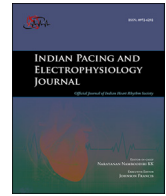




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Use of a novel pacing mode to achieve biventricular pacing in a patient with recurrent atrial lead dislodgement after CRT-D implantation



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ABSTRACT

Cardiac resynchronization therapy device (CRT-P and CRT-D) implantation has increased tremendously with increasing operator experience, eligible patients and expansion of indications. Refinements in devices and algorithms now aid physicians to improve biventricular pacing and optimize CRT. We report a case in which an interesting device program was used to achieve biventricular pacing after repeated dislodgement of the atrial lead in a patient implanted with CRT-D.

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1. Introduction

CRT implantations have increased exponentially over the last decade owing to increasing operator experience, improvement in hardware, increasing number of eligible patients and expansion of indications. Improvement in leads and delivery equipment has led to an reduction in lead dislodgements in contemporary practice. Trouble after a CRT implant more commonly stems from the left ventricular (LV) lead with a reported incidence of dislodgement of about 4–13.6% [1,2] while atrial lead and right ventricular (RV) leads may get dislodged in less than 2% [3] of cases. Lead issues may lead to either complete loss or inadequate biventricular pacing. In this report we describe a case in which the atrial lead was dislodged twice in a patient after CRT-D implantation. Due to the repeated atrial lead dislodgement delivering consistent biventricular pacing became a problem. We discuss the options one has in such a situation and about an interesting change in the device program used to manage this patient. The merits and potential applications of this novel mode are discussed.

2. Case

A 60 year old lady was referred to our clinic with a diagnosis of non ischemic cardiomyopathy with severe LV dysfunction. Her

symptoms had been progressively worsening. She was in NYHA class III at presentation. She had been admitted recently with decompensated heart failure. She was in sinus rhythm. Complete left bundle branch block (LBBB) was present at the baseline with the QRS duration of 160 ms (Fig. 1). Severe LV dysfunction with global hypokinesia was noted on echocardiography with an ejection fraction of 30% and mild mitral regurgitation. She remained symptomatic despite being on an optimised medical therapy including titrated doses of diuretics, beta blocker, angiotensin receptor blocker and aldosterone antagonist. She was considered a good candidate for CRT at this point and was subsequently implanted with a CRT-D (St. Jude Medical Quadra Assura MP™, St. Paul, Minn., USA) device. A tined lead (Tendril, St. Jude Medical, St. Paul, Minn., USA) was positioned in right atrial (RA) appendage, a single coil defibrillator lead (Optisure, St. Jude Medical, St. Paul, Minn., USA) was positioned in RV apex while the LV lead (Quartet, St. Jude Medical, St. Paul, Minn., USA) was secured in an appropriate postero lateral vein. Implantation was technically satisfactory and the LV lead was sensing at the end of QRS. Paced QRS duration was 120 ms with good LV forces (Fig. 2). AV delay was optimized to maximise biventricular pacing, while no VV delay was programmed. The patient experienced a remarkable improvement in her symptoms following the implant. However after an initial improvement she started slipping again about 3 months after the implantation with worsening functional class. On reassessment, her ECG showed sinus rhythm with complete loss of biventricular pacing. Interrogation suggested atrial lead dislodgement. On fluoroscopy, the atrial

