International Journal of Innovative Research in Medical Science (IJIRMS)
Volume 01 Issue 07 Sept 2016, ISSN No. – 2455-8737
Available online at - www.ijirms.in

Open Access Journal www.ijirms.in ISSN - 2455-8737

# Comparison of Serum Electrolyte Levels in Patients Who Presented at The Emergency Room of Rajavithi Hospital with Atrial Fibrillation with Rapid Ventricular Response and those Who Had Normal Sinus Rhythm

**Sumitra Piyanuttapull MD[*1], Chalita Waenlor MD[2]**

[1]Cardiologist, Emergency Medicine Department, Rajavithi Hospital, College of Medicine, Rangsit University, Bangkok, Thailand
[2]Emergency Medicine, Rajavithi Hospital, College of Medicine, Rangsit University, Bangkok, Thailand

***Abstract***

***Background:*** *- Atrial fibrillation (AF) is a form of cardiac arrhythmia which is frequently encountered in emergency rooms, and atrial fibrillation with rapid ventricular response, a condition which increases the likelihood of morbidity and mortality, is especially common. There are many causes of AF, and it may be associated with electrolyte imbalance. This study compared serum electrolyte levels in patients who presented at the Emergency Room of Rajavithi Hospital with atrial fibrillation with rapid ventricular response and in those who had normal sinus rhythm.*

***Objectives:*** *- We compared serum electrolyte levels in patients in two groups: subjects with atrial fibrillation with rapid ventricular response and those with normal sinus rhythm. We also studied other precipitating factors that may be associated with atrial fibrillation with rapid ventricular response.*

***Method:*** *- We studied 266 patients who came to the Emergency Room of Rajavithi Hospital between 1 October 2014 and 30 September 2015. Of these, 56 were diagnosed as having atrial fibrillation with rapid ventricular response, and the remaining 210 were diagnosed with normal sinus rhythm. The serum electrolyte levels of the two groups were compared using a retrospective descriptive study. Data were collected from OPD cards, and statistical analysis was performed using SPSS program version 17 in terms of percentages, means and standard deviation.*

***Results:*** *- The patients who presented with atrial fibrillation with rapid ventricular response were significantly older than those in the normal group (p-value=0.004, OR1.03, 95%CI1.01-1.05), and serum phosphorus levels were higher in the AF with RVR group than in the normal group (p-value<0.001, OR2.03, 95%CI1.37-3.00). The group of AF with RVR patients had average phosphorous levels of 3.55±0.93 compared with 3.08±0.75 in the NSR group, while serum magnesium levels were lower in the AF with RVR group than in patients in the normal group (p-value=0.003, OR0.19, 95%CI0.06-0.57). The group of AF with RVR patients had average magnesium levels of 1.92±0.36 compared with 2.06±0.30 in the NSR group.*

***Conclusion:*** *- Patients who presented at the Emergency Room with atrial fibrillation with rapid ventricular response had higher serum phosphorus levels and lower serum magnesium levels than those with normal sinus rhythm.*

***Keywords:*** *- Atrial fibrillation (AF), Atrial fibrillation with rapid ventricular response (AF with RVR), Electrolyte, Sodium, Potassium, Chloride, Calcium, Phosphorus, Magnesium.*

## Background

Atrial fibrillation (AF) is a commonly-encountered condition in emergency rooms. Patients may present with symptoms such as palpitations and intermittent tiredness at rest or while exercising, or severe symptoms such as fainting. They may also be experiencing symptoms of AF complications such as heart failure and stroke. Atrial fibrillation can result from a variety of causes, such as valvular heart disease, enlarged left atrium, coronary artery disease, and pericarditis or from non-cardiac causes such as pneumonia, surgery, electrolyte imbalance, hyperthyroidism, pulmonary embolism, exposure to cocaine and caffeine, acute alcohol intoxication, septic or febrile illness, senility, genetics, distress and obesity, or unknown-causes.

The researcher was particularly interested in investigating one of the factors thought to be associated with atrial fibrillation occurrence, namely the imbalance of serum electrolyte levels. Quite a lot of research has focused specifically on the relationship between serum electrolyte levels and the onset of atrial fibrillation, particularly atrial fibrillation with rapid ventricular response, which results in high mortality rates, lengthier hospital stays and increased

likelihood of disablement. Knowing whether the levels of serum electrolyte were related to the occurrence of atrial fibrillation with rapid ventricular response could lead to the provision of more rapid and accurate patient monitoring and care.

