Heart Rhythm Congress 2015: Cases and Traces

Review of an Arrhythmia Episode

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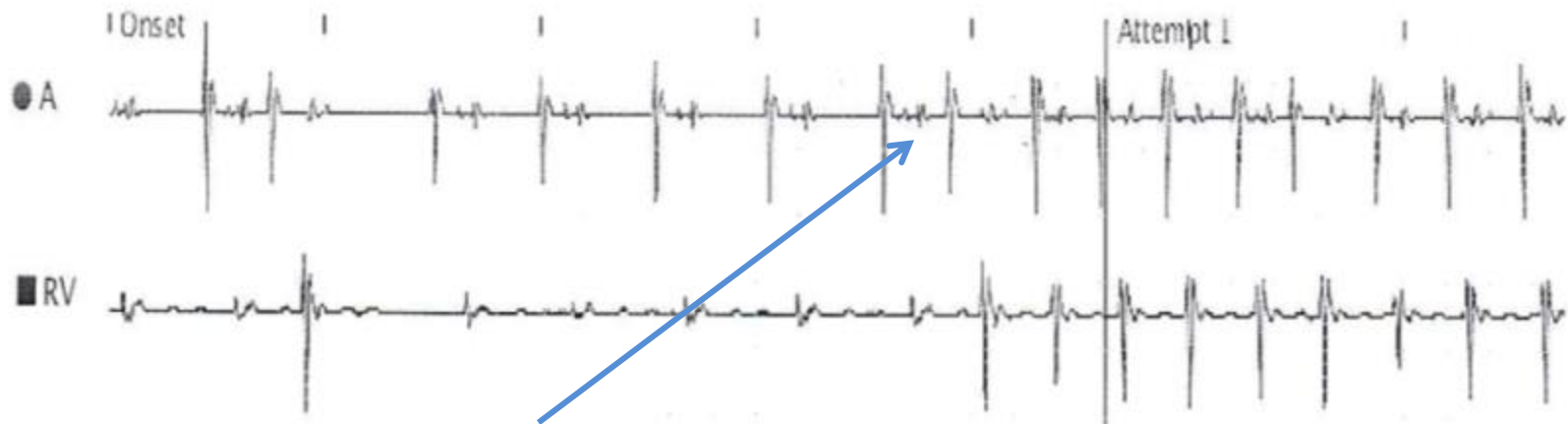
Case study

- **70 year old male**

- **Ischemic Cardiomyopathy**

- **Primary prevention ICD 2007**
  - **Post MI**
  - **Poor LV function**
  - **NSVT on Holter**
  - **+ve VT stim**

- **Upgrade to CRT-D 2014**
  - **Worsening breathlessness**
  - **NYHA III**
  - **SR with LBBB with a broad QRS 186 ms**
  - **LVEF 25%**

Background

- **No previous device therapies**

- **Normal CRT function (70% AP, 99% BiVP)**

- **Occasional ATR and NSVT episodes**
  - **short duration**
  - **patient asymptomatic**

- **Recent transmission with device therapies**
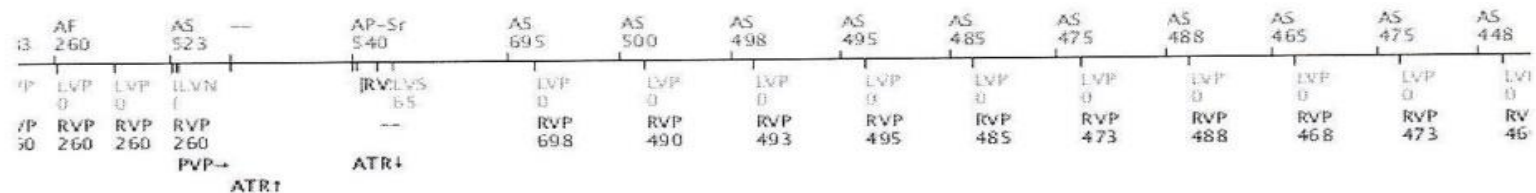
EGM displayed at 25mm per second

Drops out of VT zone and RVS/LVS seen

Rate increases back into the VT zone rhythm
1:1 AV ratio remains

A

RV

V-Detect indicates rate and duration met

ATP delivered

Shock

| AF 330 | AF 343 | AS 358 | AS 355 | AF 350 | AF 348 | AF 343 | AF 338 | AF 333 | AF 328 | AF 333 | AF 325 | AF 320 | AF 325 | AF 325 | AF 328 | AF 340 | AF 303 | AF 328 | AF 333 | AF 28 |

| VS 65 | LVS 163 | LVS 163 | LVS 161 | LVS 163 | LVS 163 | LVS 160 | LVS 160 | LVS 163 | LVS 161 | LVS 163 | LVS 163 | LVS 148 | LVS 163 | LVS 165 | LVP 0 | LVP 0 | LVP 0 | LVP 0 | LVP 0 | LVP 0 | LV 0 |

| VT 328 | VT 340 | VT 353 | RVS 358 | VT 353 | VT 350 | VT 343 | VT 340 | VT 325 | VT 333 | VT 333 | VT 340 | VT 308 | VT 310 | VT 328 | RVP 260 | RVP 260 | RVP 260 | RVP 260 | RVP 260 | RVP 260 | R\ 26 |

AFibV
V–Detect
Stb

A

RV

ATP terminates the arrhythmia

Shock

AS/BiVP restored

| AF 260 | AS 523 | — | AP-Sr 540 | AS 695 | AS 500 | AS 498 | AS 495 | AS 485 | AS 475 | AS 488 | AS 465 | AS 475 | AS 448 |

| P | LVP 0 | LVP 0 | ILVN (| RVLVS 65 | LVP 0 | LVP 0 | LVP 0 | LVP 0 | LVP 0 | LVP 0 | LVP 0 | LVP 0 | LVP 0 | LVP 0 |

| /P 50 | RVP 260 | RVP 260 | RVP 260 | — | | RVP 698 | RVP 490 | RVP 493 | RVP 495 | RVP 485 | RVP 473 | RVP 488 | RVP 468 | RVP 473 | RV 46 |