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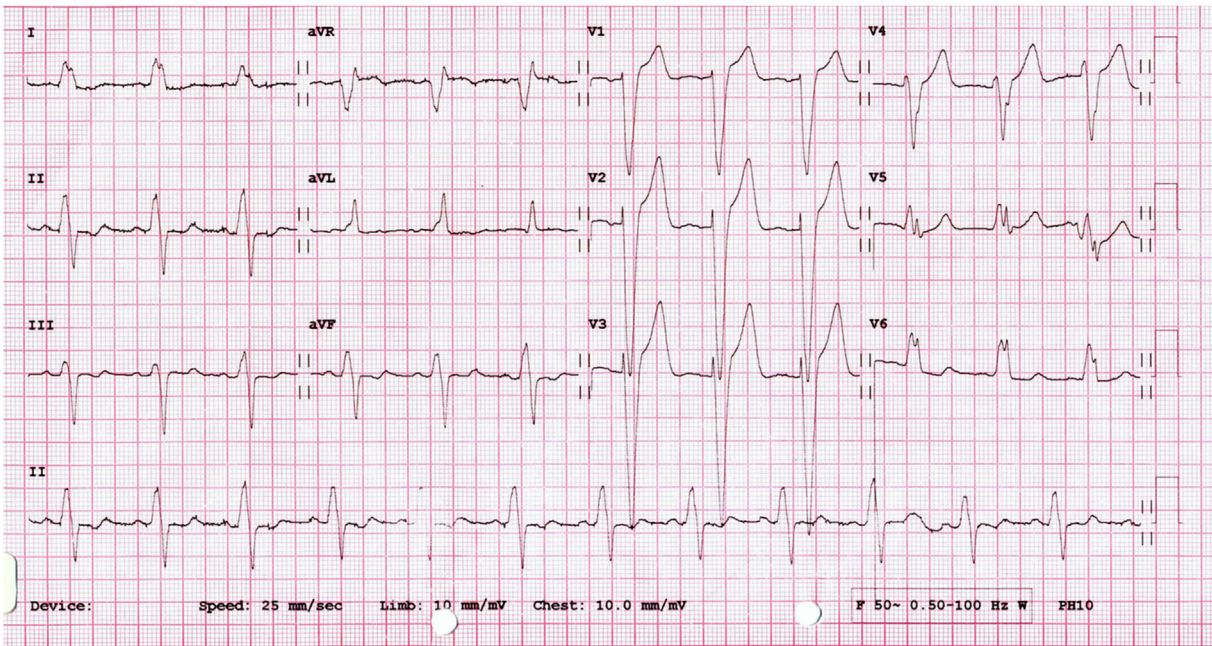


Fig. 1. Complete LBBB at the baseline with a QRS duration of 160 ms. (LBBB – Left bundle branch block).

lead was noted in the superior vena cava (Fig. 3). The ventricular leads were in position. Atrial lead revision was planned. The original tined lead could not be repositioned into the right atrial (RA) appendage. Hence a new screw in lead Tendril™ ST Optim (St. Jude Medical, St. Paul, Minn., USA) was positioned in the RA appendage (Fig. 4) The pocket was closed after ensuring satisfactory lead positions and parameters. On the third day of revision, routine interrogation inexplicably showed prominent ventricular (V) and diminutive atrial activity (A) in the newly

implanted atrial lead (Fig. 5) suggesting dislodgement of the atrial lead again! There was no atrial capture (Fig. 6). Appropriate biventricular pacing was however still noted with tracking of the small A while the larger V EGM was blanked. Automatic switch to non tracking mode was noted intermittently with increase in 'A sense' events when both the electrograms on the atrial lead were sensed (Fig. 7). We pondered over all the possible options then including a) Atrial lead revision again! b) Epicardial placement of atrial lead c) Programming the device to VVI mode to achieve

