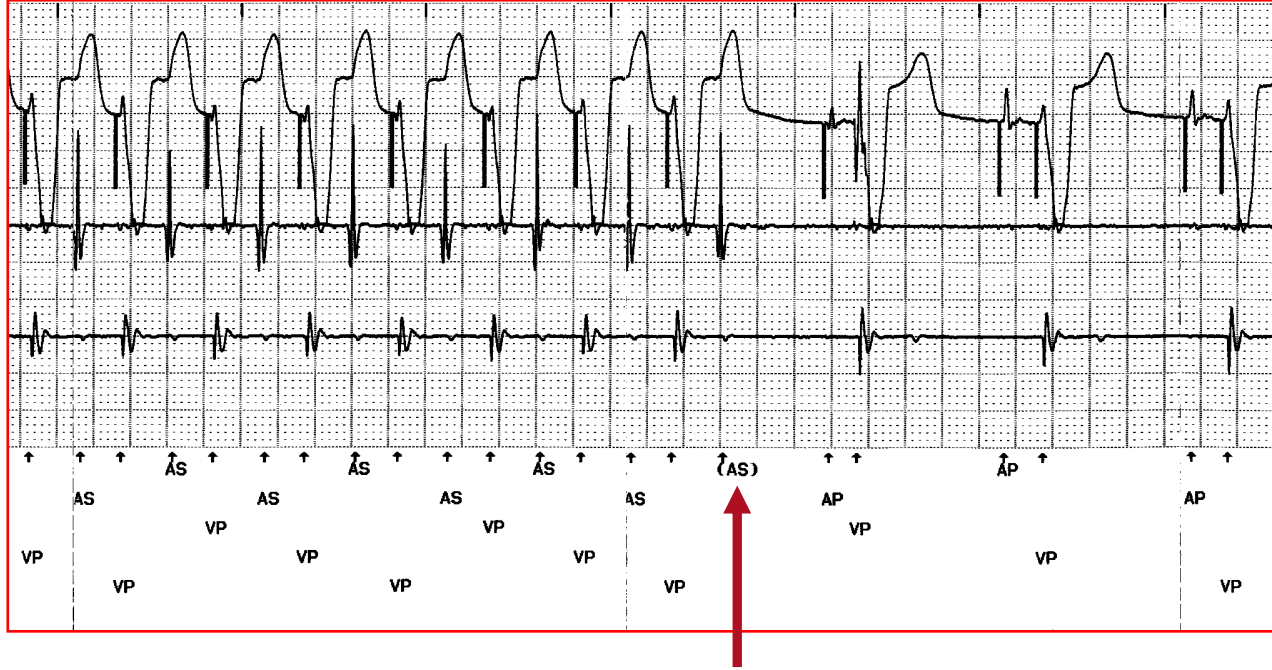


Although the anterograde P wave is usually larger than the retrograde P wave in a given patient, the retrograde P wave may occasionally be larger and sensed when the smaller anterograde P wave remains unsensed.

A. F. Penna

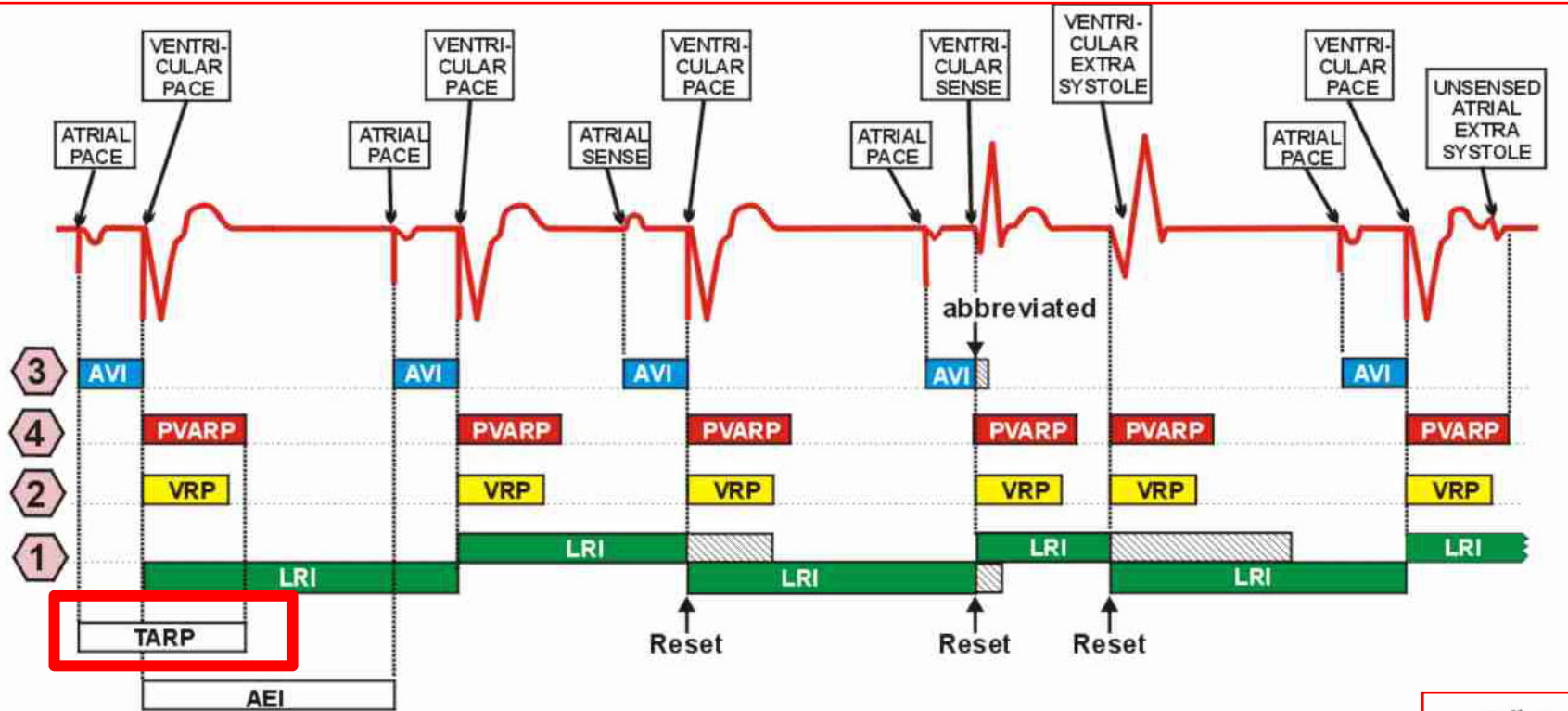
- AS ile başlar
- UTR geçmez
- Magnet ile sonlanır