## Materials and Methods

This study was performed in the Emergency Room of Rajavithi Hospital, a tertiary care center in Bangkok, Thailand. The aim of this retrospective descriptive study was to compare serum electrolyte levels in AF with RVR patients and in those with NSR treated in the Emergency Room in order to identify other precipitating factors which cause atrial fibrillation with rapid ventricular response. Normal sinus rhythm is defined from Electrocardiograms (EKG) as: QRS complex follows in every P wave, is normally narrow and its duration does not exceed 0.12 seconds; regular R-R interval; P wave is vertical in leads II, III and aVF, and heart rate is 60-100 beats/minute. Atrial fibrillation (AF) is the state in which electrical signals originate not from the SA node but rather from more than 1 atrial point, resulting in arrythmia. The P wave disappears and the fibrillation (f) wave is inconsistently wavy back and forth, and it is evident in Lead II, III, aVF, and V2. QRS complex is normal, and the atrial rate is 350-700 bpm. The ventricular rate (VR) often fluctuates irregularly between 60-100 bpm. Ventricular rates > 100 bpm, 60-200 bpm, and < 60 bpm are classified as Rapid Ventricular Response (RVR), Moderate Ventricular Response (MVR) and Slow Ventricular Response (SVR) respectively. Atrial fibrillation with rapid ventricular response (AF with RVR) is atrial fibrillation with ventricular rate > 100 bpm.

Electrolytes are mineral substances in the blood including sodium, potassium, chloride, calcium, phosphorus and magnesium. Electrolyte imbalances are disorders or imbalances of electrolyte levels in the body and are classified as follows:

hypernatremia - serum sodium level > 145 mEq/L; hyponatremia - serum sodium level < 135 mEq/L; hyperkalemia - serum potassium level > 4.9 mEq/L; hypokalemia - serum potassium level < 3.5 mEq/L; hyperchloremia - serum chloride level > 106 mEq/L; hypochloremia - serum chloride level < 98 mEq/L; hypercalcemia - serum calcium level > 10 mg/dL; hypocalcemia - serum calcium level < 8.6 mg/dL; hyperphosphatemia - serum phosphorous level > 4.5 mg/dL; hypophosphatemia - serum phosphorous level < 27 mg/dL;

Hypermagnesemia - serum magnesium level > 2.6 mg/dL; and hypomagnesemia - serum magnesium level < 1.6 mg/dL

The diagnosis criteria for atrial fibrillation adopted in this study are those stipulated in the Guideline for Patients with Atrial fibrillation AHA/ACC/HRS 2014. Blood chemistry was examined using Cobas Integra 800.

The data used to select patients who satisfied all of the inclusion criteria were drawn from medical records, medical history, and medical examination. The inclusion criteria were: patients who came to the Emergency Room for electrocardiography and were diagnosed as having atrial fibrillation with rapid ventricular response for the first time (the AF with RVR group) or patients with normal sinus rhythm (the NSR group). All patients had blood puncture for blood chemistry tests to establish levels of sodium, potassium, chloride, calcium, phosphate and magnesium, were more than 18 years old, and consented to having treatment at Rajavithi Hospital. The exclusion criteria were: patients who presented with atrial fibrillation at ventricular rate < 100 /min (AF normal rate and slow rate); patients who had chronic atrial fibrillation (Chronic AF); and patients with abnormal electrocardiogram showing arrhythmia which was not atrial fibrillation.

### Statistical analysis

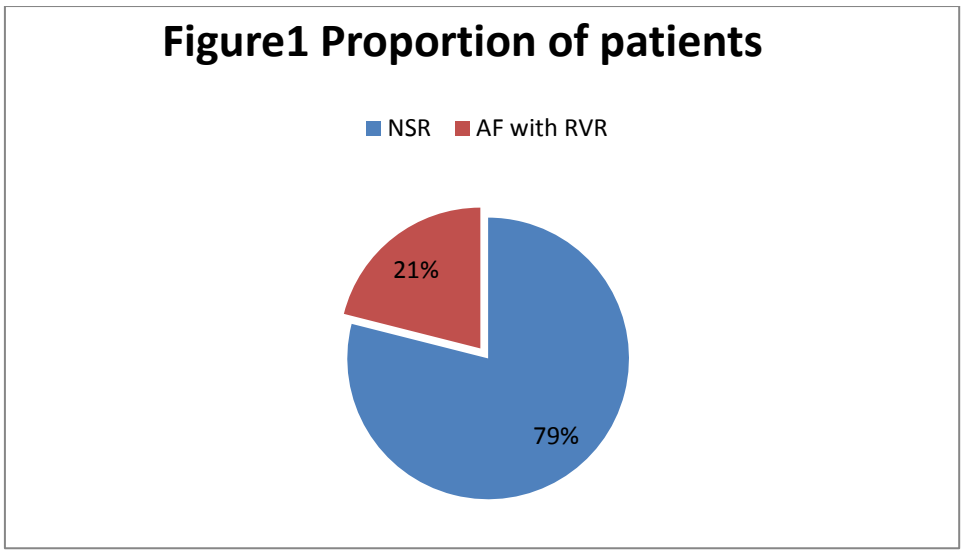
The purpose of Descriptive Statistics is to describe personal characteristics by finding quantity, percentage, mean, standard deviation, and median. Inferential Statistics use techniques such as Student T-test to compare quantitative data in the event of normal distribution, and Mann-Whitney U Test is utilised in the event of non-normal distribution of data. With regard to qualitative data, comparison is made using Chi-square test/Fisher Exact Test, and a p-value < 0.05 is deemed to indicate statistical significance. After univariate analysis, the factors that are related to research are analysed with Logistic Regression, and statistical analysis is conducted using SPSS version 17.0.