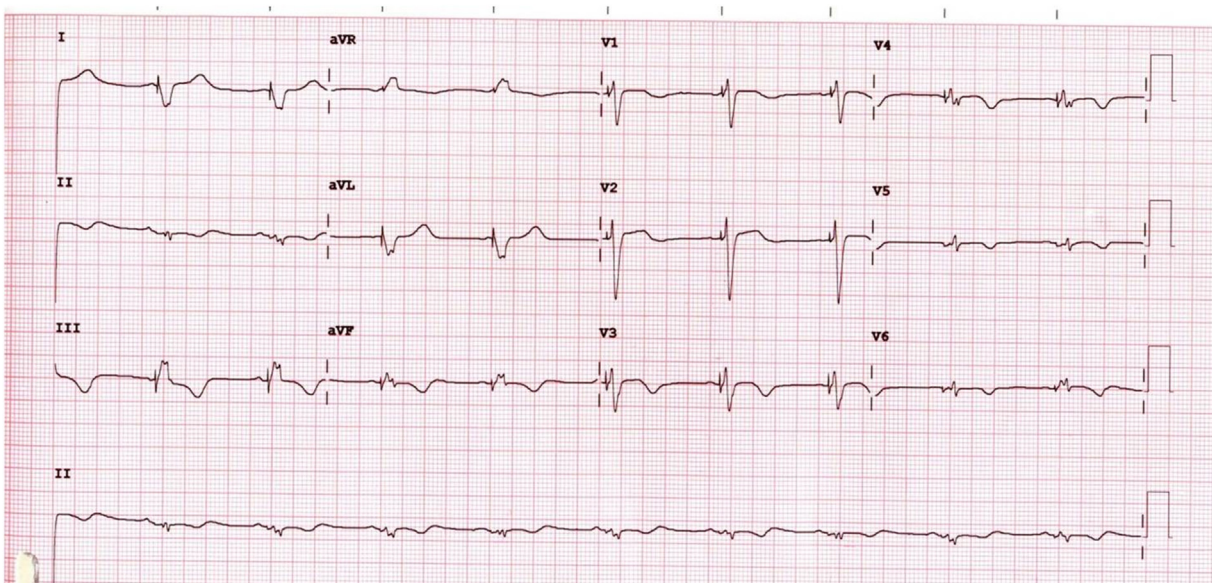


Fig. 2. Biventricular paced complexes post CRT-D implantation were narrower with good LV forces.

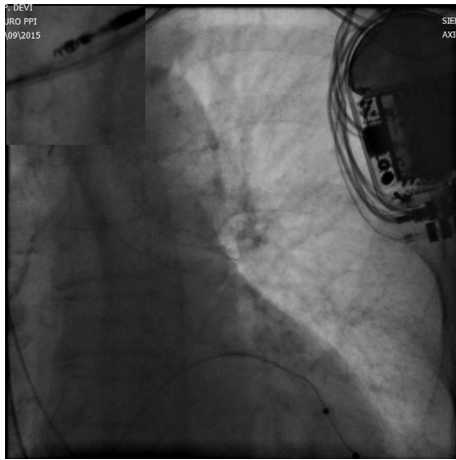


Fig. 3. Dislodged atrial lead in the SVC. (SVC – Superior vena cava).

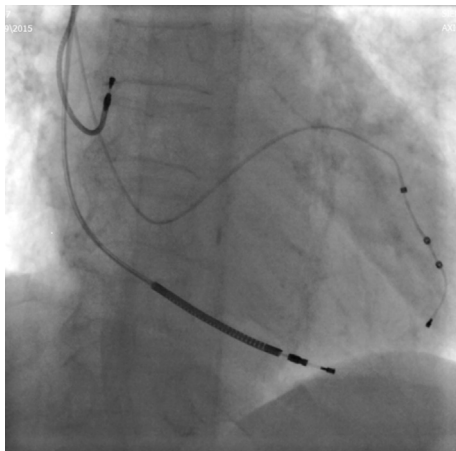


Fig. 4. New atrial lead positioned in the RA appendage. (RA – right atrium).

biventricular pacing d) Increasing atrial sensitivity and post ventricular atrial blanking (PVAB) period? e) Programming the device to a ventricular tracking mode VVT.