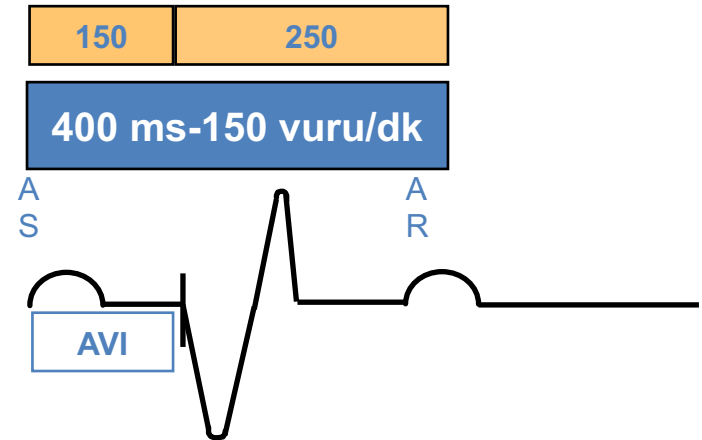
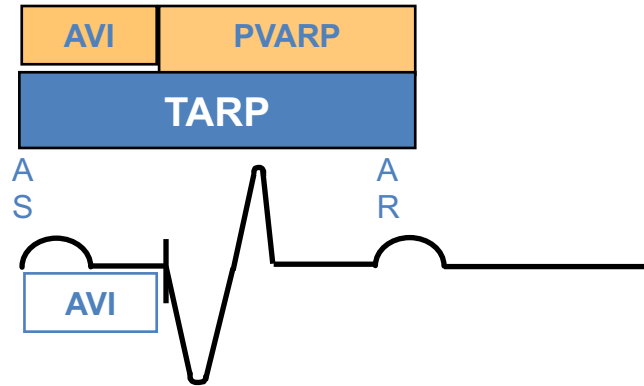
PMT müdahalesi



X sayıda “VP-AS” algılanmasının ardından PVARP otomatik uzatılıyor
⇒ (tek) P dalgası iletilmediğinde ⇒ taşikardi sonlanıyor