PVP→   ATR↓
ATR↑

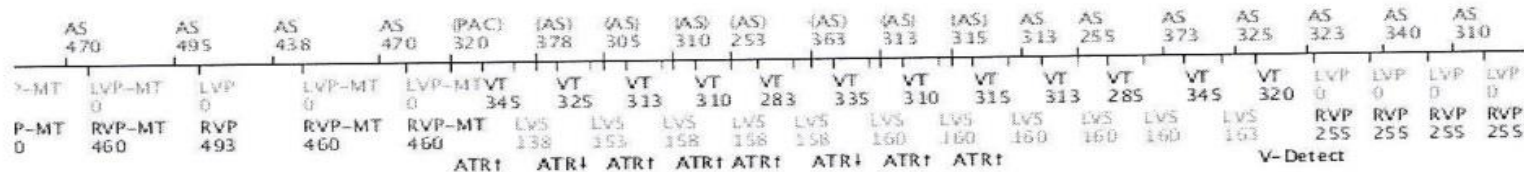**Rhythm reinitiates again starting with an A and with 1:1 AV conduction**

AS 470	AS 495	AS 438	AS 470	(PAC) 320	(AS) 378	(AS) 305	(AS) 310	(AS) 253	(AS) 363	(AS) 313	(AS) 315	AS 313	AS 255	AS 373	AS 325	AS 323	AS 340	AS 310
?-MT	LVP-MT 0	LVP 0	LVP-MT 0	LVP-MT 0	VT 345	VT 325	VT 313	VT 310	VT 283	VT 335	VT 310	VT 315	VT 313	VT 285	VT 345	VT 320	LVP 0	LVP 0	LVP 0	LVP 0
P-MT 0	RVP-MT 460	RVP 493	RVP-MT 460	RVP-MT 460	LVS 138	LVS 153	LVS 158	LVS 158	LVS 158	LVS 160	LVS 160	LVS 160	LVS 160	LVS 160	LVS 163		RVP 255	RVP 255	RVP 255	RVP 255
					ATR↑	ATR↓	ATR↑	ATR↑	ATR↑	ATR↓	ATR↑	ATR↑				V-Detect		

2nd ATP delivered

ATP terminates the arrhythmia

AS 358	AS 270	AS 255	AS 258	AS 258	AS 265	--	AS 383	AS 510	AS 475	AS 475	AS 480	AS 443	AS 470	AS 458	AS 460	AS 458	A: 4
LVP 0	LVP 0	LVP 0	LVP 0	LVP 0	LVN		--	LVS 153	Inh-[LVS]	LVP 0	LVP 0	LVP 0	LVP-MT 0	LVP-MT 0	LVP-MT 0	LVP-MT 0	LVP-MT 0
RVP 255	RVP 255	RVP 255	RVP 255	RVP 255	RVP 255				RVP 518	RVP 473	RVP 473	RVP 480	RVP-MT 460	RVP-MT 460	RVP-MT 460	RVP-MT 460	RVP-MT 460
					PVP→ ATR↑		ATR↓										
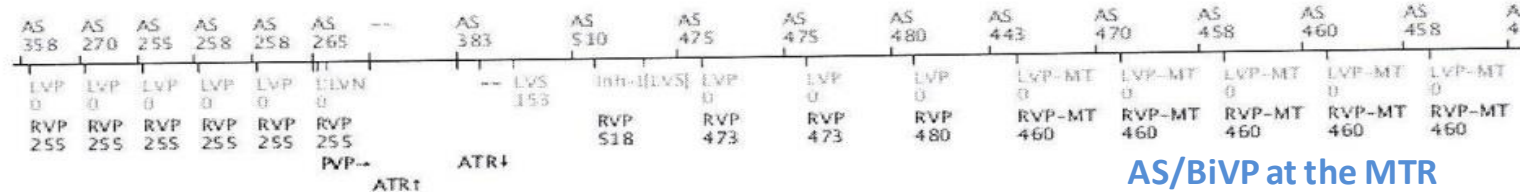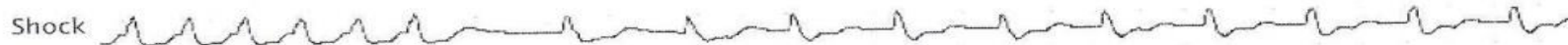
AS/BiVP at the MTR

Q: Appropriate or Inappropriate therapy?

- Inappropriate therapy

- Atrial arrhythmia with 1:1 conduction and likely intrinsic LBBB

- ATP was successful

Q: Why did the device give therapy?

