

First Iraqi Experience in Sinus Node Electrogram Recording and its role in the diagnosis of Sinus Node Dysfunction (A study which is carried in the cardiac care unit in Al-Kadhimiya Teaching Hospital)

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Abstract

Background: Measurement of Sinoatrial Conduction time from the sinus node electrogram record is an accurate and useful method. It gives idea about the function and integrity of the sinus node.

Objective: To record normal sinus node electrogram as a first experience in Iraq, and obtain normal values of Sinoatrial Conduction Time (SACT), which is measured directly from sinus node electrogram. Then to make a correlation between directly measured SACT from sinus node electrogram and indirectly measured SACT from premature atrial stimulation.

Method: The study was conducted during the period between June 2005 to October 2006 on 70 patients suffering from syncopal or palpitation attacks attending the Cardiac Care Unit in Al-Kadhimiya Teaching Hospital. In 62 patients sinus node electrograms were successfully recorded and Sinoatrial conduction time was measured indirectly by both Strauss Method (Premature Atrial Stimulation method), and Narula Method (Continuous Atrial Pacing Method).

Results: Seventy subjects were undergone cardiac electrophysiological study. Sinus Node Electrogram (SNE) was recorded successfully in 62 subjects and the Sinoatrial Conduction Time (SACT) was measured. In the control group with normal sinus node function (N=33), mean SACT was 81.2 ± 11.6 msec (mean $\pm$

SD). In patients (N=29) with sinus node dysfunction, 16 out of 29 mean SACT was 88.2 ± 6.3 msec. In the rest 13 patients the mean SACT was 206.8 ± 14.8 msec., which is significantly prolonged. In 33 subject of the control group, SACT had been measured indirectly using continuous atrial pacing (Narula method) in addition to premature atrial stimulation technique (Strauss method). The mean SACT were 83.5 ± 13.1 msec. and 82.4 ± 11.7 msec. by Strauss and Narula methods respectively, which indicates no significant differences between the indirect method (Strauss and Narula), from the direct method measured from the SNE ($p > 0.01$).

Conclusion: SNEs that were recorded for the first time in Iraq, in subjects with apparently normal sinus node function, were comparable to the measured values obtained by different world wide laboratories. The significant correlation between the indirect methods [continuous atrial pacing (Narula method) and premature atrial stimulation technique (Strauss method)] and the direct method (SNE) makes SNE a precise method for the measurement of SACT.

Key words: Sinus node electrogram, sinoatrial conduction time, Sinus node dysfunction.

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Introduction

Method of directly recording a sinus node electrogram was developed by Gramer et al.

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In 1977, who identified extracellular potential changes, associated with directly recorded electrical activity of the sinus pacemaker in isolated rabbit atria^(9, 12,20). Subsequently, several investigators developed techniques to record electrograms from human subjects^(9, 10,12). Several studies had been carried to develop the techniques for increasing the opportunity of sinus node electrogram recording^(2, 4,5). The

success rate for transvenous endocardial recording of sinus node electrogram first reported by Hariman et al., was 50%, using ordinary electrode catheter^(10,18,19,20,22). Whereas, Reiffel et al. were able to record sinus node electrograms in 83% of patients, by using special designed catheter for sinus node electrogram. The catheter was positioned at the junction between the SVC and right atrium^(13,15,19,20). Gomes et al. demonstrated an 86% success rate when the catheter was looped in the right atrium and abutted the sinus node region^(6,9).

Patients and Methods

Seventy subjects, mean age 58 ± 10 years, were studied. Each patient gave informed signed consent. The subjects were undergoing electrophysiological studies for a variety of reasons. In 62 subjects sinus node electrograms were successfully recorded (Table 1).