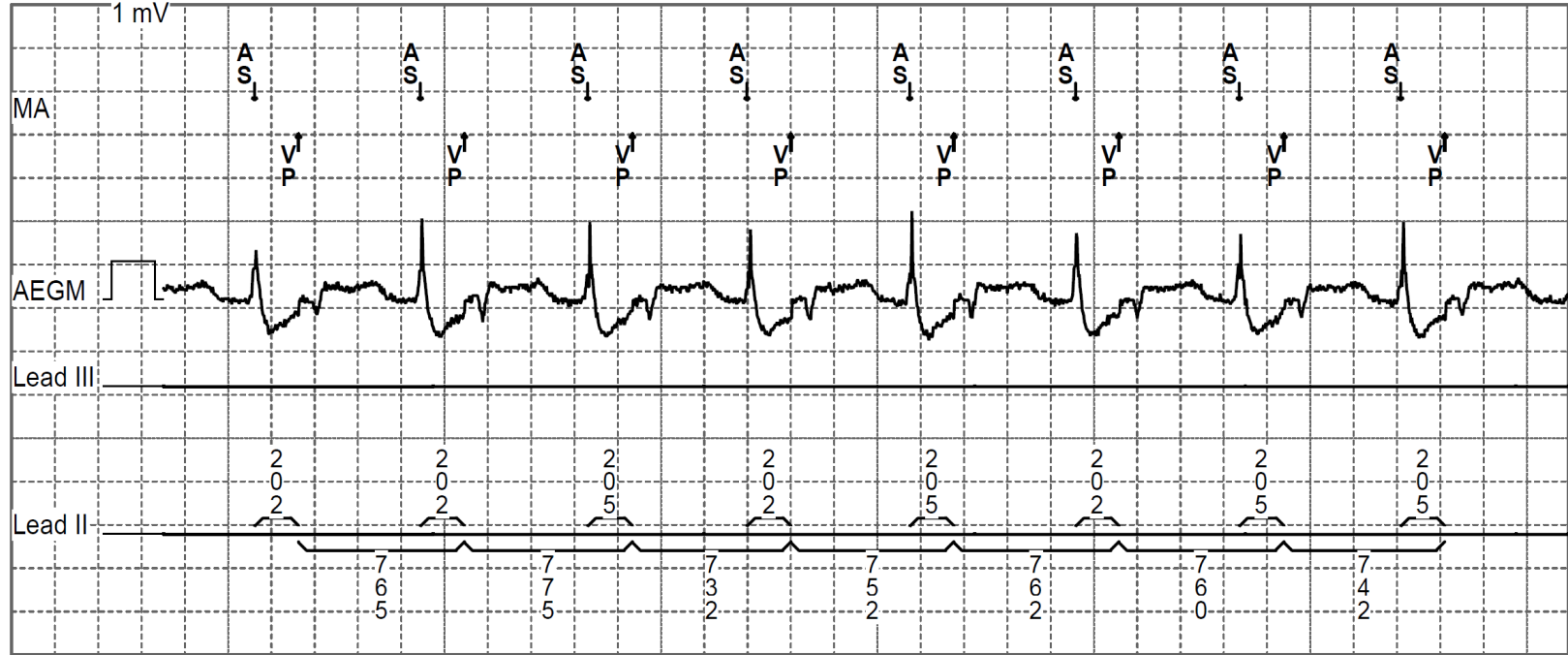
TARP: AVI+PVARP



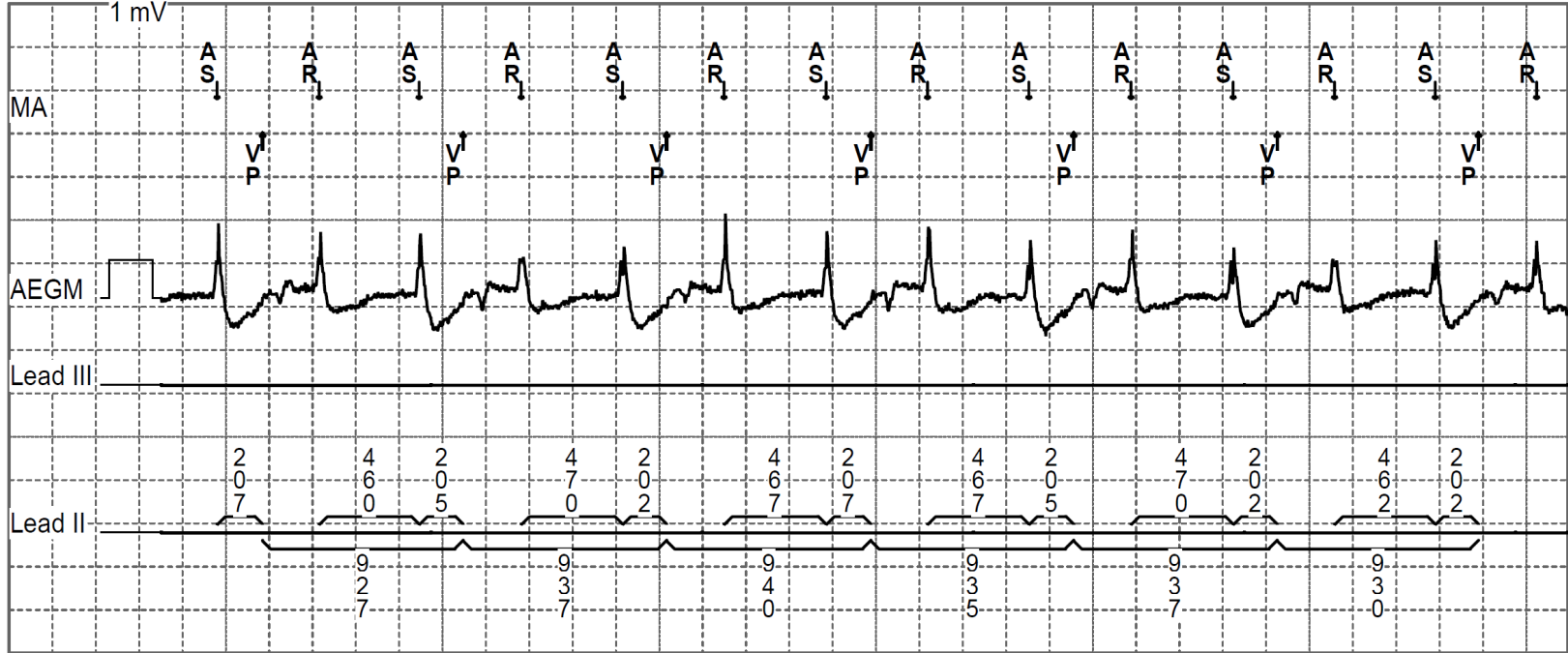


Collected: 01/22/20 11:23:15 AM

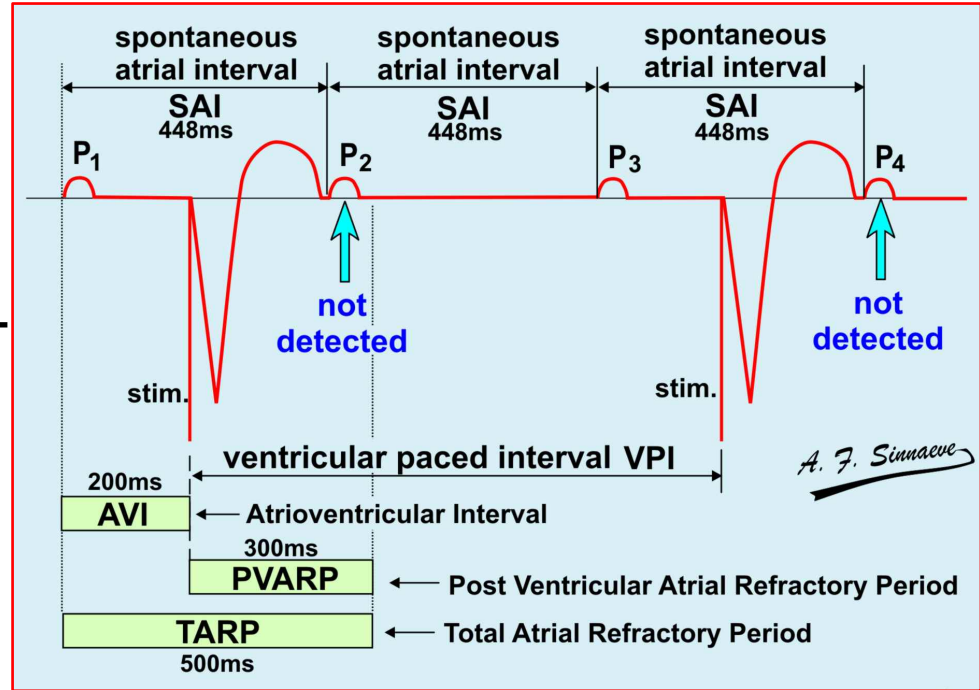
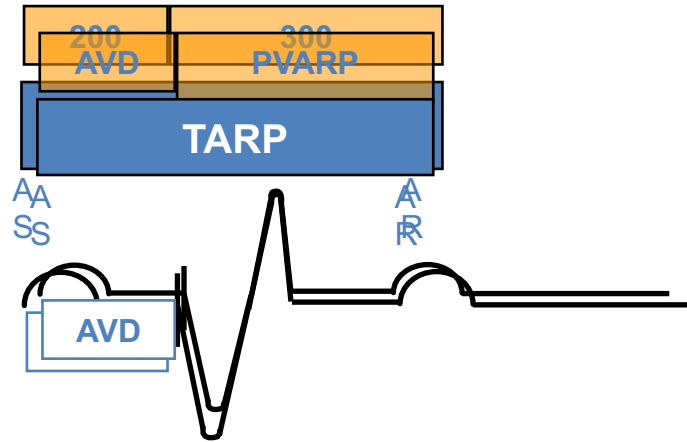
25.0 mm/sec



25.0 mm/sec

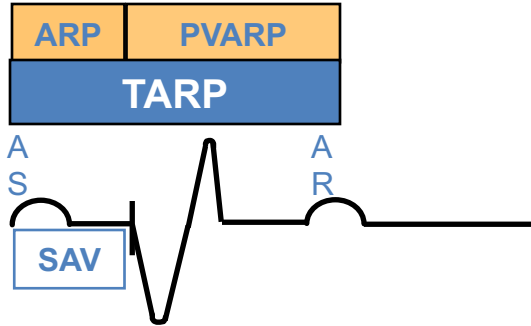


Üst hız yanıtı -I :TARP-Problemi

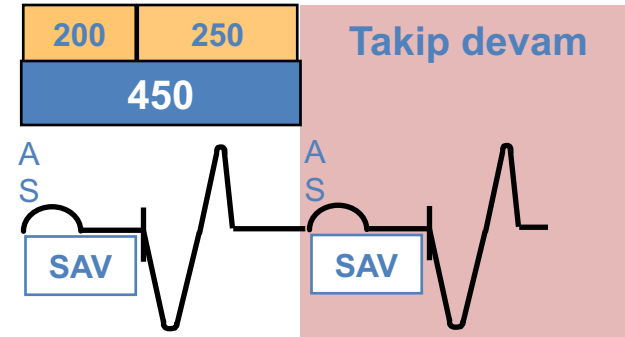
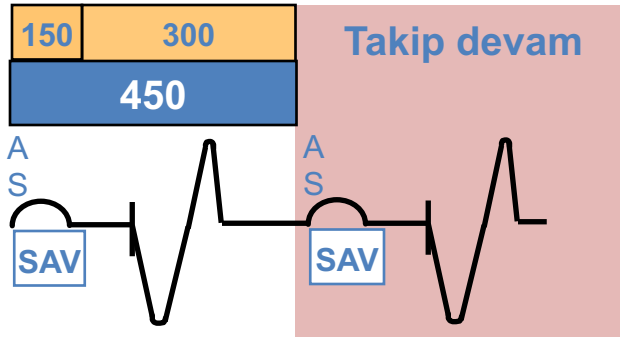
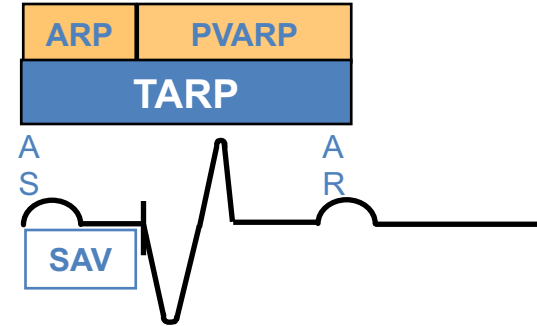