Need to:

- know the tachy and discriminator settings

- review the episode details

- review the EGM and markers

Tachy settings

- **VF zone: 220 bpm 2.5 sec detection**

  Therapies: Quick convert ATP followed by 8 x 41J shocks

- **VT zone: 170 bpm 10 sec detection**

  Therapies: 2 Burst ATP, 1 Ramp ATP followed by 6 x 41J shocks

- **VT zone detection enhancements: Onset/Stability ON**

INITIAL DETECTION			POST-SHOCK DETECTION		
V Rate > A Rate	On		V Rate > A Rate	On	
AFib Rate Threshold	170	min⁻¹	AFib Rate Threshold	170	min⁻¹
Stability	20	ms	Stability	20	ms
	And		Sustained Rate Duration	00:15	mm:ss
Onset	9	%			
Sustained Rate Duration	03:00	mm:ss			
Shock if Unstable		ms			

Episode details

VT Event Onset

Avg A Rate	182 min^{-1}
Avg V Rate	183 min^{-1}
Detection	Onset/Stability
Onset	Percent

At V-Detect

Avg A Rate	186 min^{-1}
Avg V Rate	186 min^{-1}
Rate Zone	VT
Stability	10 ms
V>A Rate	False
. AFib	True
SRD Met	False
ATP Timeout	False
Onset Intvl	(170 ms, Off)
Onset %	32 %

Review of the EGM and Markers

EGM displayed at 25mm per second

8 out of 10 cycles in the VT zone

V-Episode with diagnosis of sudden onset
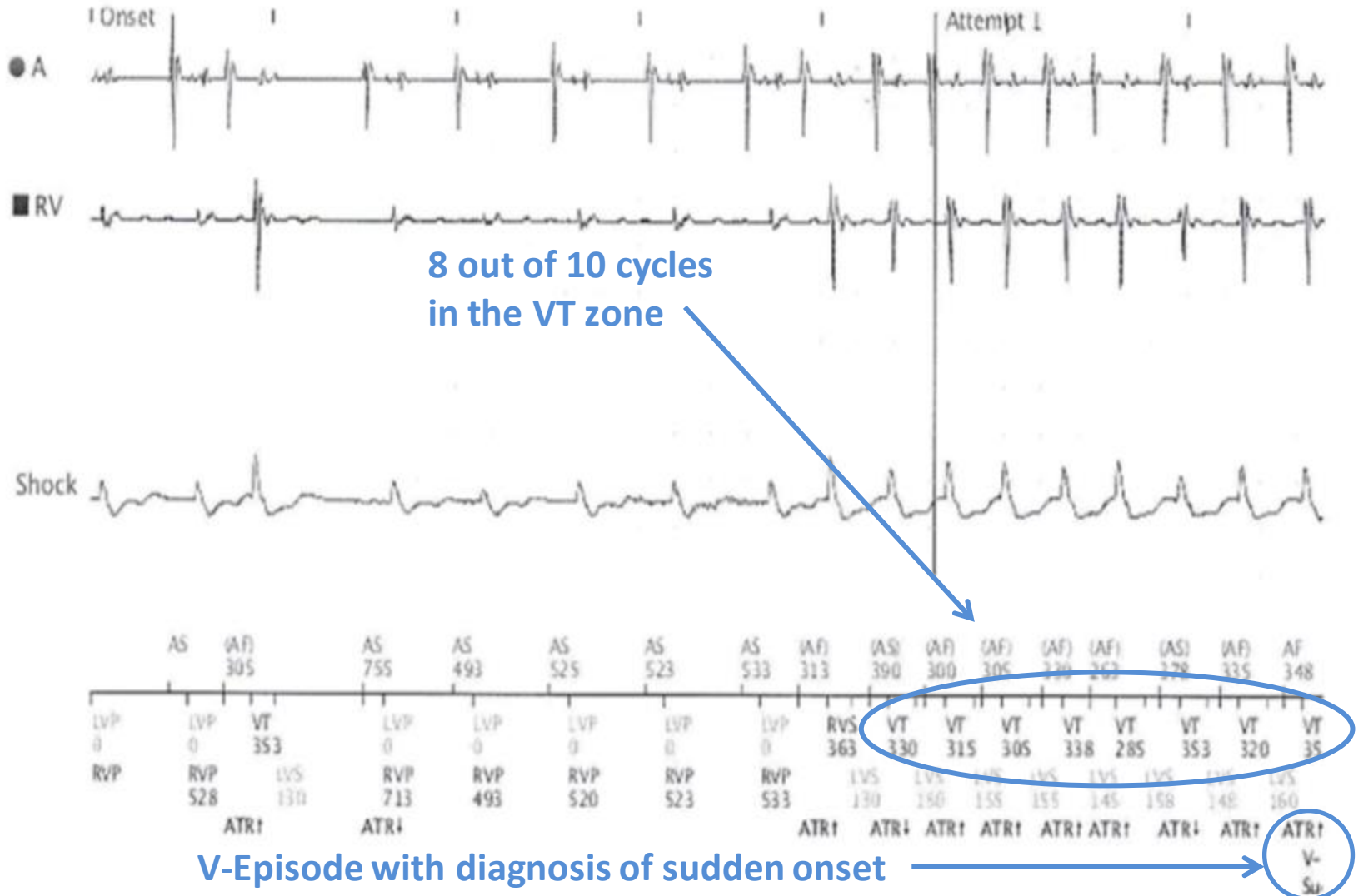
Onset Discriminator

Distinguishes between gradual and sudden onset (ST v VT)

Stage 1
- **Finds 'pivot point'**
- **Adjacent ventricular interval where the cycle length has shortened the most**
- **Change ≥ to programmed Onset value ----> declared sudden onset**
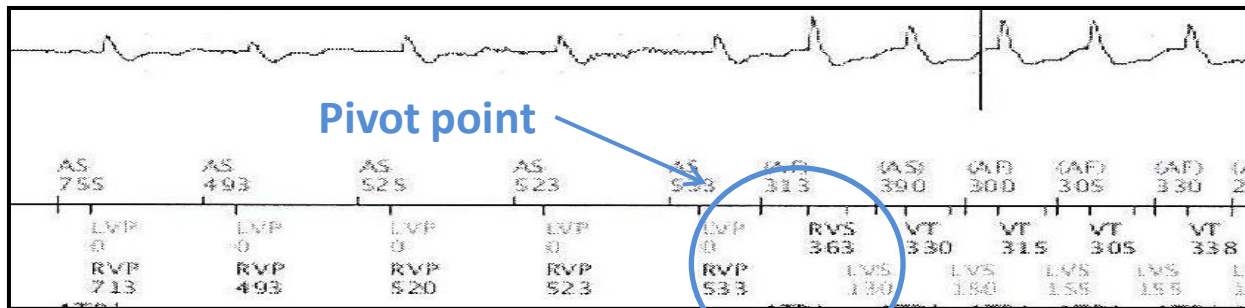
Pivot point

