Misleading transition: How His-bundle pacing imitated left bundle branch pacing

Maciej Fularz[1], Przemysław Mitkowski[2]

[1]Department of Cardiology, University of Zielona Gora, Zielona Góra, Poland
[2]1st Department of Cardiology, Poznan University of Medical Sciences, Poznań, Poland

Correspondence to:
Maciej Fularz, MD,
Department of Cardiology,
University of Zielona Gora,
Zyty 28, 65–046 Zielona Góra,
Poland,
phone: +48 68 32 96 381,
e-mail: m.fularz@cm.uz.zgora.pl

DOI: 10.33963/v.kp.98208

Received:
July 19, 2023

Accepted:
November 12, 2023

Early publication date:
December 7, 2023

Transitions of the paced QRS complex are pivotal in confirming conduction system pacing. Non-selective capture is usually observed at higher pacing output. A decrease in pulse amplitude could lead to selective capture of either the myocardium or conduction system. Identifying this phenomenon in most cases of His-bundle pacing (HBP) is relatively simple. Selective HBP usually provides QRS complexes identical to the intrinsic rhythm. Myocardial-only capture in the para-Hisian site produces broader QRS with left bundle branch block morphology. Appropriate diagnosis of transitions in left bundle branch pacing (LBBP) may be more challenging as differences between distinct modalities could be subtle. Jastrzębski et al. [1] provided useful criteria. During transition to selective LBBP, the V6–V1 interpeak interval increases due to loss of myocardial capture and, in consequence, more delayed right ventricle activation, while R-wave peak time in lead V6 remains unchanged. During transition to myocardial capture, R-wave peak time in lead V6 increases because left ventricle activation is less rapid. An isoelectric interval may also be useful as it occurs during selective HBP and selective LBBP [2].

An 84-year-old female patient with permanent atrial fibrillation and bradycardia was qualified for implantation of a single-chamber pacemaker. The intrinsic QRS complex was narrow. The lead was positioned in the basal septum to perform LBBP. An intraprocedural transition of paced QRS complex was demonstrated and identified as a transition from non-selective to selective LBBP (Figure 1A). Echocardiography confirmed that the lead was deployed deep in the basal septum (Figure 1B). The bipolar electrical parameters on the day after implantation were: R-wave 2.8–4.0 mV, pacing threshold 0.5 V × 0.4 ms, and impedance 552 ohms. Postprocedural chest radiograms are shown in Supplementary material, *Figure S1*. During a follow-up outpatient visit, a gradual output decrease test was performed. Surprisingly, an additional transition was found. In the first step, non-selective capture transformed to selective HBP and after a further decrease in pulse amplitude, selective HBP with right bundle branch block (RBBB) occurred (Figure 1C).

Transition to selective HBP was absent during the procedure probably due to temporarily equal capture thresholds of the myocardium and right bundle branch fibers. In consequence, a direct transition from non-selective capture to QRS complex with RBBB pattern occurred, and it was initially diagnosed as selective LBBP. Later demonstration of transition to selective HBP during the control visit revealed that the paced QRS complex with RBBB morphology was actually selective HBP with RBBB. Reachability of this type of capture could be explained by the longitudinal dissociation of His-bundle [3, 4]. According to this theory, fibers predestined to form right and left bundle branches are isolated from each other within His-bundle. Hence, their capture thresholds may differ, and selective recruitment of left bundle branch fibers inside His-bundle is achievable. The final diagnosis of HBP was also supported by a potential to QRS complex interval of 40 ms (Figure 1D) and relatively low R-wave sensing.

The three main lessons learned from the presented case are (1) His-bundle can be captured in deep septum [5], which may result in terminal R-wave during non-selective capture