Üst hız yanıtı -I :TARP-Problemi

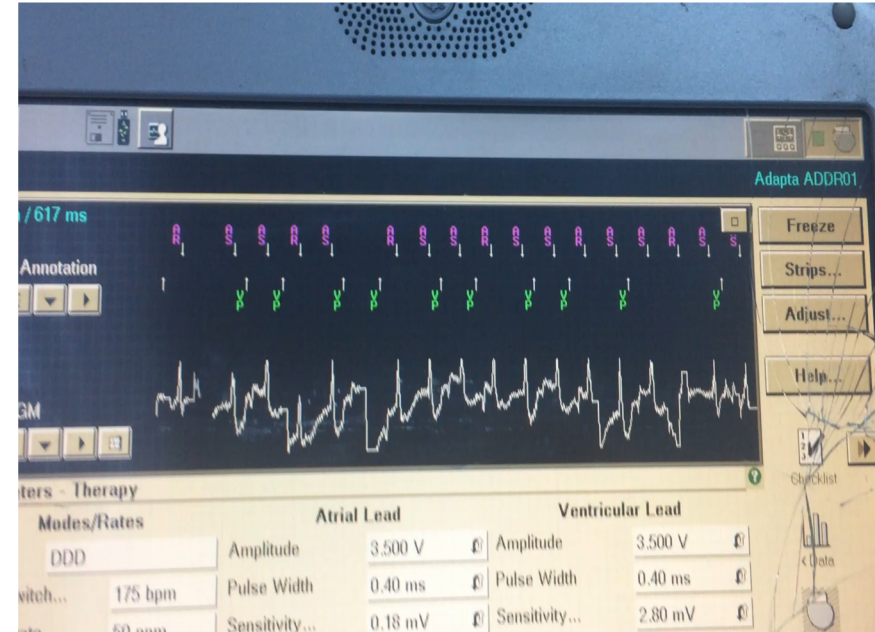
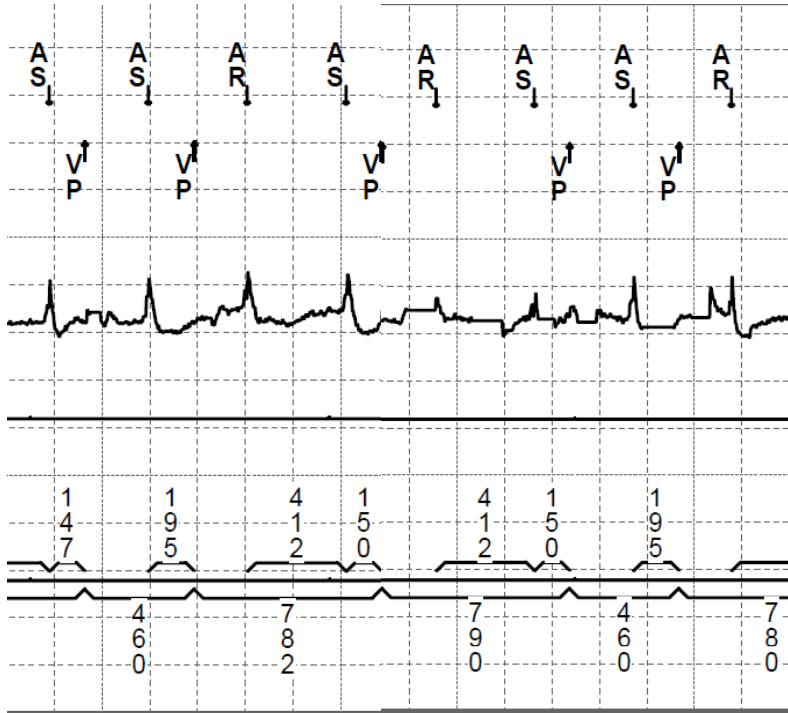
AV gecikme kısaltılabilir