Stage 2
- **Averages intervals preceding pivot point**
- **Averages 3 of the first 4 intervals following the pivot point**
- **Average interval ≥ programmed Onset threshold ----> declared sudden onset**

Stage one and two must both be calculated as sudden to initiate therapies

Duration starts

Duration starts
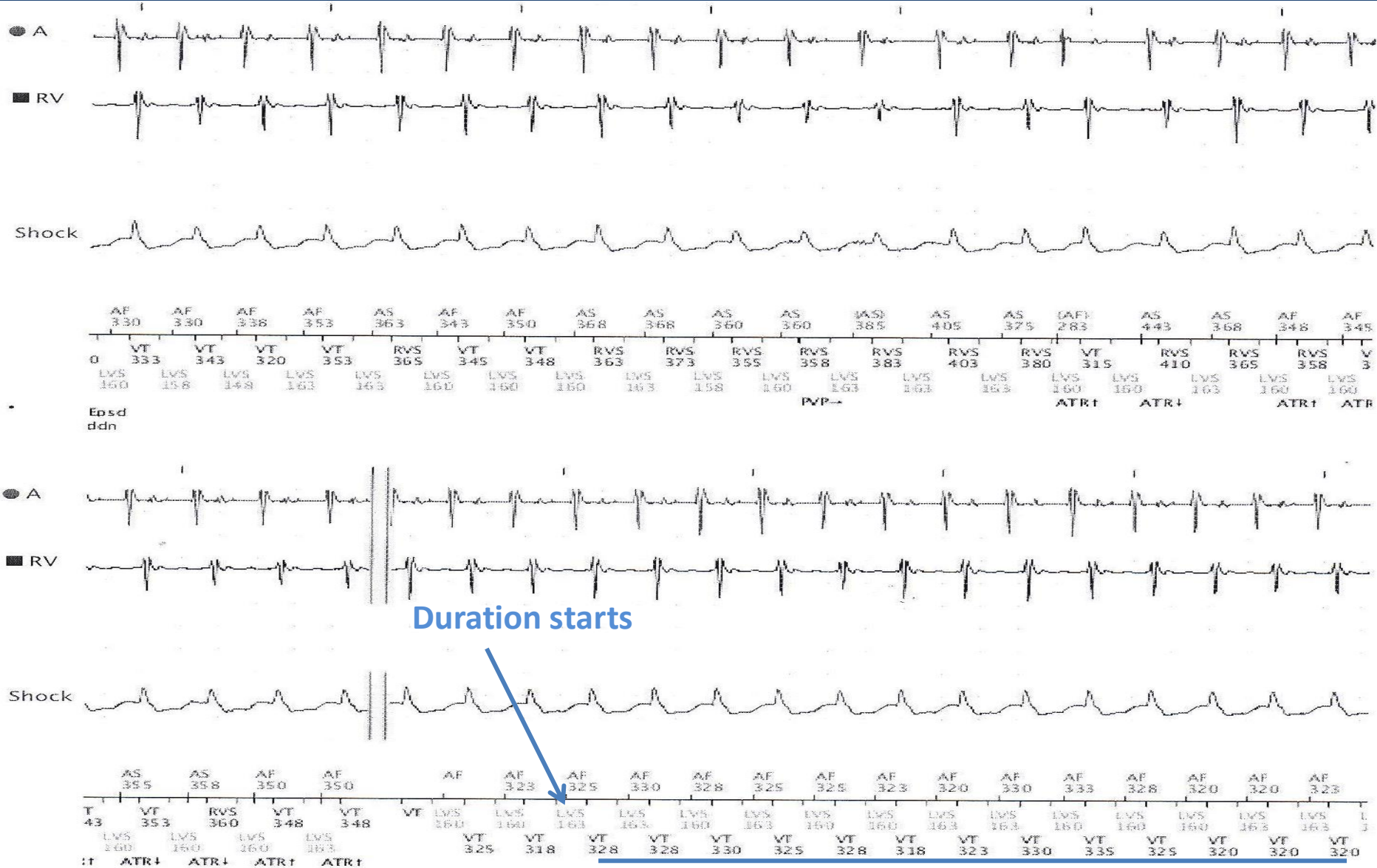
Duration ends discriminators decide
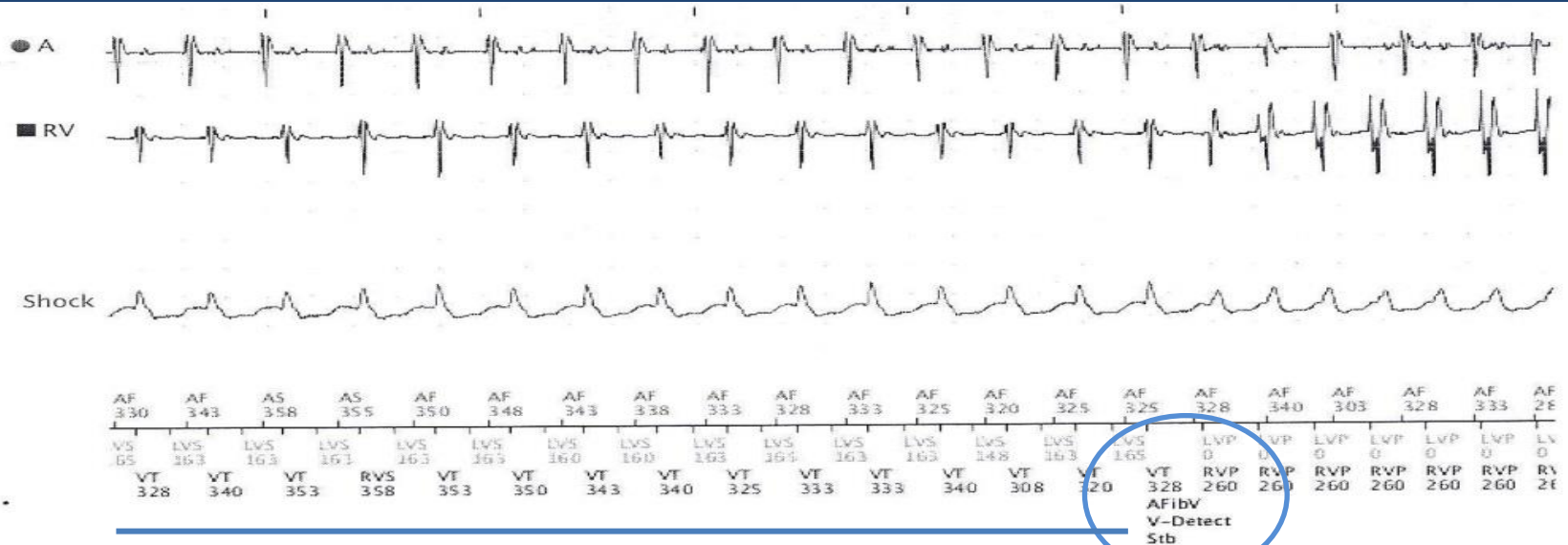
End of Duration (10 seconds)
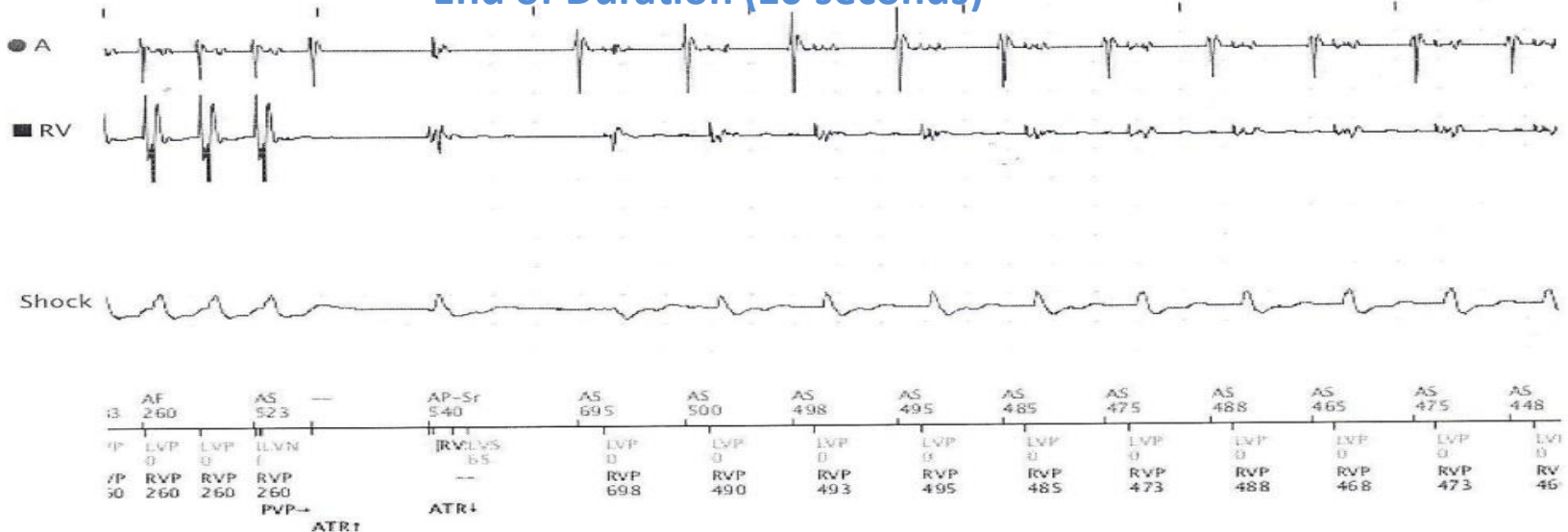
V rate > A rate

