Supernormal Conduction in the Right Bundle Branch: Lack of Influence of Autonomic Blockade

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Summary. A programmed atrial stimulation at a driving rate of 100/min was performed in a 47-year-old woman with left bundle branch block. Supernormal conduction lasting 40 ms was revealed within the right bundle branch. After autonomic blockade (0.2 mg propranolol/kg body weight and 0.04 mg atropine/kg body weight) the position and duration of the supernormal conduction did not change. This suggests that the autonomic nervous system has no influence on the supernormal phase of conduction in the human intraventricular conduction system.

Key words: Supernormal conduction — Bundle branch block — His bundle electrogram — Programmed atrial stimulation

The phenomenon of supernormal intraventricular conduction describes a paradoxical improvement in conduction which occurs in the early phase of recovery of a bundle branch or division of the left bundle branch. The situation is paradoxical because the improvement in conduction occurs during a short critical period early in the cardiac cycle, whereas later impulses are blocked or have greater conduction delays [1]. Several cases of supernormal intraventricular conduction have been described [2–4, 7, 8, 10–14, 16]. However, some of these cases are still open to alternative diagnosis. The following case demonstrates supernormal conduction in the right bundle branch and the lack of autonomic influences on the phenomenon of supernormality, which as far as we know have not yet been described.

Case Report
A 47-year-old woman was admitted for electrophysiologic evaluation of intermittent type II second degree atrioventricular (AV) block and left bundle branch block. The clinical examination, laboratory analyses, X-ray and one- and two-dimensional echocardiography revealed no abnormalities. The serum potassium level was 4 mmol/l. For electrophysiologic investigation two quadripolar electrode catheters were introduced percutaneously into the right femoral vein. The first catheter was positioned high on the lateral wall of the right atrium. The distal two electrodes were used for stimulation, the proximal ones for recording a bipolar atrial electrogram. The second electrode catheter was positioned across the tricuspid valve to record a His bundle electrogram [15]. During sinus rhythm (rate 94/min) every sinus beat was conducted to the ventricle. The following intervals were measured: PA = 55 ms, AH = 85 ms and HV = 50 ms. A type II second degree AV block distal to the recording site of the His potential was induced at a driving rate of 120/min.

A programmed atrial stimulation was performed at a driving rate of 100/min. As the atrial coupling interval was short-

Fig. 1. Supernormal conduction in the right bundle branch. HRA is a bipolar lead from the high lateral wall of the right atrium. HBE is the His bundle electrogram. Top: At an H1H2 interval of 540 ms conduction to the ventricle still persists. Bottom: Shortening of the H1H2 interval to 530 ms leads to AV block distal to H2.
Fig. 2. Supernormal conduction in the right bundle branch. Same notation as in Fig. 1. Top: At an $H_1H_2$ interval of 450 ms $H_2$ is not conducted to the ventricle. Bottom: Conduction to the ventricle is resumed when the $H_1H_2$ interval is shortened to 440 ms.

Fig. 3. Supernormal conduction in the right bundle branch. Same notation as in Fig. 1. Top: At an $H_1H_2$ interval of 400 ms conduction to the ventricle still persists. $A_3$ originates high in the right atrium probably representing a sinus node echo beat. Bottom: When the $H_1H_2$ interval is shortened to 390 ms there is again an atrioventricular (AV) block distal to $H_2$. $A_3$ originates high in the right atrium, probably representing a sinus node echo beat.

Fig. 4. Supernormal conduction in the right bundle branch. Influence of autonomic blockade. Same notation as in Fig. 1. Top: At an $H_1H_2$ interval of 540 ms conduction to the ventricle still persists. Bottom: Shortening of the $H_1H_2$ interval to 530 ms leads to atrioventricular (AV) block distal to $H_2$.

The procedure was repeated after autonomic blockade with 12.2 mg propranolol i.v. and 2.45 mg atropin i.v., corresponding to a dose of 0.2 mg propranolol/kg body weight and 0.04 mg atropine/kg body weight [6]. The heart rate increased from 94/min to 97/min which was within the expected limits for the patient's age (calculated value 91.3 ± 16.4/min [6]). The AH interval shortened from 85 to 80 ms while the other intervals (PA and HV) did not change. During the programmed atrial stimulation at the driving rate of 100/min, the premature beat was conducted to the ventricle at $H_1H_2$ intervals from 450-600 ms and blocked at $H_1H_2$ intervals from 450-530 ms. A paradoxical resumption of AV conduction was observed at $H_1H_2$ intervals of 400-440 ms which were similar to those preceding autonomic blockade (Fig. 5). The block distal to the recording site of the His potential reappeared at $H_1H_2$ intervals of 370-390 ms (Fig. 6).

Discussion

Our patient suffered from a left bundle branch block, so that conduction from the atrium to the ventricle took place through the right bundle branch. During the programmed atrial stimulation, there was initially a block in the right bundle...