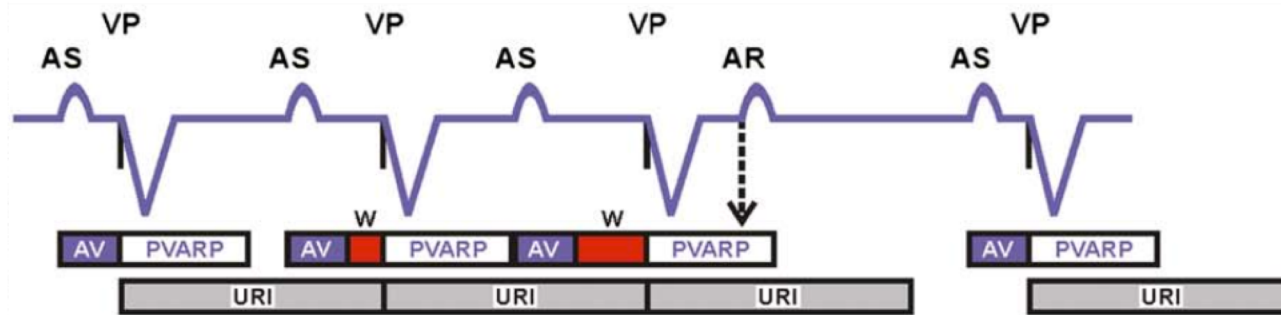
PVARP kısaltılabilir

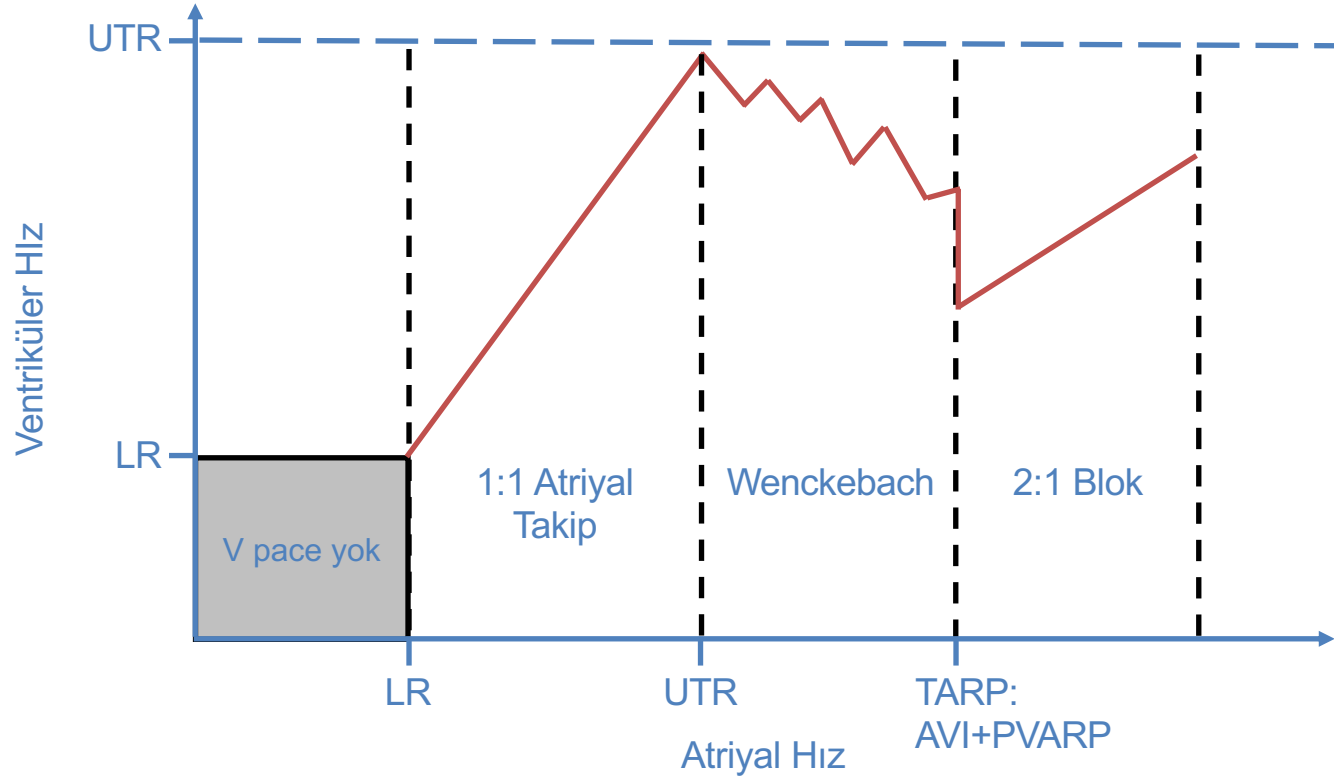


Üst hız yanıtı -II :Upper tracking rate



Üst hız yanıtı -II :Upper tracking rate

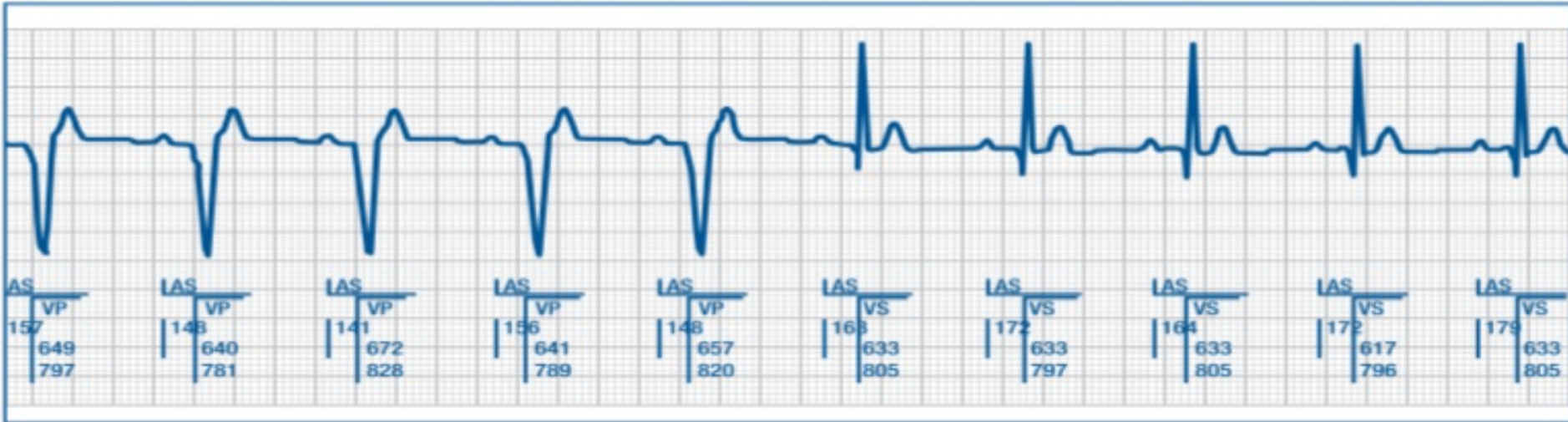




AVI ya da Refrakter dönemlerde farklılık

- Hıza bağlı değişen AV delay
- Sensör/ hıza bağlı değişken PVARP
- VEV yanıtı
- Ventriküler safety pacing
- Blanking
- Non-competatif atriyal pacing

