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Coupled Beats After AV Node Ablation: What is the Mechanism?

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Case Presentation

An 83 year old lady was highly symptomatic from paroxysmal Atrial Fibrillation (AF) despite numerous antiarrhythmic and rate-limiting medications. Given her preserved left ventricular function, a pace and ablate strategy was pursued. Ablation of the AV node proved challenging requiring 2 procedures with apparently stable AV block and regular escape at 40bpm after the first sitting. Persistent Right Bundle Branch Block (RBBB) was created prior to AV node block at the first sitting. Two irrigated-tip ablation catheters (Coolflex, medium curve, St Jude's Medical, MN, USA) were placed on either side of the interventricular septum but with the intention to ablate the AV node from the left. Identification of the His bundle from the left proved difficult as the patient was now in AF. Instead the left bundle was targeted and complete AV block achieved by combined Right Bundle Branch (RBB) and Left Bundle Branch (LBB) ablation.

Post ablation the escape rhythm was observed to switch from predominant right bundle branch block-like (RBBB-like) morphology to occasional left bundle branch block -like (LBBB-like) morphology (Figure 1A). What is the mechanism?

Comment

After successful AV node ablation, the patient is usually left with an automatic slow escape beat [1]. In this case the predominant RBBB-like beat can be thought of as such an escape probably originating from the left ventricle. To explain the LBBB-like beats, 2 possible mechanisms should be mentioned (i) they may represent a second automatic focus akin to parasystole or (ii) a complex re-entry involving the separately ablated left and right bundle branches.

Figure 1 – Panel A - Recordings of 4 surface leads and intracardiac electrograms from the distal poles of an irrigated tip ablation catheter (Coolflex, St Jude's Medical, MN, USA) placed at the right ventricular apex (RVA). The predominant RBBB-like escape beats were interspaced with intermittent LBBB-like beats. Over a period of 2 minutes recording the coupling interval between RBBB-like to LBBB-like beats varied closely from 698-801ms. No fusion beats were observed. Panel B – the ablation catheter has been moved to a right ventricular septal position. In this position the intermittent LBBB-like beats were completely suppressed but a local non-propagating deflection was recorded (arrow). Over a period of 2 minutes recording the coupling interval between RBBB-like to the non-propagating signal varied from 660-773ms.

Traditionally parasystole has been described as an automatic focus protected from external influences by "entrance block" and leading to intermittent ventricular activation by a postulated "exit block" [2]. Thus classically a parasystolic mechanism is suspected if (i) there is varying coupling interval of the ectopic beat (including fusion beats) and (ii) the length of the interectopic intervals are in simple mathematical relationship to one another (the "minimum multiple" law) [2]. In the case presented here the first rule is met; over a 2 minute period, the coupling interval between the LBBB-like beat and the preceding RBBB-like beat varied from 698-801ms, with mean coupling interval = 753±42ms and the mean change in coupling interval = 55±42ms. Such variation makes a re-entry mechanism unlikely. However, the second rule of parasystolic foci was not fulfilled, as over the same period the intervals between the eight LBBB-like beats were 2.5s, 4.3s, 18.0s, 46.0s, 37.0s 56.2s and 21.9s respectively (i.e. no common denominator). This, may be explained by the more common type of parasystole with incomplete entrance block which can be influenced by external depolarisations (also known as modulated parasystole) [3].

On manipulation of the RV ablation catheter from the apex to the septum, there was complete suppression of the LBBB-like beats in the surface ECG (Figure 1b). Instead there was repeated detection of a lower amplitude local signal at a similar coupling interval to the previous LBBB-like beats. Indeed over a 2 minute period, the coupling interval of this non-propagating impulse varied between 660-773ms. This unique observation is highly suggestive of increased exit block of a parasystole whose local, non-propagating activation is recorded. To confirm our observations, it would be ideal to pace from this area in order to get the LBBB beat manifested. However, this was a retrospective analysis of the case that did not allow for further manoeuvres.

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