- **Compares average of last 10 A and V intervals preceding the end of duration**

If average V ≥ average A rate + 10bpm ----> declared VT

VT Event Onset	
Avg A Rate	182 min^{-1}
Avg V Rate	183 min^{-1}
Detection	Onset/Stability
Onset	Percent
At V-Detect	
Avg A Rate	186 min^{-1}
Avg V Rate	186 min^{-1}
Rate Zone	VT
Stability	10 ms
V>A Rate	False
AFib	True
SRD Met	False
ATP Timeout	False
Onset Intvl	(170 ms, Off)
Onset %	32 %
Event Ended	

- **V>A prioritised over all other discriminators**

- **Not used in redetection**

Afib rate threshold

- **If 6 of last 10 A intervals > A Fib rate threshold marked as (AF)**

If 6 of last 10 A intervals > 170 bpm (Afib Thres < 353 ms) Diagnosed as AF

VT Event Onset	
Avg A Rate	182 min⁻¹
Avg V Rate	183 min⁻¹
Detection	Onset/Stability
Onset	Percent
At V-Detect	
Avg A Rate	186 min⁻¹
Avg V Rate	186 min⁻¹
Rate Zone	VT
Stability	10 ms
V-A Rate	False
AFib	True
SRD Met	False
ATP Timeout	False
Onset Intvl	(170 ms, Off)
Onset %	32 %
Event Ended	

