

Comparison of Rate Assessment between Resting Heart Rate and 24-Hour Holter Monitoring in Patients with Chronic Atrial Fibrillation

Akanis Srisukwattana MD*,
Rungroj Krittayaphong MD*

* Division of Cardiology, Department of Medicine, Siriraj Hospital, Mahidol University, Bangkok, Thailand

Background: Target heart rate in rate control strategy has been proposed by the Atrial Fibrillation Follow-up Investigation of Rhythm Management (AFFIRM) study. There is limited data on the correlation of measured heart rate at rest and during Holter monitoring.

Objective: To evaluate the proportion of achieved target heart rate between resting heart rate measuring and 24-hour Holter monitoring in patients with chronic atrial fibrillation who receive rate control strategy.

Material and Method: Patients with chronic atrial fibrillation who archived target resting heart rate under rate control strategy at Siriraj Hospital and who underwent 24-hour Holter monitoring were studied to evaluate the correlation between two methods of heart rate control.

Results: 47 patients were enrolled. Underlying cardiac conditions were as follows: hypertensive heart disease 44.7%, valvular heart disease 25%, coronary artery disease 17% and dilated cardiomyopathy 12.8%. There were 10 patients (21.3%) whose achieving target resting heart rate was not correlated with 24-hour Holter monitoring. Three patients (6.4%) underwent permanent pacemaker implantation due to sick sinus syndrome (SSS) or tachycardia-bradycardia syndrome.

Conclusion: In chronic atrial fibrillation patients that receive rate control strategy, evaluation of only resting heart rate might not be enough for long-term evaluation and treatment and 24-hour monitoring may be an additional helpful test in order to more precisely adjust medication for long-term treatment and detection of SSS.

Keywords: Rate control, Atrial fibrillation, Holter monitoring

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Atrial fibrillation is the most common sustained cardiac arrhythmia. The prevalence was 1%, predominately in male. It doubled the risk of death, increased thromboembolism by 5 fold and increased tachycardia-induce cardiomyopathy two fold⁽¹⁾.

Common etiologies of atrial fibrillation were hypertensive heart disease, coronary artery disease, valvular heart disease and dilated cardiomyopathy. Symptoms are usually caused by a poorly controlled or irregular ventricular rate. Treatment of chronic atrial fibrillation consist of evaluation the possible causes, choosing mode of treatment between rate control and rhythm control strategy and prevention of thromboembolism.

Several studies compared strategy of treatment between rate control and rhythm control strategy⁽²⁻⁴⁾. The Atrial Fibrillation Follow-up Investigation of Rhythm Management (AFFIRM) study⁽²⁾ was the landmark randomized control trial in chronic atrial fibrillation that compare between rhythm control and rate control strategy. The result of the AFFIRM study showed that management of atrial fibrillation with the rhythm control strategy offers no survival advantage over the rate control strategy and there are potential advantages, such as a lower risk of adverse drug effects, with the rate control strategy. This "rate control strategy" approach and anticoagulant may simplify therapy and permit the use of drugs that are less toxic than anti-arrhythmic drugs.

Definition of rate control⁽⁵⁾ required an initial resting heart rate of less than 80 beats/min. If that goal was achieved, a standard 6-min walk test or 24-hour Holter monitoring was required to confirm adequate rate control.

Correspondence to:

Krittayaphong R, Division of Cardiology, Department of Medicine, Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.

Phone: 0-2419-7000

E-mail: sirkt@mahidol.ac.th

Criteria for adequate rate control from Holter monitoring consist of both of 1) average heart rate during 24-hour less than 100 bpm (at least 18 h of interpretable monitoring) and 2) maximum heart rate less than 110% maximum predicted age-adjusted exercise heart rate.

In normal clinical practice only small number of patients with atrial fibrillation underwent Holter monitoring except for those with symptoms possibly related with syncope. Most physicians use only resting heart rate for evaluating and adjusting medication for heart rate control. But resting heart rate alone might not represent real achieved ventricular rate control. Holter monitoring might be an additional test for the evaluation to ensure optimal rate control in patients with chronic atrial fibrillation.