As the lady was elderly and had already undergone two procedures, we were concerned about the morbidity of yet another procedure and the possibility of pocket infection. Also after two consecutive dislodgements we were not sure if another endocardial lead revision was appropriate without understanding the possible anatomical problem in RA appendage. Epicardial lead placement carried a prohibitively high risk to be considered given her clinical profile. Programming the device to VVI mode would have delivered biventricular pacing but at the cost of AV synchrony which was of critical importance. Loss of AV synchrony would have nullified the hemodynamic benefit of biventricular pacing. Another option was to just increase the atrial sensitivity and post ventricular atrial blanking (PVAB) period. This would have maximised atrial tracking and minimized unnecessary mode switches by blanking out the deflection due to ventricular activity. Although atrial sensing was a bit too unpredictable for reliable tracking, this still seemed a reasonable option. Final option was to program a ventricular tracking mode

namely VVT in which LV pacing would be triggered with RV lead sensing. It was a reliable way to maximize biventricular pacing preserving AV synchrony. But with the apical position of the RV lead, a relative delay in LV pacing with respect to QRS was expected in VVT mode. Nevertheless it seemed a promising option and the device was programmed to VVT mode. We were curious to know how this mode influences electrical resynchronization and the resulting hemodynamics. An obvious difference in the paced QRS morphology was noted with the new mode (Fig. 8) compared to the conventional DDD mode (Fig. 2). The LV forces on ECG in VVT mode appeared less impressive. On Doppler, aortic VTI was significantly higher in VVT mode compared to VVI mode (Fig. 9) as expected. We allowed the patient some time with the new mode to see how she responds. PVAB period was increased so as to avoid underdetection of ventricular tachyarrhythmia misdiagnosed as supraventricular tachycardia due to atrial far field oversensing. The patient continued to be symptomatic through the next six weeks. With our backs to the wall, we now were considering lead revision yet again, this time of course after definition of RA appendage anatomy versus programming back to DDD mode with heightened atrial sensitivity and PVAB as mentioned earlier. However much to our relief, at her next visit we found a remarkably improved atrial sensing with a larger A and smaller far field V in the atrial channel (Fig. 10). On fluoroscopy the atrial lead was noted to be straightened with the tip in the base of RA appendage. The position of the lead tip was slightly different from where it was originally screwed in. No further intervention was done. DDD mode was reinstated and an increase in PVAB period was programmed to take care of the far field V. AV delay was programmed to achieve maximal biventricular pacing. There was a prompt and significant improvement in her symptoms after this programming. Patient was doing fine 3 months later.

3. Discussion

The device being a CRT-D the RV lead was positioned apically. In presence of complete LBBB earliest endocardial activity in RV is noted in the septum [4]. Hence LV pacing which was triggered with RV apical activity was a bit late with respect to QRS to effect proper resynchronization with VVT mode in this case. The relatively late LV pace also manifests with an obvious difference in the ECG as pointed out. For the same reason VVT mode could be a very good alternative if the RV lead is in septal position, as the LV pacing would be timed with the beginning of RV electrical activity effecting good resynchronization. VVT mode may be useful in patients who have AF with inadequate biventricular pacing due to rapid intrinsic conduction. However presence of frequent premature ventricular contractions (PVC) may render this mode unsuitable. Difficulty to adjust the delay between the sensed V and the LV pace analogous to VV delay in biventricular pacing may be a disadvantage with this mode. As to the unusual behaviour of the revised atrial lead, the lead may have had an acute dislodgement after being positioned in the RA appendage. The tip had probably straightened and moved to the base of RA appendage where it was recording a faint atrial activity due to the poor contact and a large ventricular activity due to proximity to the right ventricular outflow tract. With time the tip may have got endothelialized resulting in improved atrial sensing which allowed us to reprogram DDD mode.