Those patients were divided into two groups:

Group I (Control Group): Patient who came with palpitation due to ventricular tachycardia, with normal sinus node function (N=33). They were underwent electrophysiological study for the study of ventricular arrhythmias. Group II (Patients

Group): Patients who came with dizziness and/or syncopal attacks which is highly suggestive of sick sinus disease. This is proved by full history taking (sudden onset and termination of the symptoms), and by the ECG or Holter monitoring (N=29). A quadripolar catheter (Biosense Webster. 6F) with 10mm interelectrode distance was introduced. The catheter in the superior vena cava was positioned at about the junction of the SVC and right atrial wall such that the concave curve of the catheter was facing the concave surface of the right atrial wall. The distal pole of the catheter was in direct contact with the atrial endocardium. The electrogram recorded from the distal two poles of the catheter was displayed on a multichannel page of the monitor with speed of monitoring 100 mm/sec. with low pass filter frequencies 0.1-500 Hz and high gain amplification of 50-100 uV/cm. Sinus node electrograms characterized by the presence of an upstroke slope, followed by an atrial injury potential. The upstroke slope was usually proceeded by a diastolic slope, (Figure 1, 2).

Table 1: The characteristics of the subjects of the control group.

<i>Age</i>	<i>male</i>	<i>female</i>	<i>SACT (Sinus Node Electrogram)</i>	<i>SACT (Straus)</i>	<i>SACT (Narula)</i>
58±10	21	12	81.2 ± 11.6 msec	83.5 ± 13.1 msec	82.4 ± 11.7 msec

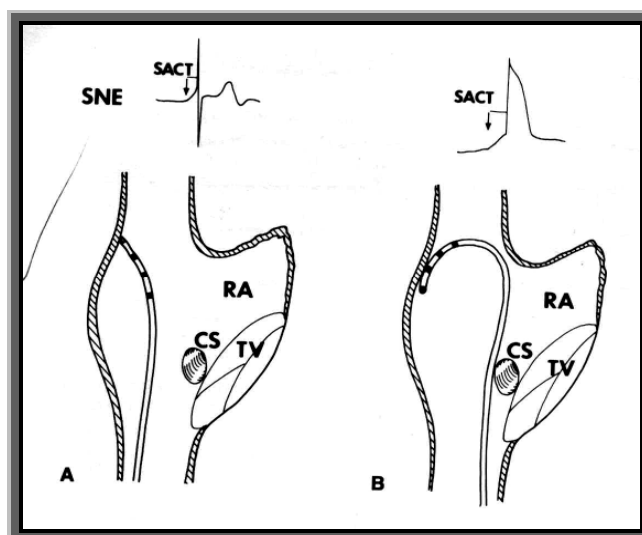


Figure 1: Schema of methods for obtaining sinus node electrogram. Tricuspid (TV); coronary sinus (CS); right atrium (RA). A: direct contact catheter method; B: looped catheter method.

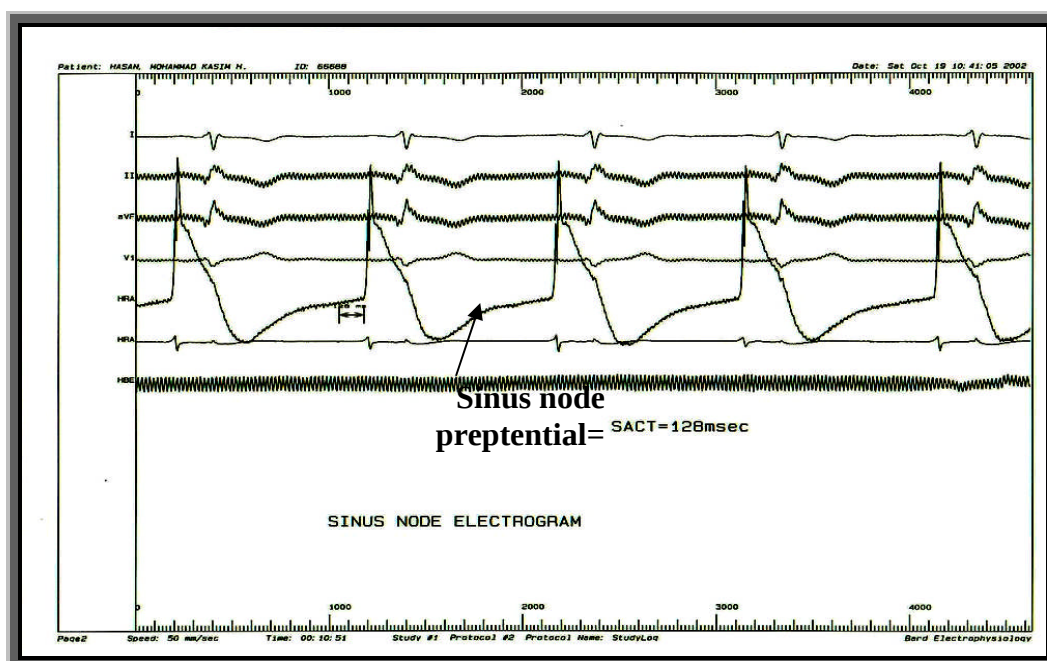


Figure 2: record of sinus node electrogram by the looped catheter method.