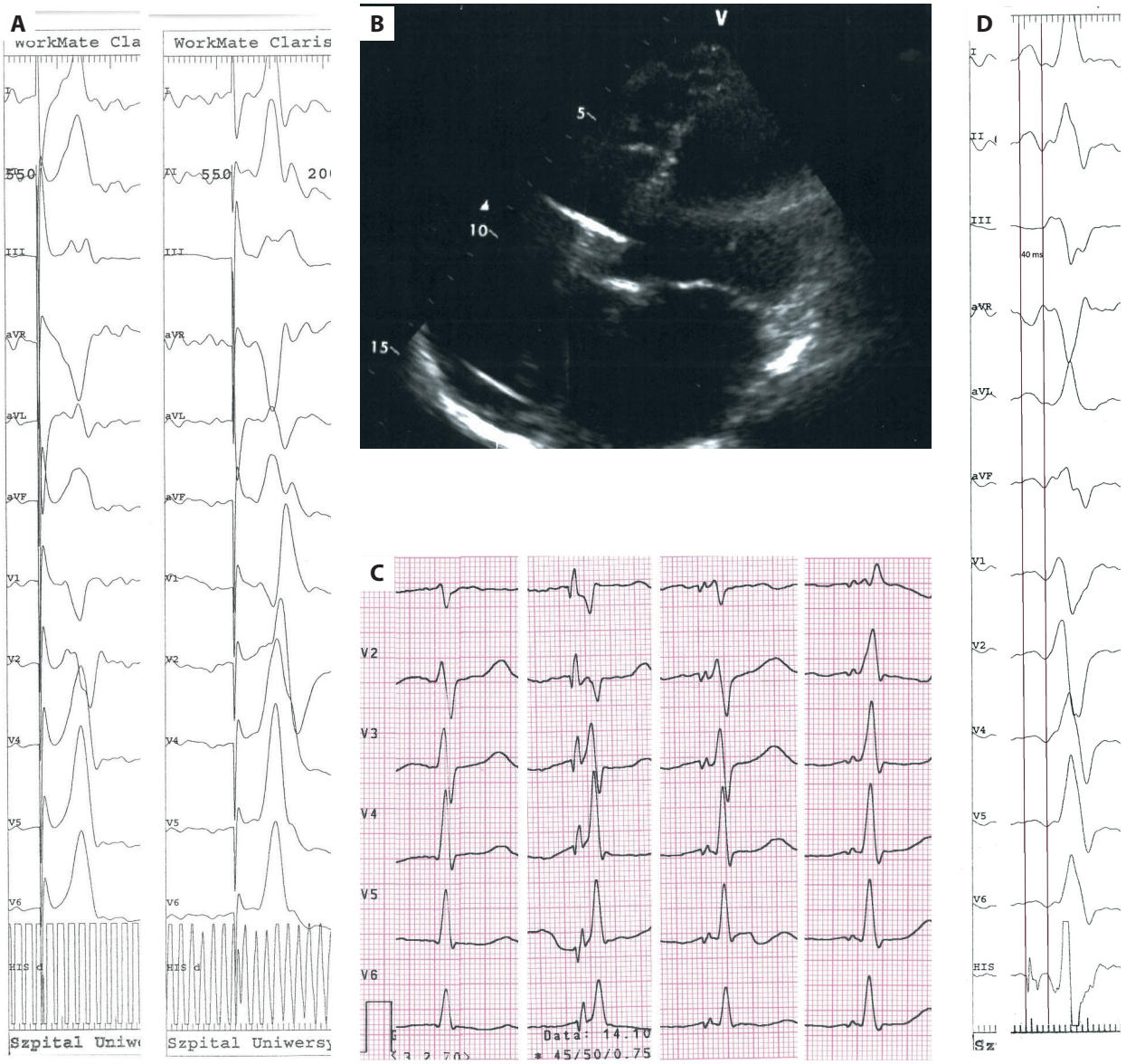

Figure 1. A. Intraprocedural transition initially diagnosed as transition to selective left bundle branch capture. Note the manifestation of the right bundle branch block pattern (terminal R-wave in lead V1, terminal S-wave in lead I) and the presence of an isoelectric interval after the pacing spike (most visible in leads V4–V6) during selective capture, while R-wave peak time in lead V6 was constant at 80 ms. **B.** Echocardiographic image shows the deep position of the lead in the basal interventricular septum. **C.** Native QRS complex (first on the left) and transitions of paced QRS morphology from non-selective capture with tiny terminal R-wave (second from the left, output 2 V × 0.4 ms) to selective His-bundle pacing (third from the left, output 0.75 V × 0.4 ms) and finally to selective His-bundle capture with right bundle branch block (fourth from the left, output 0.5 V × 0.4 ms) during the gradual decrease of pulse amplitude (precordial leads are shown, sweep speed 50 mm/s). The second and the fourth QRS complexes correspond with the paced QRS complexes presented in panel A. **D.** Intraprocedural recording of conduction system potential (at the bottom)

due to a left-sided myocardial component, resembling non-selective LBBP; (2) Left bundle branch fibers may be selectively captured inside the distal His-bundle, which may imitate selective LBBP; (3) Some transitions may not be demonstrable due to temporarily equal capture thresholds of two structures and may appear later.

Supplementary material

Supplementary material is available at https://journals.viamedica.pl/kardiologia_polska.

Article information

Conflict of interest: None declared.

Funding: None.

REFERENCES

1. Jastrzębski M, Burri H, Kiełbasa G, et al. The V6-V1 interpeak interval: a novel criterion for the diagnosis of left bundle branch capture. Europace. 2022; 24(1): 40–47, doi: 10.1093/europace/euab164, indexed in Pubmed: 34255038.
2. Wu H, Jiang L, Shen J. Recording an isoelectric interval as an endpoint of left bundle branch pacing with continuous paced intracardiac electrogram monitoring. Kardiol Pol. 2022; 80(6): 664–671, doi: 10.33963/KP.a2022.0094, indexed in Pubmed: 35380007.
3. Jastrzebski M, Kukla P, Czarnecka D. His bundle capture proximal to the site of bundle branch block: A novel pitfall of the para-Hisian pacing maneuver. HeartRhythm Case Rep. 2018; 4(1): 22–25, doi: 10.1016/j.hrcr.2017.09.002, indexed in Pubmed: 29379721.
4. Teng AE, Massoud L, Ajijola OA. Physiological mechanisms of QRS narrowing in bundle branch block patients undergoing permanent His bundle pacing. J Electrocardiol. 2016; 49(5): 644–648, doi: 10.1016/j.jelectrocard.2016.07.013, indexed in Pubmed: 27485351.
5. Vijayaraman P. Deep septal, distal His bundle pacing for cardiac resynchronization therapy. HeartRhythm Case Rep. 2020; 6(10): 791–793, doi: 10.1016/j.hrcr.2020.07.024, indexed in Pubmed: 33101957.