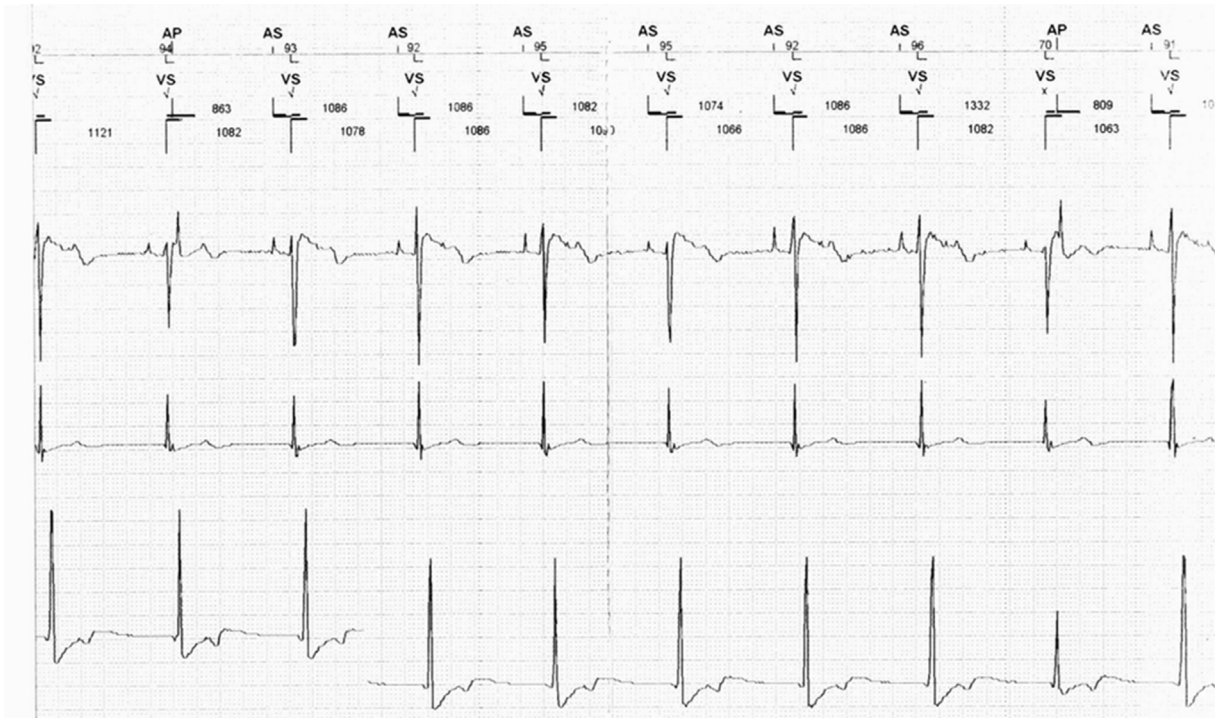


Fig. 5. Large ventricular and small atrial activity noted on day 3 of atrial lead revision suggesting lead dislodgement again.