AVI Histerezis

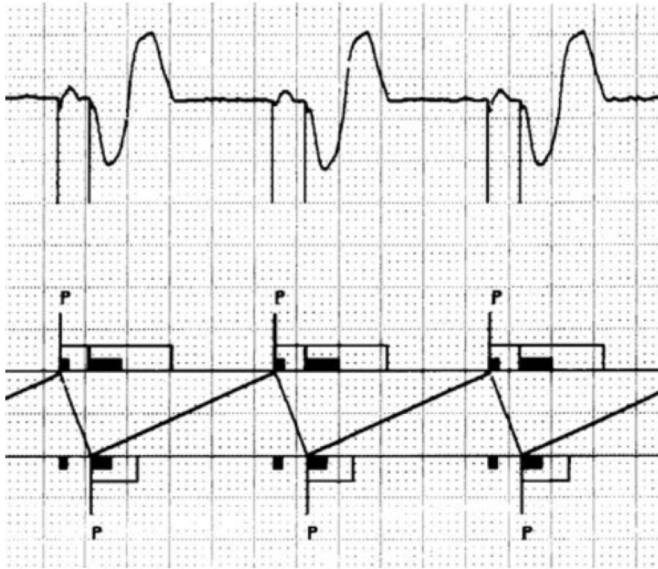


Sensed AVI:150ms

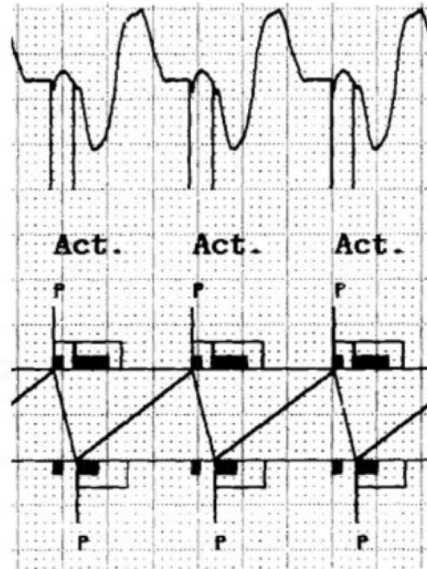
Paced AVI:160ms

Histerezis: 50ms

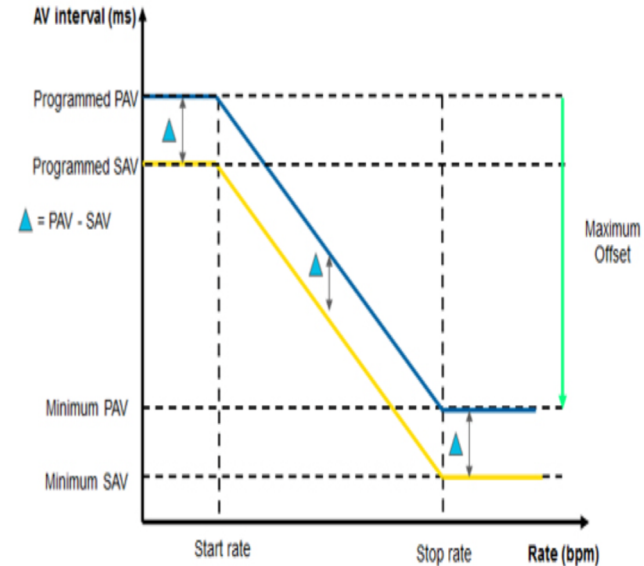
Hıza bağlı değişen AV delay

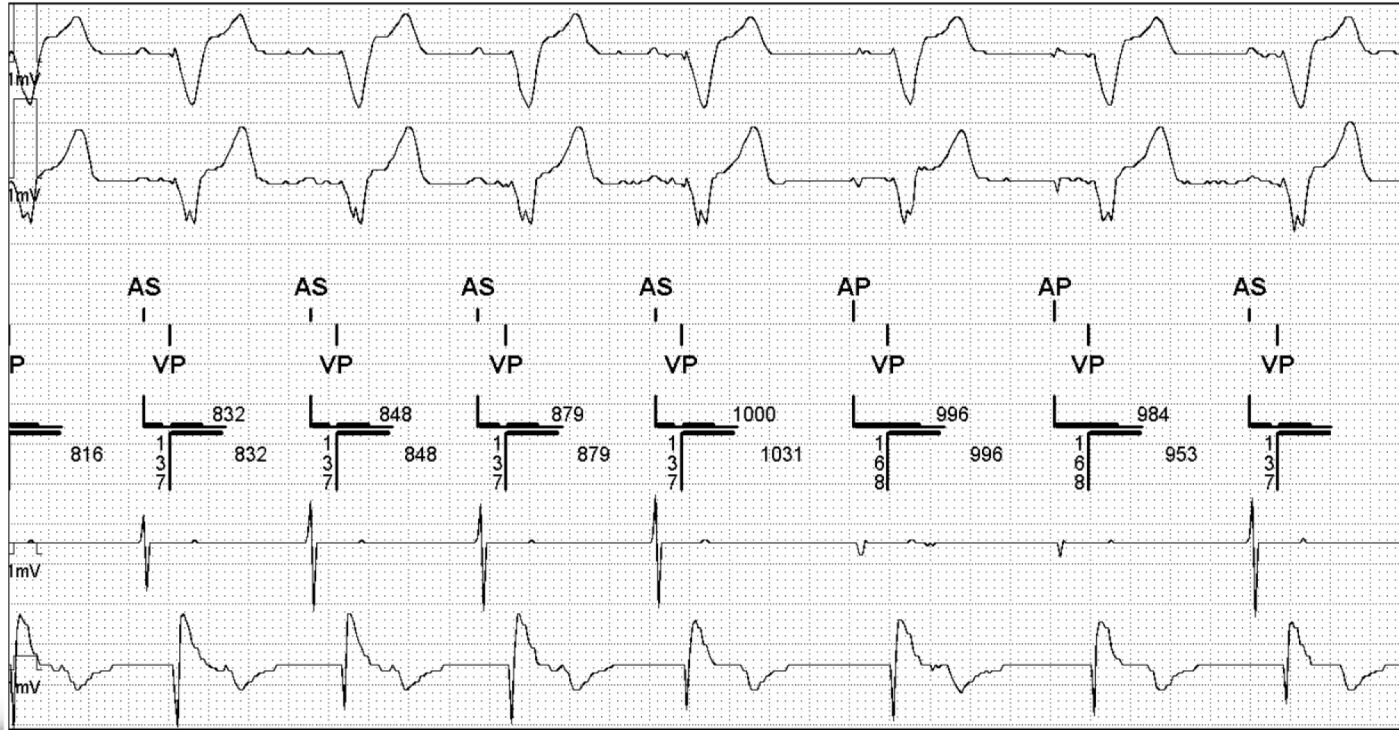


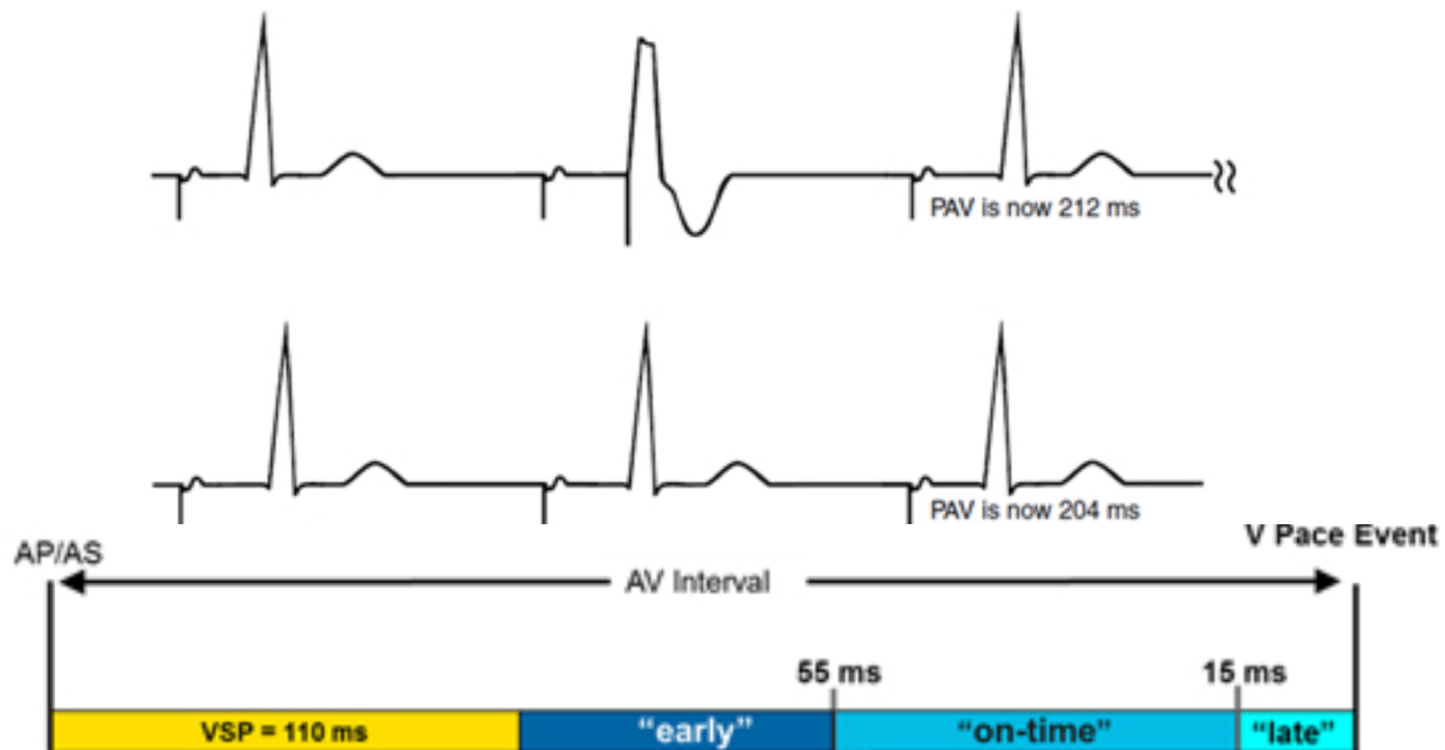
PAV delay with no activity: 150 ms

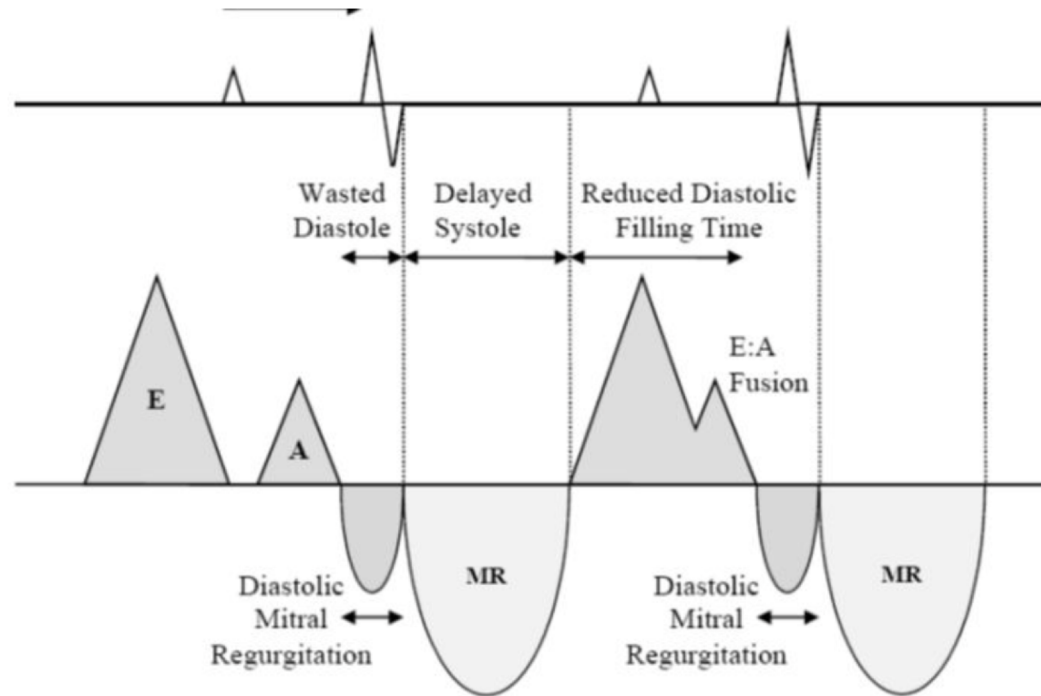


PAV with activity: 120 ms

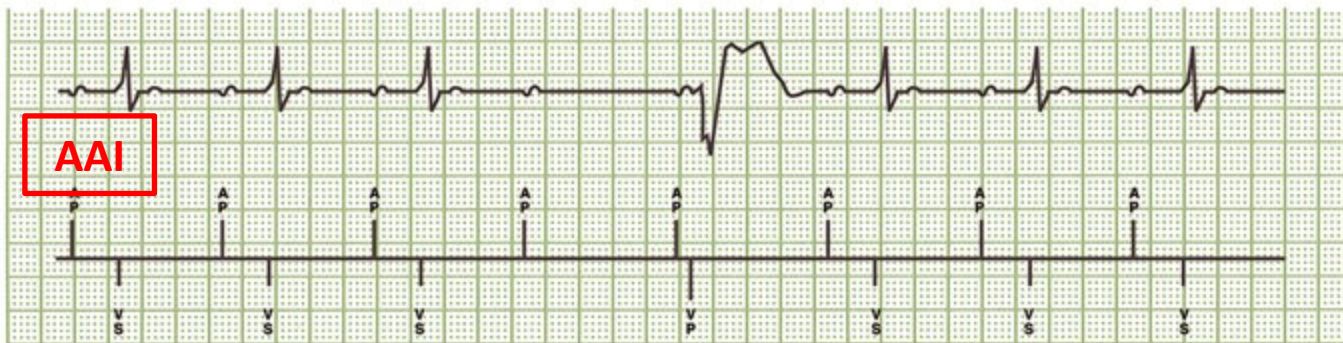