### Ethical Issues

This study was reviewed and approved by the ethics committee of Rajavithi Hospital and was funded by Rajavithi Hospital

## Results

This study compared serum electrolyte levels of patients with AF with RVR and those of NSR patients who came for treatment at the Emergency Room of Rajavithi Hospital. Retrospective data were collected of 3,327 patients who came for treatment and electrocardiography at Rajavithi Hospital between 1 October 2014 and 30 September 2015. A total 266 patients met the inclusion criteria: 210 (78.9%) were classified into the group of normal sinus rhythm patients, while 56 (21.1%) were patients with atrial fibrillation with rapid ventricular response (AF with RVR) as shown in Figure 1.




Descriptive characteristics of the study population are shown in table 1. The average age of the population of patients with AF with RVR was 60.88+ 13.74 years, compared to just 53.21+17.96 years in the NSR group, and this difference was statistically significant as were the presence of underlying HT and thyroid disease. Presenting symptoms of chest pain and dyspnea, which were higher in the group of NSR patients than in those in the AF with RVR patients, were also statistically significant factors.

**Table1. Demographic data of all patients**

| Characteristics | AF with RVR (n=56) | NSR (n=210 ) | p-value |
|---|---|---|---|
| **Age ( years )** | 60.88±13.74 | 53.21±17.96 | 0.001 |
| **Sex** | | | 0.666 |
| **Male** | 23(41.1) | 93(44.3) | |
| **Female** | 33(58.9) | 117(55.7) | |
| **Underlying disease** | | | |
| **HT** | 34(60.7) | 87(41.4) | 0.015 |
| **DM** | 11(19.6) | 54(25.7) | 0.347 |
| **DLP** | 10(17.9) | 34(16.2) | 0.766 |
| **CKD** | 2(3.6) | 9(4.3) | 0.811 |
| **CVA** | 0 | 5(2.4) | 0.244 |
| **CAD** | 9(16.1) | 45(21.4) | 0.376 |
| **Thyroid** | 3(5.4) | 2(1.0) | 0.031 |
| **Smoking** | 21(37.5) | 82(39.0) | 0.833 |
| **Alcohol drinking** | 18(32.1) | 81(38.6) | 0.377 |
| **Presenting symptoms** | | | |
| **Chest pain** | 8(14.3) | 122(58.1) | <0.001 |
| **Dyspnea** | 23(41.1) | 18(8.6) | <0.001 |
| **Syncope** | 3(5.4) | 9(4.3) | 0.731 |
| **Palpitation** | 23(41.1) | 61(29.0) | 0.085 |
| **Dizziness** | 2(3.6) | 3(1.4) | 0.294 |


*Corresponding Author - Sumitra Piyanuttapull MD,*

**Table 2: Serum Electrolyte Levels of the two groups of patients**

| Parameter | AF with RVR (n=56) | NSR (n=210) | p-value |
|---|---|---|---|
| **BS** | 170.84±102.49 | 150.28±87.19 | 0.182 |
| **BUN** | 18.13±11.88 | 14.53±10.43 | 0.027 |
| **Cr** | 1.13±1.35 | 1.08±1.19 | 0.761 |
| **Na** | 137.96±5.02 | 137.78±4.19 | 0.775 |
| **K** | 3.83±0.60 | 3.88±0.55 | 0.568 |
| **Cal** | 101.55±5.27 | 100.20±4.94 | 0.074 |
| **HCO3** | 23.16±4.42 | 23.80±3.36 | 0.237 |
| **Ca** | 9.21±0.52 | 9.22±1.31 | 0.929 |
| **P** | 3.55±0.93 | 3.08±0.75 | 0.001 |
| **Mg** | 1.92±0.36 | 2.06±0.30 | 0.003 |

**Table 3: Factors related to AF with RVR occurrence**

| Factor | p-value | OR | 95%CI |
|---|---|---|---|
| **Age** | 0.004 | 1.03 | 1.01-1.05 |
| **HT** | 0.011 | 2.19 | 1.20-3.99 |
| **Chest pain** | <0.001 | 0.12 | 0.05-0.27 |
| **Dyspnea** | <0.001 | 7.43 | 3.62-15.26 |
| **BUN** | 0.034 | 1.03 | 1.00-1.05 |
| **P** | <0.001 | 2.03 | 1.37-3.00 |
| **Mg** | 0.003 | 0.19 | 0.06-0.57 |

The group of AF with RVR patients had average magnesium levels of 1.92±0.36, significantly lower than that of the NSR group which was 2.06±0.30 (p=0.003). The AF with RVR patients had average phosphorous levels of 3.55±0.93 which was significantly higher than that found in the group with NSR (p=0.001). The other electrolytes were not statistically significant factors, as shown in table 2.