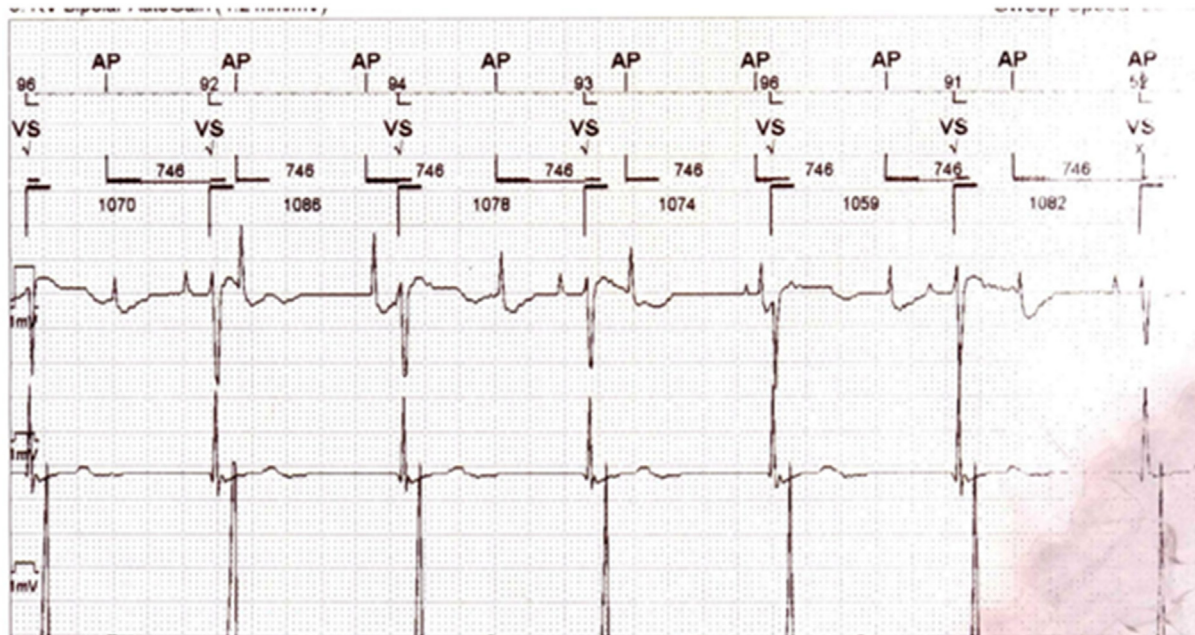


Fig. 6. Atrial non capture on day 3 of lead revision.

4. Conclusion

Lead dislodgements can put physicians in a spot of bother as regards to delivering biventricular pacing. Astute programming of the device may sometimes offer a good alternative to lead revision particularly in the face repeated dislodgements. VVT as a pacing mode may be a reasonable option to deliver CRT in select patients with septal position of the RV lead.

Conflict of interest

None.

Funding

None.

