Impulse Conduction from the Heart to Adjacent Great Blood Vessels – A Memorial to Dr. Hiroto Mashiba

Nowadays a considerable number of patients with atrial fibrillation (AF) can be treated by the use of radiofrequency catheter ablation applied onto the proximal part of the pulmonary veins (PVs), including some atrial tissues surrounding these ostia. The treatment may be traced back to the report by Jais P et al.1) in 1997; they attributed some AFs to a focal rapid firing activity (automaticity or triggered activity) of atrial muscles located in the PVs and such activities were eliminated by discrete radiofrequency energy application. This means that excitation of the atrial muscle is propagated from the left atrium (LA) to the PVs, and vice versa.

Solid evidence of electrical impulse conduction from the LA to the PVs was first documented by the late Dr. Hiroto Mashiba2) in 1966 when he worked as Lecturer and Chief of Cardiac Electrophysiology Lab in the First Department of Medicine, Faculty of Medicine, Kyushu University. He recorded intracellular action potentials (APs) from the pulmonary veins simultaneously with the ECG in open-chested rats (atrio-pulmonary conduction) and found the following:2) 1) The time of action potential upstroke delayed with regard to the P wave when the AP recording site was shifted toward the peripheral portion of the PV. 2) The interval between the P wave and action potential upstroke was gradually prolonged when the orifice of the PV was ligated by a thread, with stepwise increases in the strength. 3) Ultimately, the impulse conduction was totally blocked albeit the resting potential was kept unaltered.

He and his colleagues also reported that the AP originating in the sinus node was propagated to the left and right superior venae cavae (sino-caval conduction) as well as to the right atrium in the rabbit,3) which was accompanied by a synchronized propagation of contraction.4) Contractions recorded from isolated left superior vena cava of the rabbit exhibited mixed characteristics of vascular smooth muscles and atrial muscles with respect to their contractile patterns4) and pharmacologic responses.5) By using an electrophoretic staining method, the AP recorded in the PVs or the superior venae cavae was confirmed to derive from the cardiac muscles extending from the left or the right atrium respectively (now called “myocardial sleeves”).6)

Thus, Dr. H. Mashiba is worth remembering for these pioneering works (discoveries of sino-caval and atrio-pulmonary conduction) and for his making the correct prediction that these events would relate to the genesis or origin of supraventricular tachyarrhythmias including “atrial fibrillation”2)— a prediction made more than 30 years before the first application of catheter ablation to the treatment of atrial fibrillation.

References
2) Mashiba H: Spread of excitation from the heart to blood vessels. Igakunoayumi 1966; 56: 575–580 (in Japanese)

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