The two groups were compared using Univariate and Multivariate analysis, and the group of AF with RVR patients were found to have a higher average age than those in the NSR group, and this was a statistically significant difference (p = 0.004) ( OR1.03 95%Cl1.01-1.05). With regard to blood chemistry values, the average BUN level in the group of AF with RVR patients was higher than that of the group of NSR patients, and this was also a statistically significant difference with p = 0.034 ( OR1.03 95%Cl1.00-1.05 ). Electrolyte levels examined for the purpose of this study revealed that average phosphorous (P) levels in the AF with RVR patients were significantly higher than those of patients in the NSR group (p < 0.001) (OR 2.03 95Cl1.37-3.00) and average magnesium (Mg) levels in AF with RVR patients were significantly lower than those of the NSR patients with p = 0.003 (OR0.19 95%Cl0.06-0.57) as shown in table 3.

## Discussion

In this study of 226 patients with AF with RVR and NSR who were treated in the Emergency Room of Rajavithi Hospital, 56 patients (21.1%) were classified as having AF with RVR, which was similar to data obtained for the hospital's 2013 budget year.

The average age of the group of AF with RVR patients was statistically significantly higher than that of patients in the NSR group, at 60.88±13.74 and 53.21±17.96 respectively. This was consistent with findings of the research of Milda Svagzdien et al.[7] in which the group of AF patients had a higher average age than that of the group of normal EKG patients.

Comparison of blood chemistry levels of the two groups of patients revealed that the average phosphorus levels in the group of AF with RVR patients were significantly higher than those of the subjects in the NSR group with p-value < 0.001 (OR 2.03% 95%Cl 1.37-3.00). This was consistent with the research of Faye L. Lopez et al.[5] in which high serum phosphorous levels were found to be related to AF occurrence; however, it was in conflict with the research findings of Milda Svagzadien et al.(7) which found that

serum phosphorous levels were lower in the AF group than in the normal group, and that average magnesium levels were significantly lower in the AF with RVR group patients than in the NSR one with p = 0.003 ( OR0.19 95%Cl 0.06-0.57). Abigail May Khan et al.[2] also discovered that low serum magnesium was related to AF occurrence, as did the research of Jeffrey R. Misialek et al.[6] The differences in levels of sodium, potassium, chloride and calcium levels in the two groups were not statistically significant.

Calculations using Univariate analysis indicated that the average BUN value in the group of AF with RVR patients was significantly higher than that of the patients in the NSR group, with p = 0.034 (OR1.03 95%Cl 1.00-1.05). Underlying HT and presenting symptoms (chest pain and dyspnea), were higher in the NSR group, and the differences were statistically significant. However, it might not be said that such factors would be among the preventive factors of AF with RVR occurrence since although patients with these conditions would be sent for electrocardiography in the emergency room, after ECG in this study, they were found to be normal.

## Limitation of Study

As this was a retrospective descriptive study, the fact that some information was not recorded in medical records meant that we were unable to collect complete details and eliminate some factors that could have affected data analysis; for example, levels of thyroid hormones may affect the occurrence of AF with RVR in patients with underlying thyroid disease.

## Conclusion

The patients who presented with atrial fibrillation with rapid ventricular response had higher levels of serum phosphorous and lower serum magnesium levels than the patients with normal sinus rhythm on presentation at the Emergency room.

## Reference

1. Craig T, Samuel WL. 2014 AHA/ACC/HRS Guideline for the Management of Patients With Atrial Fibrillation: Executive Summary. JACC VOL. 64, NO. 21, 2014.

2. Abigail MK, Lubitz SA, Sullivan LM, Sun JX, Levy D, Vasan RS, et al. Low Serum Magnesium and the Development of Atrial Fibrillation in the Community: The Framingham Heart Study. Circulation. 2013 January 1; 127(1): 33–38.

3. Sahin V, Kaplan M, Bilsel S, Filizcan U, Cetemens S, Bayserke O, et al. The relation between blood and tissue magnesium levels and development of atrial fibrillation after coronary artery bypass surgery. Anadolu Kardiyol Derg 2010; 10: 446-51.

4. Krijthe BP, Heeringa J, Kors JA, Hofman A, Franco OH, Witteman J, et al. Serum potassium levels and the risk of atrial fibrillation, The Rotterdam Study. International Journal of Cardiology 168 (2013) 5411–5415.