The primary objective of the present study was to evaluate the proportion of those patients with inadequate ventricular rate control as evaluated from Holter monitoring among those who had adequate resting heart rate control. The secondary objective was to evaluate episodes of bradycardia that could be related to the use of medication or underlying sinus node disease.

Material and Method

Study design

This is a retrospective study. The present study was approved by the Ethic committee of Siriraj Hospital. Data was collected from January 2008 to December 2008 from all patients with chronic atrial fibrillation in Siriraj hospital who achieved adequate resting ventricular rate control and underwent to 24-hour Holter monitoring for any reasons. Resting heart rate was recorded before Holter monitoring on the same day without any changes in medication.

Baseline characteristics were recorded as follows: age, sex, underlying cardiac conditions, underlying diseases, medications at last visit before Holter monitoring, data of echocardiogram and reason for Holter monitoring. Data of Holter monitoring was recorded as follows: 24-hour mean heart rate, maximum heart rate, minimum heart rate, episodes of pause and longest duration of pause.

Patient population

Inclusion criteria were patients with documented chronic atrial fibrillation who achieved resting heart rate with under the following three parameters: 1) age more than 18 years old 2) receiving medication for rate control strategy treatment such as

beta-blocker, calcium channel blocker (CCB) or digitalis for at least 4 weeks and 3) ECG from continuous Holter monitoring showing atrial fibrillation continuously.

Exclusion criteria were 1) receiving rhythm control strategy 2) history of AV nodal ablation 3) history of permanent pacemaker implantation.

Chronic atrial fibrillation was defined as atrial fibrillation that lasted more than 1 year⁽⁶⁾. Resting heart rate was measured before Holter monitoring in the sitting position after a 5-minute rest. Achieved resting target heart rate was defined as an initial resting heart rate below 80 bpm at rest. Achieved target heart rate from Holter monitoring include both of 1) average heart rate during 24-hr less 100 bpm (at least 18 h of interpretable monitoring) and 2) 2 maximum heart rate less than 110% maximum predicted age-adjusted exercise heart rate⁽²⁾. Significant pause was defined as no ventricular beat from ECG for more than 3 seconds⁽⁷⁾.

Statistical analysis

The authors used mean \pm standard deviation (SD) in descriptive data for quantitative information and percent for qualitative information. The authors used t-test for compare of continuous variables. Comparisons of categorical variables were made by the Chi-square test or Fisher's exact test wherever appropriate. The p-value of less than 0.05 was considered significant.

Results

A total 47 patients who have adequate resting ventricular rate control and underwent 24-hour Holter monitoring were studied. Underlying cardiac conditions were as follows: hypertensive heart disease 44.7%, valvular heart disease 25%, coronary artery disease 17% and dilated cardiomyopathy 12.8%. The reasons of Holter monitoring were as follows; syncope in 9 patients, presyncope in 12 patients, palpitation in 23 patients and unknown in 6 patients. There were 10 patients (21.3%) who did not achieve ventricular rate control from Holter monitoring criteria; 9 of 10 had maximum heart rate more than 110% of maximum age predicted heart rate, 3 of 10 had average heart rate more than 100 bpm and two of ten had exceeded heart rate in both criteria of Holter monitoring (Fig. 1). Baseline characteristics were not significantly different between patients who did and did not achieve heart rate control by Holter monitoring (Table 1).

Heart rate data (Table 2) showed that there was a significantly lowering of maximum heart rate, mean heart rate and minimum heart rate in patients who

achieved heart rate control by Holter monitoring compared with those who did not.