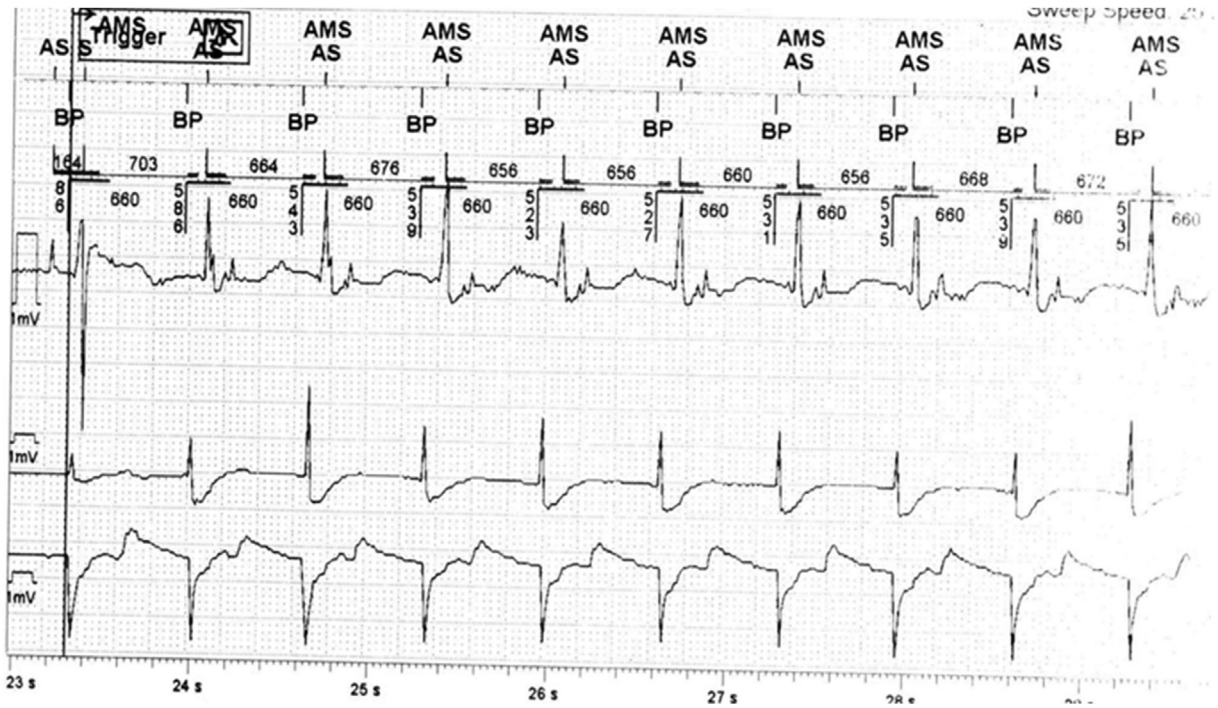


Fig. 7. Automatic mode switch due to 'high' atrial rate caused by oversensing of the atrial lead.

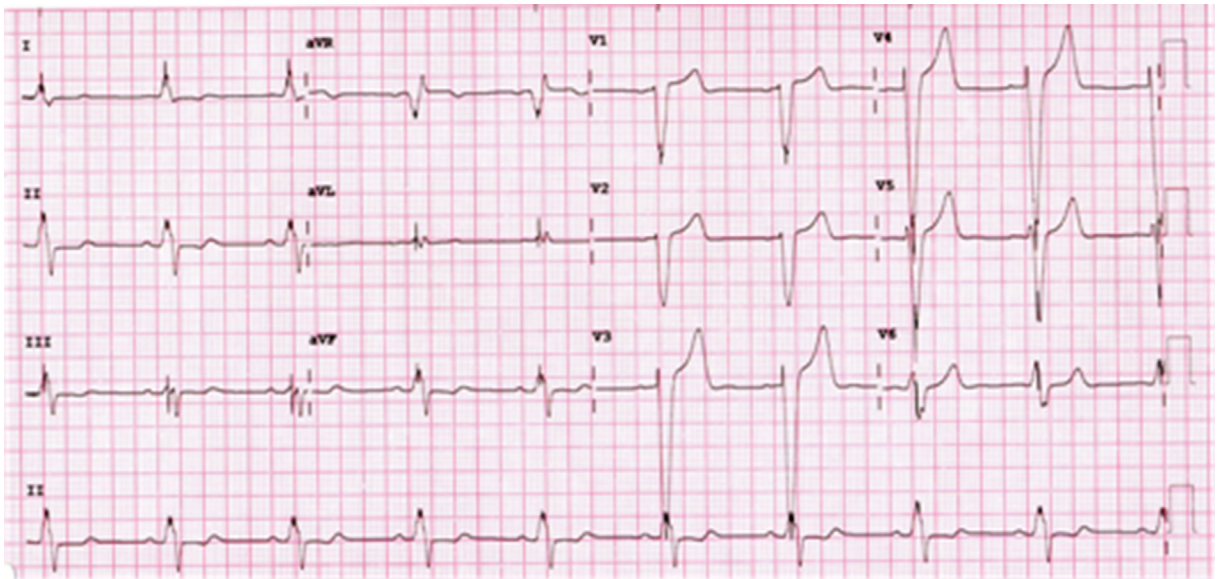


Fig. 8. Paced complex morphology in VVT mode was distinct from that in DDD mode. Note the altered LV forces.