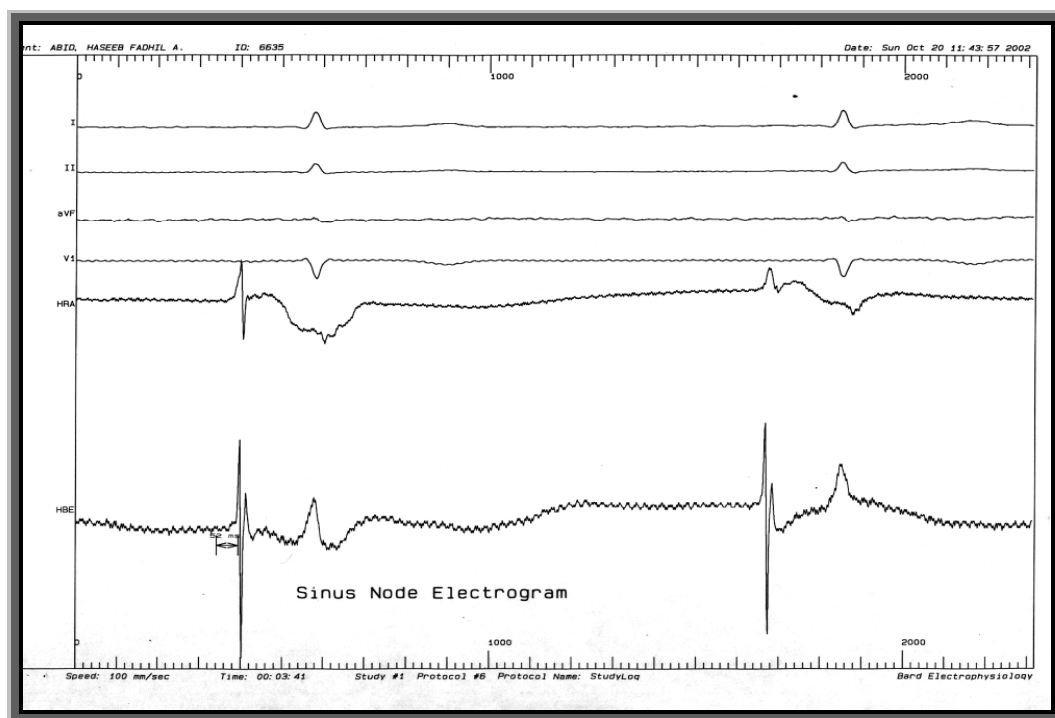


Figure 3: record of sinus node electrogram by direct contact catheter method

The direct SACT was measured from the onset of the upstroke slope to

atrial activation on the sinus node recording.



Figure 4: Schematic illustration showing the direct measurement of SACT. A: atrial depolarization; V: ventricular depolarization; T: T wave.

In the control group The SACT was measured indirectly by two methods: 1) Strauss Method (Premature Atrial Stimulation method) ^(1,3,23); in which programmed premature atrial beats (PABs) were introduced during sinus rhythm. After a control period recording, single premature atrial stimuli were delivered after every eighth spontaneous sinus cycle, beginning late in diastole. The coupling interval (A1-A2) of the premature atrial stimuli was decreased in decrements of 10-20 msec. until the effective refractory period of the right atrium was obtained ⁽²³⁾. For every premature atrial stimulus delivered, the spontaneous sinus cycle (A1- A1) immediately preceding the stimulated atrial complex, the coupling interval of the premature stimulated atrial beats (A1-A2) and the return cycle (A2-A3) were measured. The SACT was measured by:

$$\text{SACT} = [(A2\ A3)-(A1\ A1)]/2$$

2) Narula Method (Continuous Atrial Pacing Method) ^(3, 5, 12, 16); in which the high right atrium was paced for eight beats at cycle lengths slightly shorter than the basic cycle length (BCL). (Rate slightly faster ≥ 10 beats /min. than the control sinus rhythm). On cessation of pacing, the recordings were continued for the subsequent eight or more spontaneous sinus cycles for purposes of analysis. The protocol was repeated three more cycle lengths of 5, 10, and 15 msec. shorter

than the first cycle length ^[16]. The SACT was calculated by subtracting the mean sinus cycle from the interval between the last paced atrial electrogram (P) and the atrial electrogram of the first escape sinus cycle (A2). The average of the SACT obtained at all 4 cycle lengths was taken as the representative SACT. The SACT was measured by:

$$\text{SACT} = [(P\ A2)-(A1\ A1)]/2$$

Results

In the control group (Group I) (table 1), the mean value and $\pm$ SD of the SACT (directly measured from SNE) was 81.2 ± 11.6 msec. ; while in patient group (Group II) (Table 2). 13 out of 33 (39.3%), the mean value and $\pm$ SD of the SACT was 206.8 ± 14.8 msec. The SACT values were significantly abnormally prolonged as they compared with those of control group ($p < 0.01$) (Table 2). In the remaining patients (about 60.6%), the mean values and $\pm$ SD of SACT were 88.2 ± 6.3 msec. , which did not significantly differ from those of control group ($p > 0.01$).

In the control group, SACT had been measured by the two indirect methods (Strauss and Narula). The mean values and $\pm$ SD of SACT were 83.5 ± 13.1 msec. and 82.4 ± 11.7 msec. respectively with no significant differences between them on one side and the direct method on the other side ($p > 0.01$) (Table 1).

Table 2: The characteristics of the subjects of the patients group.

<i>Age</i>	<i>male</i>	<i>female</i>	<i>No. Out of Total 29</i>	<i>SACT (Sinus Node Electrogram)</i>
58±10	21	12	13	206.7 ± 14.8 msec
			16	88.2 ± 13.1 msec

Discussion

The SACT can be measured directly on the sinus node electrogram (SNE) (7,8,9,12,14).

In this study the sinus node electrograms were successfully recorded in 62 out of all studied 70 patients (88.5%). In the study of Gomes et al., the success rate was 90%, which is the highest success rate in recording sinus node electrogram (2,17,21). Lower success rate had been obtained previously by Hariman et al., in 1980 and Reiffel et al., in 1980, which were 50% and 83% respectively (10,19,20). So the present results are near the results of Gomes et al.

In 33 out of 36 subjects of the control group the sinus node electrogram was recorded and the SACT was measured directly. The values of SACT using SNE were ranged between 55 and 105 msec. The mean was 81.24 ± 11.66 msec.

In the study of Gomes et al. the range of SACT was 60-112 msec. with a mean of 87 ± 12 msec. (Gomes et al., 1982). While in the study of Reiffel et al., the range of SACT was 46-116 msec. with mean of 90 ± 18 msec (19,20).

In 29 out of 34 patients of the patient group, the sinus node electrograms were successfully

recorded. In 13 out of 29 patients the SACT measured by direct method ranged 187 – 229 msec. with mean of 206.76 ± 14.8 msec. Those patients showed significant abnormal prolongation of SACT as compared with that of control group ($p < 0.01$). In the remaining patients (16 patients), the SACT measured by direct method was ranged between 79 to 100 msec. with mean of 88.2 ± 6.2 msec., which was not significantly different from the control group ($p > 0.01$).

There were no significant differences in the SACT measured directly from sinus node electrogram and SACT measured indirectly by both Strauss and Narula methods. Similar findings had been obtained by Joseph et al., in 1982 (12,14,22).

The direct recording helped to confirm the accuracy of the indirect techniques used in electrophysiologic studies of the sinus node. In addition, the application of the SNE technique to the validation of indirect SACT estimation has given the ability to utilize SACT estimation more critically. It becomes possible to recognize conditions when the indirect estimations are quite accurate and when they are not (19,20).

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