There were 6 patients who had episodes of pause more than 3 seconds. The median duration of pauses was 5 seconds (minimum 3.1, maximum 12 seconds, mean 5.9 seconds) (Table 3). There was no significant difference of the presence of episode of pause between two groups. Sick sinus syndrome (SSS) was diagnosed in two of six patients due to significant pauses and symptoms even after discontinuation of medications for heart rate control. Permanent pacemaker implantation was performed in 3 patients (6.4%); 2 with SSS and 1 with significant pauses but who needed medication to control ventricular rate.

Discussion

The present study has shown that up to one in five (21.3%) there was no correlation between adequate ventricular rate control from Holter monitoring and resting heart rate. This finding indicates that a significant number of patients cannot truly achieve

adequate ventricular rate control from AFFIRM study definition. The inadequate heart rate control would lead to not only more symptoms but also other complications such as tachycardia-induced

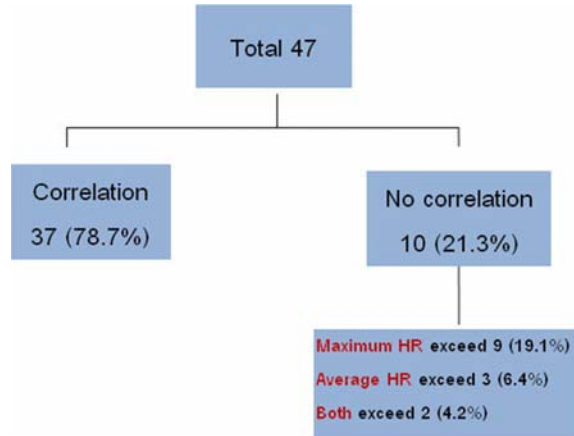


Fig. 1 Total number of patients and result of correlation from Holter monitoring data

Table 1. Baseline characteristics overall and when compared between two groups

Baseline characteristics	Holter monitoring			p-value
	Correlation of target HR (n = 37)	No correlation of target HR (n = 10)	Total (n = 47)	
Age (years)	71.1 ± 9.6	70.1 ± 15.3	70.74 ± 10.9	0.65
Male	19 (52.7%)	3 (30%)	22 (46.1%)	0.17
Systolic blood pressure (mmHg)	122.8 ± 28.6	128.8 ± 26.7	124.1 ± 28.2	0.56
Diastolic blood pressure (mmHg)	74.8 ± 15.1	69.8 ± 16.6	73.7 ± 15.4	0.37
Mean HR (bpm)	68.4 ± 10.1	69.7 ± 7	68.7 ± 9.4	0.69
Underlying disease				
HT	25 (67.57%)	8 (80%)	33 (70.21%)	0.29
Dyslipidemia	11 (29.73%)	2 (20%)	13 (27.66%)	1
CKD	1 (2.7%)	0 (0%)	1 (2.12%)	1
CVA	3 (8.11%)	0 (0%)	3 (6.38%)	1
Cardiac disease				
CAD	7 (18.92%)	1 (10%)	8 (17.02%)	0.67
Valvular heart disease	10 (27.03%)	2 (20%)	12 (25.53%)	1
HT heart disease	18 (48.65%)	6 (60%)	24 (51.06%)	0.31
DCM	4 (10.81%)	1 (10%)	5 (10.64%)	1
Medication				
Beta blocker	26 (70.28%)	7 (70%)	33 (70.2%)	1
Calcium antagonist	3 (8.1%)	0 (0%)	3 (6.38%)	1
Digitalis	8 (21.6%)	3 (30%)	11 (23.4%)	0.68
Amiodarone	1 (2.7%)	3 (30%)	4 (8.5%)	0.06

HR = heart rate, HT = hypertension, CKD = chronic kidney disease, CVA = cerebrovascular accident, CAD = coronary artery disease, DCM = dilated cardiomyopathy

Table 2. Heart rate data from Holter monitoring: comparison between two groups

HR data	Holter data			
	Total = 47	Mean average HR (bpm)	Mean maximum HR (bpm)	Mean minimum HR (bpm)
Correlation of target HR	37 (78.7%)	70.2 ± 12.2	122.2 ± 25.5	41 ± 8.8
No correlation of target HR	10 (21.3%)	91.5 ± 12.8	177.6 ± 17.8	49 ± 9.3
p-value		< 0.001	< 0.001	0.016

HR = heart rate

cardiomyopathy and heart failure^(8,9). If the authors use Holter monitoring and the heart rate is still not adequately controlled then medications can be adjusted for more precise ventricular rate control.