- **Starts at onset of arrhythmia**

- **If AF determined looks at stability**

Stability

- **Average difference calculated throughout the Duration.**

- **Average difference compared with programmed stability value**

- **If average difference is > programmed stability classed unstable**

Average difference of 5 cycles 55/5 beats stability value 11 ms
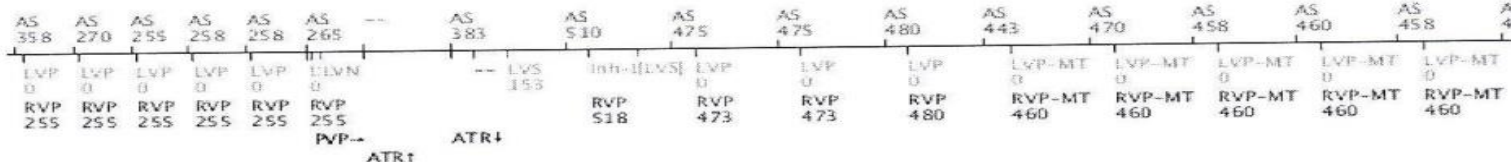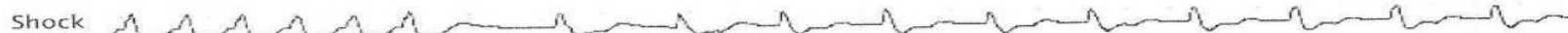
Arrhythmia redetected further therapy
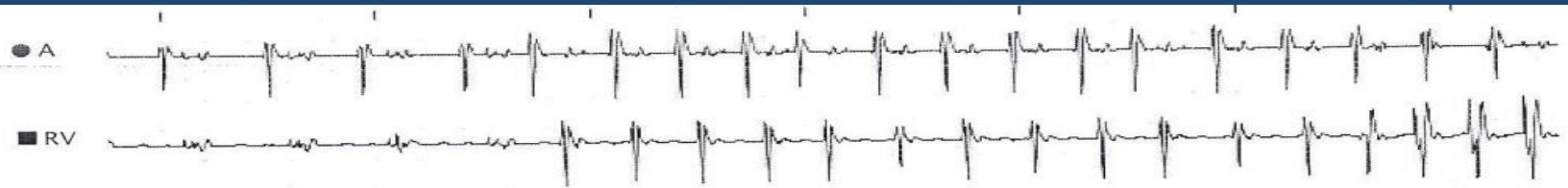
8 out of 10 cycles in the VT zone
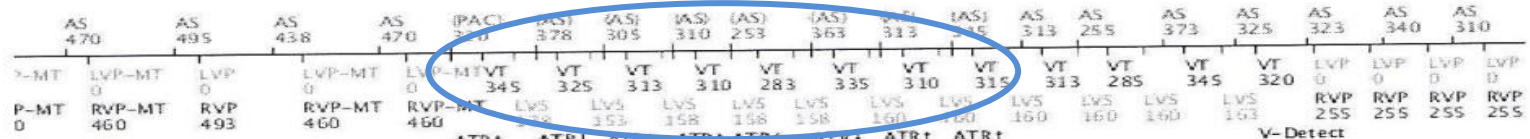
1 sec redetection
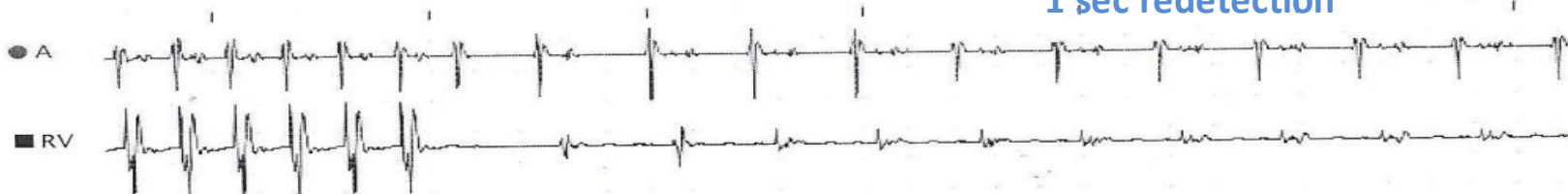
ATP delivered

Summary of episode

- **Inappropriate therapy for an atrial arrhythmia**

- **Appropriate device function for current settings**

- **Risk of inappropriate shocks**

- **Patient to be reviewed in clinic**
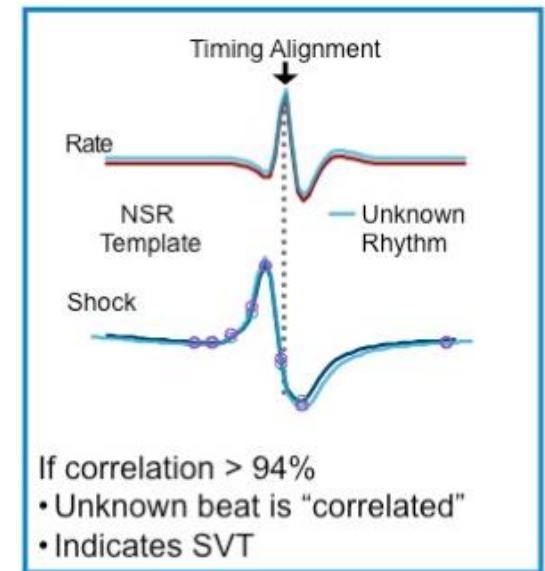
Q: What programming changes would you make?