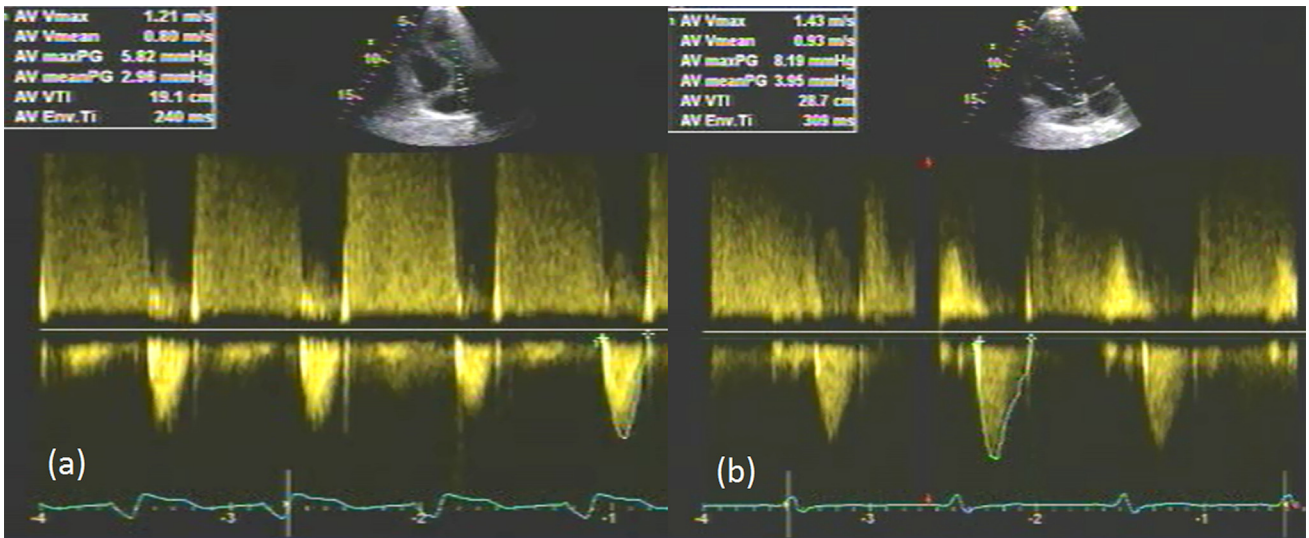


Fig. 9. Aortic VTI was significantly higher in (a) VVT mode (27.8) than (b) VVI mode (19.1).

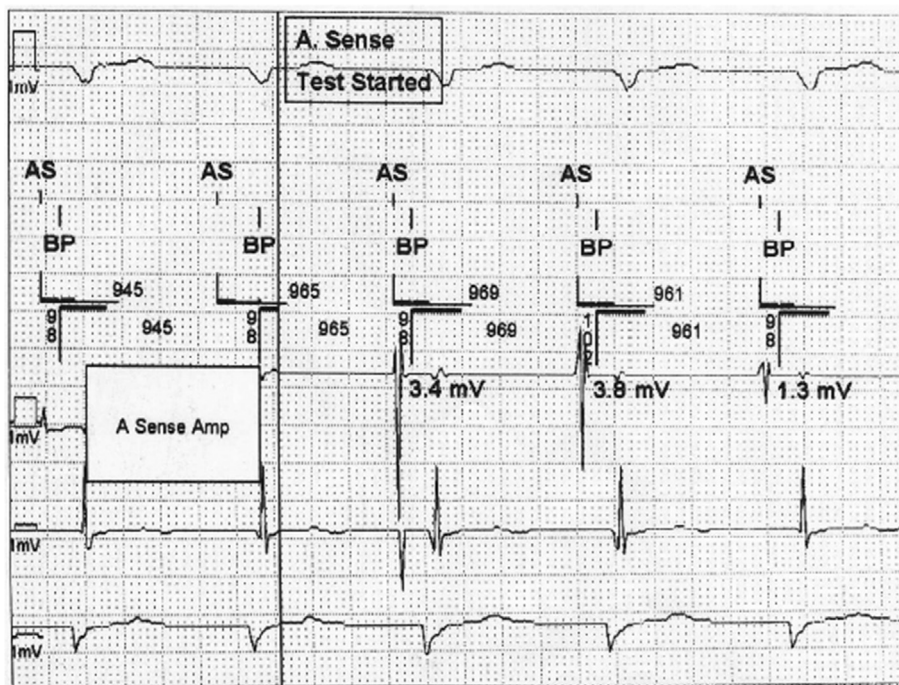


Fig. 10. Near normal atrial sensing with a far field V noted after 6 weeks.

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