Rate control strategy is the preferred treatment option compared to rhythm control in the majority of patients without severe symptoms⁽⁶⁾. AFFIRM study showed that rhythm control is no better than rate control in terms of mortality⁽²⁾. Previous studies cannot demonstrate that strict rate control is better than usual rate control^(10,11). However, atrial fibrillation with relatively rapid ventricular response could lead to tachycardia induced cardiomyopathy and heart failure which is frequently under-diagnosed^(8,9). Control of rate of rhythm usually results in the improvement of left ventricular function even in those with apparently normal left ventricular function^(12,13). Beta blocker or non-dihydropyridine calcium antagonist is the preferred medication for long-term rate control^(1,6). Digitalis cannot provide a good rate control during exercise⁽¹⁴⁾. However, it can be used as the first line medication in those with left ventricular dysfunction or heart failure^(1,6). Amiodarone for rate control indication may be preserved for those who have contraindication for the first line agents or do not respond to the first line drugs^(1,6). Beta blocker is used in the majority of patients in the present study followed by digitalis. Calcium antagonist and amiodarone were used in a few patients. There were 6 patients (12.8%) who had pauses more than 3 seconds. The reasons from Holter monitoring in this group were as follow; three were palpitation, two was presyncope and one was syncope. Two of the patients with palpitation had been diagnosed as SSS. Holter monitoring would help to reveal bradycardia and pauses which increased yield in the diagnosis of SSS. Holter monitoring has been reported to increase the yield for diagnosis of SSS in those with suggestive symptom but cannot document ECG during

Table 3. Episode of pause and duration of pause from Holter monitoring

Presence of pause	Total = 47	Percent	Mean (sec)
No pause	41	87.2	1.1 ± 1.2
Pause	6	12.8	5.9 ± 3.3
Total	47	100	1.7 ± 2.3

Table 4. Episodes of pause from Holter monitoring data compared between two groups

Presence of Pause (n = 47)	Correlation of target HR (n = 37)	No correlation of target HR (n = 10)	p-value
Pause (n = 6)	5 (10.6%)	1 (2.1%)	0.64
No pause (n = 41)	32 (68.1%)	9 (19.1%)	

HR = heart rate

symptom^(3,15). All patients with episodes of pause from Holter monitoring received beta blocker and half of them received digitalis.

Permanent pacemaker implantation was performed in 6.4% in the present study. The prevalence of significant pauses in the present study may be high due to Holter monitoring which may be performed in some patients due to symptoms suggestive of SSS. Pacemaker is the standard treatment in patients with tachycardia bradycardia syndrome with symptoms related to bradycardia or due to medication that should be continued⁽¹⁶⁾.

Study limitations

There are some limitations of the present

study. First, this is a retrospective study the total population which was enrolled due to abnormal symptoms; some were related with presyncope and syncope. The result of the present study may not represent usual atrial fibrillation patients. Second, some patients received amiodarone for ventricular rate control but this is not a rate control drug. Third, the authors did not evaluate intra-observer and inter-observer variation of the assessment of resting heart rate and Holter monitoring. However, assessment of heart rate and pause during Holter monitoring was performed by well-developed software which required some manual edit of the data to correct minor error that may occur from misreading or artifact. Holter monitoring was performed by one reader.

Conclusion

In chronic atrial fibrillation patients who receive rate control strategy, evaluation only of resting heart rate might not be enough for long-term evaluation and treatment. 24-hour Holter monitoring may be an additional helpful test in order to adjust medications for long-term treatment and detect SSS.