Options

1. **Use morphology discriminator/Rhythm ID**

2. **Adjust rate or detection interval**

3. **Adjust stability threshold**

4. **Adjust zones to single zone with or without VT monitor zone**

5. **No changes continue to monitor with HM**

6. **Other options - review medications, EP study**

- **Compares shock EGM morphology with a stored reference template**

- **3 of 10 beats match template**

- **Markers RID+ and RID-**

- **Reference template stored by either passive or active method**

Timing Alignment

Rate

NSR Template

Unknown Rhythm

Shock

If correlation > 94%
- Unknown beat is "correlated"
- Indicates SVT

Ambulatory update of Rhythm ID

Passive Method, look for intrinsic every two hours — On

Active Method, temporary non-tracking brady mode — On
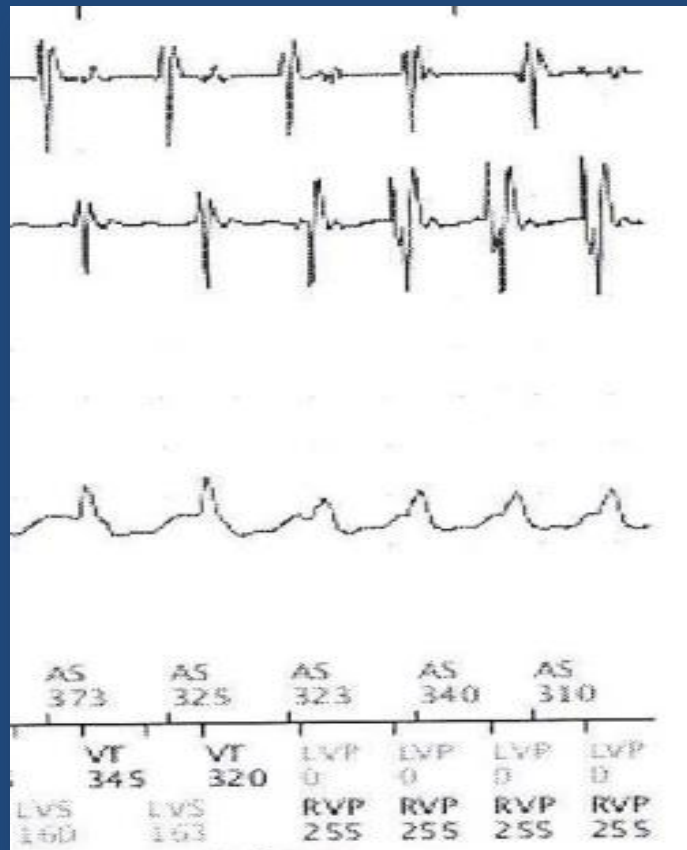
Temporary LRL — 45 min⁻¹

What did we do?

- **Increased detection duration to 60 seconds**

- **Increased rate trigger to 180 bpm**

- **Medications reviewed but no room for adjustment as some postural dizziness possibly related to beta blocker**

