Intracardiac Stimulation for the Diagnosis of Arrhythmia

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Intracardiac stimulation (IS) has been widely used as the diagnostic method for various kinds of arrhythmias. Our results as to IS are as follows: 1) Since sinus recovery time (SNRT) closely correlated with basic cycle length (BCL) in 71 normal cases ($r = 0.82$, $p < 0.001$), upper range of SNRT in normal was expressed as $SNRT = 1.4BCL + 451$ msec. 2) Paroxysmal supraventricular tachycardia (PSVT) induced by IS was fairly similar to the spontaneous PSVT (107 cases). Therefore, IS can be used to confirm the diagnosis of PSVT and also to evaluate the effectiveness of antiarrhythmic agents on PSVT. 3) Although induction or termination of ventricular tachycardia by IS may be useful in a general sense, dangerous tachyarrhythmias were sometimes provoked, indicating this test should be carried out under the utmost care.

SINCE mid of 1960s, intracardiac stimulation has been applied for various clinical electrophysiological studies,¹⁻⁸ as seen in Table I. Some of them are now used as the routine diagnostic methods of clinical arrhythmias.

TABLE I APPLICATION OF INTRACARDIAC STIMULATION

<i>Lister et al (1965)</i>	<i>Evaluation of AV conduction</i>
<i>Durrer et al (1967)</i>	<i>Initiation and termination of PSVT</i>
<i>Massumi et al (1967)</i>	
<i>Sherlag et al (1969)</i>	<i>His electrogram</i>
<i>Wit et al (1970)</i>	<i>Refractory period of conduction system</i>
<i>Mandel et al (1971)</i>	<i>Overdrive suppression test</i>
<i>Wellens et al (1972)</i>	<i>Induction of VT</i>
<i>Strauss et al (1973)</i>	<i>Sino-atrial conduction time</i>

Key Words:

Intracardiac stimulation
Overdrive suppression test
Sinus node recovery time
PSVT
Ventricular tachycardia

METHOD AND INDICATION

Intracardiac stimulation includes usual pacing, rapid pacing, ultra-rapid pacing, extrastimulus method, paired or trippled stimulation, burst and so on. Fig. 1 shows some instances. A is the overdrive suppression test by right atrial rapid pacing in diagnosis of sick sinus syndrome. Premature atrial stimulation given intermittently to the basic cycle in B is used for measuring sinoatrial conduction time or refractory period of atrio-ventricular conduction system. Similar stimulation can apply for the induction or termination of paroxysmal supraventricular tachycardia as seen in C.

Site of stimulation is variable depending on the purpose of the studies as shown in Table II. Indication of intracardiac stimulation for the diagnosis of arrhythmia classified from the site of stimulation is summarized in Table II.

SOME TOPICS

In this paper, a few topics on the intracardiac stimulation will be briefly discussed.

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TABLE II INTRACARDIAC STIMULATION FOR THE DIAGNOSIS OF AR-RHYTHMIA

I. Atrial stimulation	
a. Sinus node function	
1) Overdrive suppression test (P)	
2) Sinoatrial conduction time (Ex)	
b. Function of Atrio-ventricular conduction system	
1) Atrio-ventricular conduction time (P)	
2) Refractory period (Ex)	Atrium, A-V node, His-ventricle Accessory pathway
3) Dual pathway, supernormal conduction (Ex)	
c. PSVT	
Induction & termination (P, Ex)	
d. Atrial flutter	
Induction (Ex)	
Termination (P)	
II. Ventricular stimulation	
a. Function of ventriculo-atrial conduction system	
1) V-A conduction time (P)	
2) Refractory period (Ex)	Ventricle, V-A, Accessory pathway
b. PSVT	
Ventricular tachycardia	
Induction & termination (P, Ex)	
III. Others	
His bundle stimulation, Coronary sinus (left atrium) stimulation	

P : Pacing
Ex: Extrastimulus

TABLE III INDUCTION OF VT AND COMPLICATION

	Rate of Induction	
H.J.J. Wellens 1972-1979	56/81 (69%)	
P. Denes 1976	6/17 (35%)	
J.W. Mason 1978	24/29 (83%)	nonclinical VT (acceleration of VT) 17 patients required cardioversion
M.E. Josephson 1979	34/40 (80%)	7 patients required cardioversion

Fig.2. Relationship between sinus node recovery time and basic cycle length.

A. Rate of PSVT Induction by RA Stimulation

Patients with Spontaneous PSVT		Patients without Spontaneous PSVT	
WPW Type A	17/19	WPW Type A	1/7
WPW Type B	8/13	WPW Type B	0/8
LGL	3/5	LGL	0/2
Non-Preexcitation	63/70		1/17 (5.9%)
	91/107 (85.0%)	Sick Sinus Syndrome	0/84 (0%)

B. Relationship of R-R Interval between Spontaneous & Induced PSVT

Fig.3. Spontaneous and induced PSVT.

BEFORE INJECTION

AFTER INJECTION

Simultaneous Recording of HBE + Extrastimulus Method
 → Conduction Time, Refractory Period, etc.

Fig.4. Our method of evaluation of antiarrhythmic agent using PSVT induction test.

Fig.5. Induction of VT by ventricular stimulation.

ACCELERATION OF VENTRICULAR TACHYCARDIA

Fig.6. Non-clinical VT induced by rapid RV pacing.

spontaneous PSVT previously, 91 cases (85%) were induced PSVT by stimulation, as shown in Fig. 3A. On the other hand, induction rate was only 5.9% in 17 patients who showed even similar ECG pattern to WPW or LGL syndrome, but did not have PSVT previously. Furthermore, no induced PSVT was seen in 84 cases with sick sinus syndrome without spontaneous PSVT.

Relationship of R-R intervals between spontaneous and induced PSVT in 45 cases was very close, $r = 0.89$, $p < 0.001$, as seen in Fig. 3B.

These results indicate that induced PSVT fairly reflects spontaneous PSVT. Therefore, induction of PSVT can be routinely used as the test to confirm patient's symptom such as palpitation and also to evaluate the preventive

effect of antiarrhythmic agents of PSVT as we have used since a few years ago (Fig. 4).

C. Induction and termination of ventricular tachycardia (VT)

Recently, a lot of studies as to induction or termination of VT have been reported. Fig. 5 shows a case in which VT was induced by single right ventricular stimulation. Induction rate of VT ranged between 35–80%⁹⁻¹² as seen in Table III. This method may contribute to evaluate this difficult arrhythmia in many ways. But this test sometimes provokes a dangerous tachycardia as seen in Table III or as an actual case in Fig. 6 which required DC shock. Therefore, this test should be carried out by the specialists under the emergent care.

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