Potential conflicts of interest

None.

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การศึกษาหาความสัมพันธ์ของการติดตามผลการรักษาของผู้ป่วยหัวใจห้องบนเต้นพลิ้วแบบเรื้อรัง โดยการวัดอัตราการเต้นของหัวใจขณะพักและ การวัดอัตราการเต้นของหัวใจด้วยเครื่องบันทึกหัวใจ 24 ชั่วโมง

อกนิษฐ์ ศรีสุขวัฒนา, รุ่งโรจน์ กฤตยพงษ์

ภูมิหลัง: ใช้คำจำกัดความของอัตราการเต้นของหัวใจที่เหมาะสมจาก AFFIRM study โดยอัตราการเต้นของหัวใจขณะพักน้อยกว่า 80 ครั้งต่อนาที ในกรณีของ Holter monitoring ใช้อัตราการเต้นของหัวใจเฉลี่ย 24 ชั่วโมง น้อยกว่า 100 ครั้งต่อนาที และอัตราการเต้นของหัวใจสูงสุดไม่เกิน 110% ของอัตราการเต้นของหัวใจสูงสุดเทียบกับอายุ

วัตถุประสงค์: เพื่อประเมินความสัมพันธ์ของอัตราการเต้นของหัวใจที่เหมาะสม โดยวิธีการวัดอัตราการเต้นของหัวใจขณะพัก และการวัดอัตราการเต้นของหัวใจเฉลี่ย 24 ชั่วโมงด้วย Holter monitoring ในผู้ป่วยหัวใจห้องบนเต้นพลิ้วที่ได้รับการรักษาแบบควบคุมอัตราการเต้นของหัวใจ

วัสดุและวิธีการ: ศึกษาย้อนหลังผู้ป่วยที่มีภาวะหัวใจห้องบนเต้นพลิ้วเรื้อรังที่ได้รับการรักษาแบบควบคุมอัตราการเต้นหัวใจ ที่มีอัตราการเต้นของหัวใจขณะพักต่ำกว่า 80 ครั้ง และได้รับการตรวจ Holter monitoring เพื่อดูความสัมพันธ์ของอัตราการเต้นของหัวใจที่เหมาะสมระหว่างการวัดอัตราการเต้นของหัวใจของทั้งสองวิธี

ผลการศึกษา: ผู้ป่วยทั้งหมด 47 ราย ที่ได้รับการรักษาแบบ rate control โดยมีโรคหัวใจจากความดันเลือดสูง 44.7% โรคลิ้นหัวใจ 25% โรคหลอดเลือดหัวใจอุดตัน 17% และโรคกล้ามเนื้อหัวใจ 12.8% มีผู้ป่วยทั้งหมด 10 ราย (21.3%) ที่การวัดอัตราการเต้นของหัวใจโดย 24 Holter monitoring ไม่เข้าเกณฑ์อัตราการเต้นของหัวใจที่เหมาะสมนอกจากนี้ยังพบผู้ป่วย 4 (8.5%) คนได้รับการวินิจฉัยว่าเป็น SSS และมีผู้ป่วย 3 (6.4%) รายที่จำเป็นต้องได้รับการใส่เครื่องกระตุ้นหัวใจถาวร

สรุป: ผู้ป่วยที่มีภาวะหัวใจห้องบนเต้นพลิ้วเรื้อรังที่ได้รับการรักษาแบบ rate control การประเมินอัตราการเต้นของหัวใจที่เหมาะสมขณะพักอาจไม่เพียงพอต่อการประเมิน รักษาในระยะยาว การตรวจด้วยเครื่อง Holter monitoring เป็นการตรวจที่ช่วยประเมิน รักษา และปรับขนาดของยาให้เหมาะสมในระยะยาว และยังช่วยวินิจฉัยภาวะหัวใจเต้นซ้ำผิดปกติที่จำเป็นต้องรักษาด้วยวิธีอื่นได้