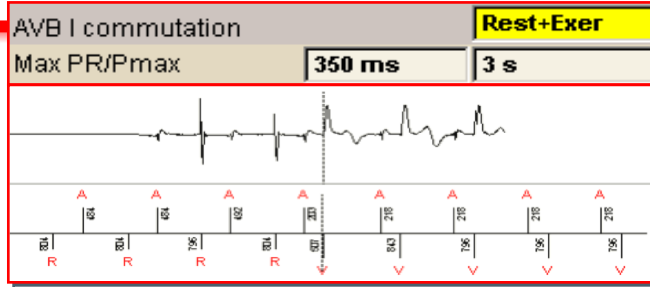




AAI $\leftrightarrow$ DDD: MVP[®] /SafeR[®]

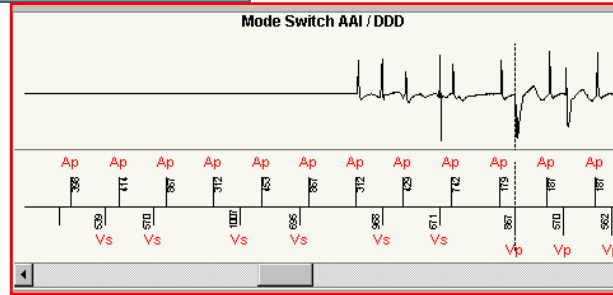


AAI ↔ DDD: MVP[®] /SafeR[®]



AV Blok I°

Uzun PR/AR olan 7 ardışık siklus
(dinlenme/egzersiz için değiştirilebilen süreler)



AV blok II° kriteri:

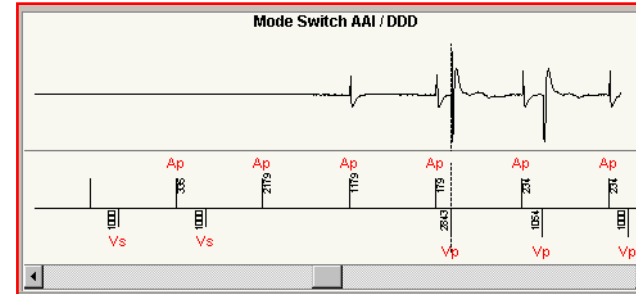
12 siklusta

3 blokluk P dalgası

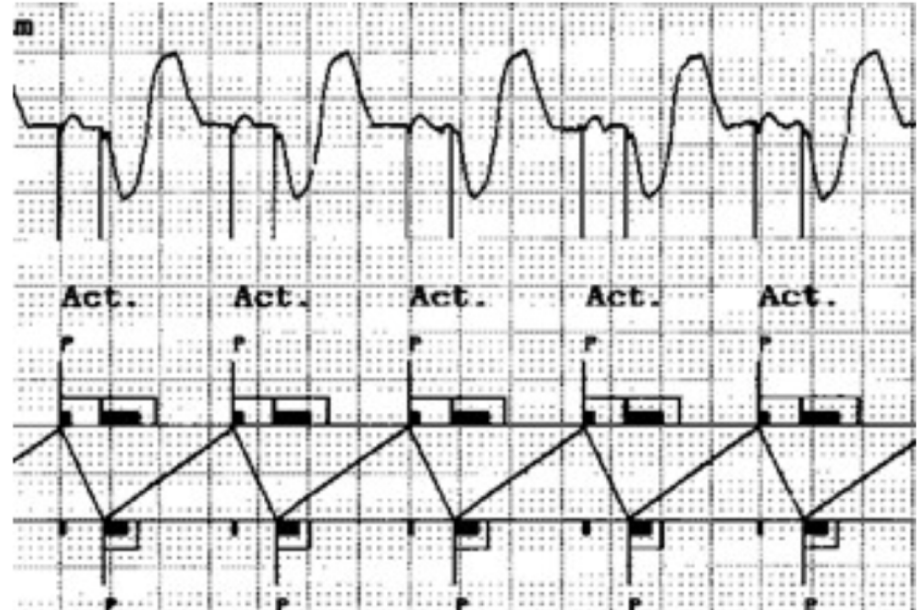
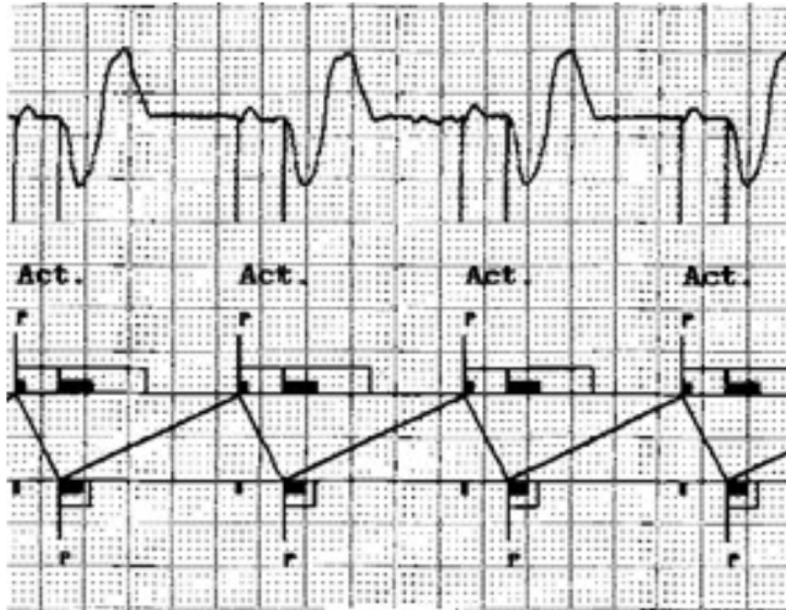
AV blok III° kriteri:

2 ardışık blokluk P dalgası

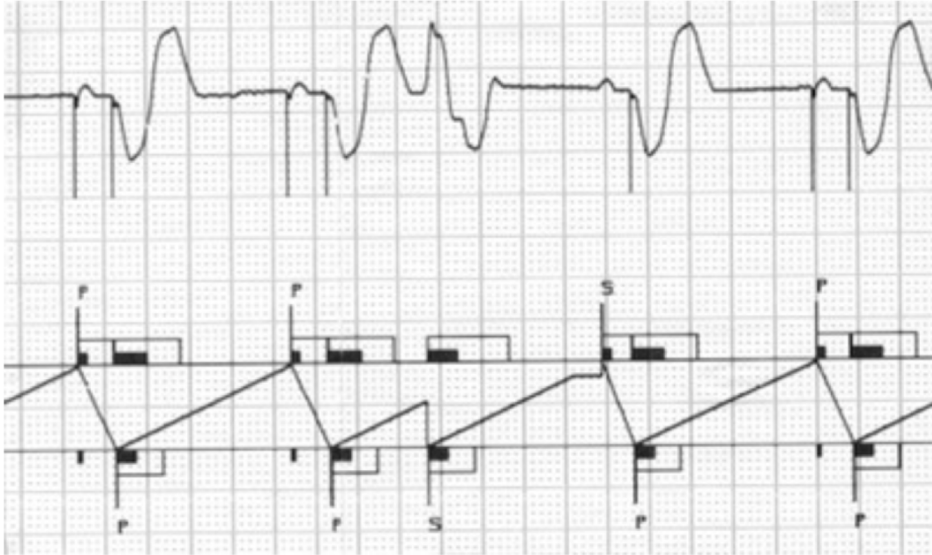
Güvenlik : Duraklama > 2/3/4sn



Sensör/ hızla bağılı değişken PVARP

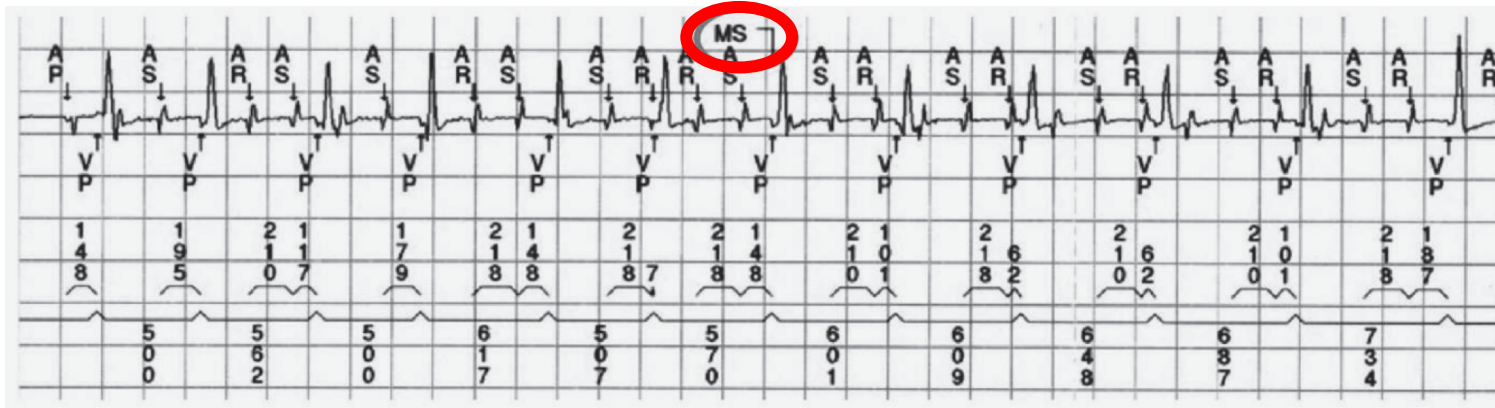


VEV yanıtı- PVARP uzatma



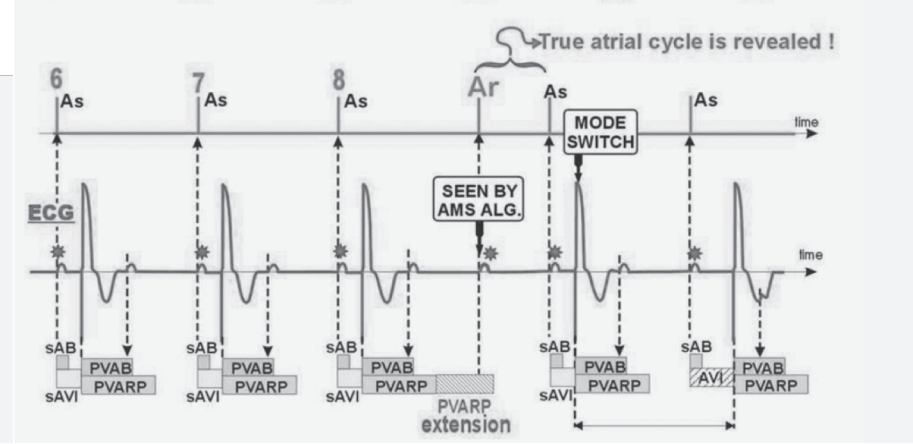
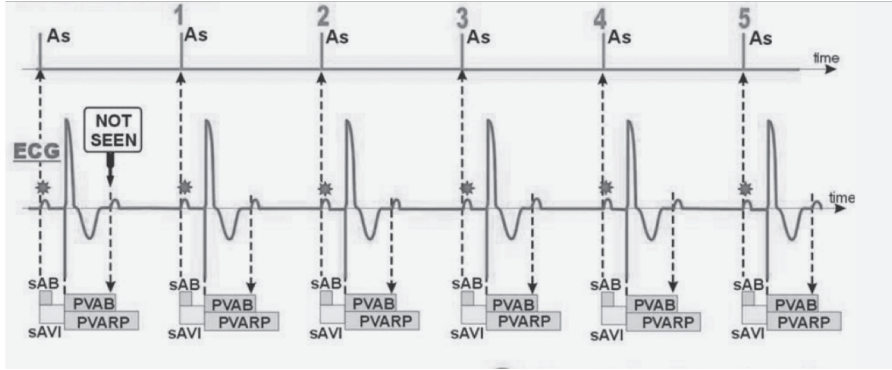
DDD / 60 / 120 PVARP 310 ms

Otomatik Mod Değişimi (AMS)



- 7 vurudan 4 tanesi AS-AR, AR-AS ya da AR-AR ise
- DDD/R → DDI/R

Otomatik Mod Değişimi (AMS)



- 8 vuru AS-VP
- $AS-AS < 2x(AVI + PVAB)$, ya da $2x(\text{Atrial aritmi algılama intervali})$
- DDD/R → DDI/R



Teşekkürler...