- **Follow up with HM in 1/12**

- **If further episodes or longer episodes of atrial arrhythmia may require anticoagulation**
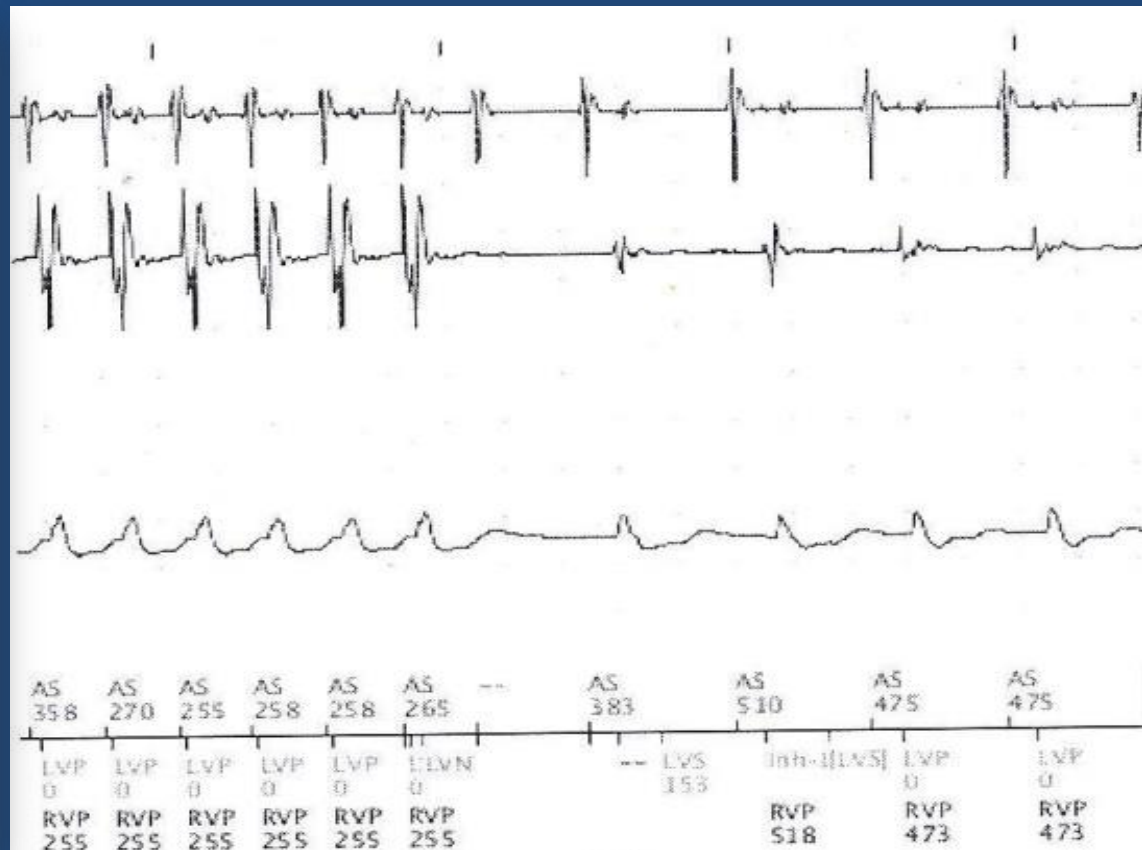
Q: Why does ATP terminate the arrhythmia?
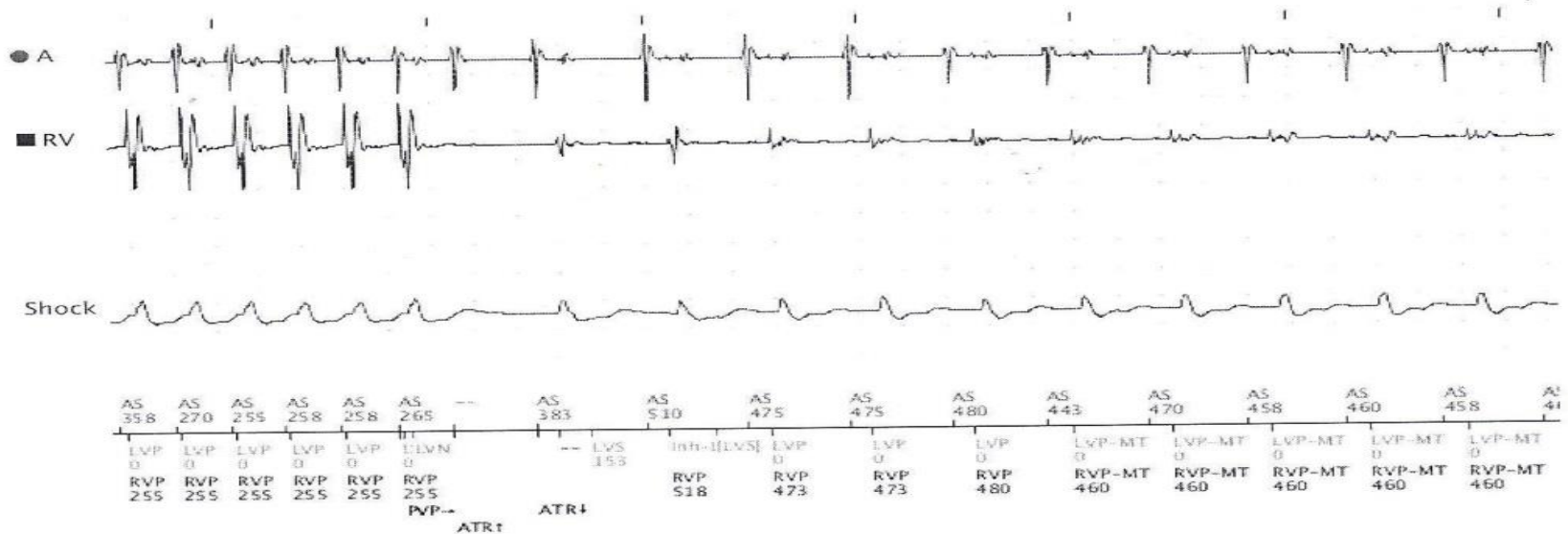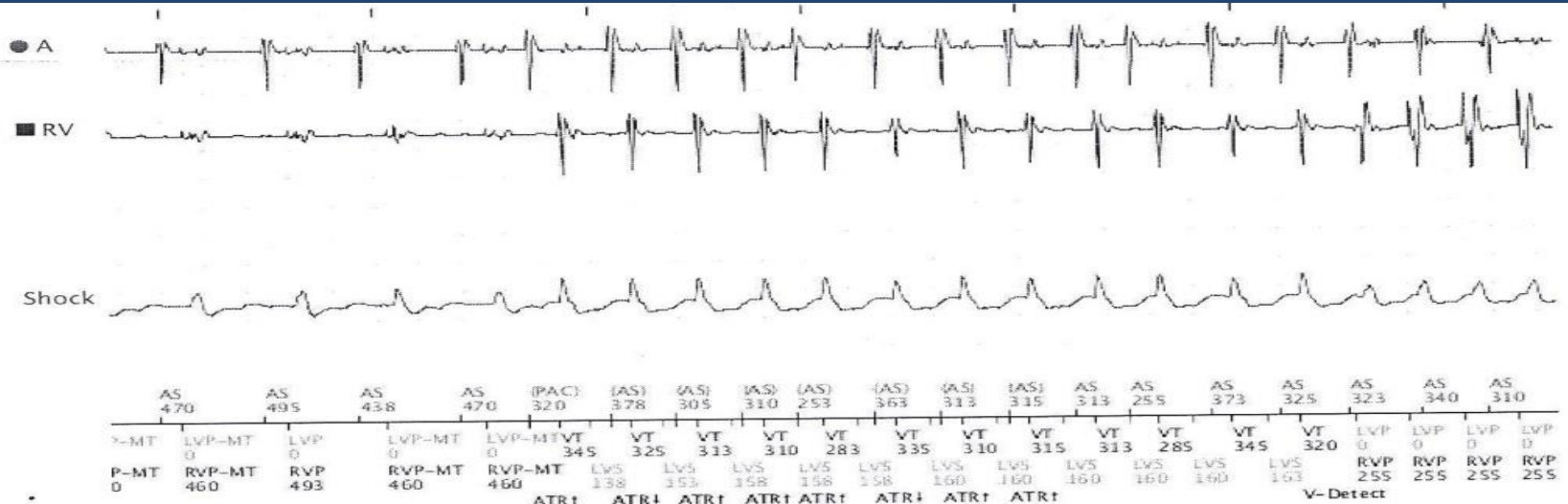
A cycle length 334ms/180 bpm   A cycle length 261ms/229 bpm

Any Questions?