# Predicting Factors, Incidence and Prognosis of Cardiac Arrhythmia in Medical, Non-Acute Coronary Syndrome, Critically Ill Patients

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***Background:*** *Cardiac arrhythmia is an important complication of critically ill patients, especially in perioperative period and early after myocardial infarction. However, the information regarding this condition in medical critically ill without active coronary artery disease patients is limited.*

***Objective:*** *To identify the predictive factors, incidence, and prognosis of tachyarrhythmia and bradyarrhythmia in non-coronary critically ill medical patients.*

***Material and Method:*** *A single center, prospective cohort study, included medical critically ill patients, age $\geq$ 18 year-old, admitted in a 15-bed medical ICU between September 2010 and August 2011. The patients with active coronary artery disease, end stage organ failure and not expected to survive $\geq$ 48 hours were excluded. The patients' baseline characteristic, APACHE II score, laboratory investigations in the first 24 hours and treatment modalities were recorded. Continuous electrocardiographic monitoring was performed during ICU admission. The arrhythmic event, requiring treatment, was recorded.*

***Results:*** *A total of 247 patients were included, the mean age was 58.5 $\pm$ 20.0 year-old and mean APACHE II score was 20.1 $\pm$ 9.8. Most of them had septic shock (57.1%) and respiratory failure (55.1%). The incidence of arrhythmia was 39.7%. Of 45 patients (18.2%) who had tachyarrhythmia, new onset atrial fibrillation was demonstrated in 34 patients (13.8%), following by ventricular fibrillation (9 patients, 3.6%) and supraventricular tachycardia (2 patients, 0.8%). Bradyarrhythmia was noted in 53 patients (21.5%). Of these, junctional bradycardia was witnessed in 34 patients (13.8%), followed by symptomatic bradycardia (15 patients, 6.1%) and atrioventricular blockage (4 patients, 1.6%). The multivariate by logistic regression analysis revealed the receiving of norepinephrine and APACHE II $\geq$ 25 as an independent predictor for tachyarrhythmia, while the receiving of norepinephrine, arterial pH < 7.3 and $HCO_3$ $\geq$ 18 were associated with bradyarrhythmia. The presence of arrhythmia, especially ventricular fibrillation, symptomatic sinus bradycardia and junctional bradycardia in medical ICU is associated with higher hospital mortality (bradyarrhythmia 88.7%, tachyarrhythmia 66.7%) than the absent group (18.1%, p < 0.001).*

***Conclusion:*** *Arrhythmia is a serious complication of medical critically ill patients and associated with high mortality rate. Appropriate shock management together with proper metabolic support may prevent this condition.*

***Keywords:*** *Cardiac arrhythmia, Atrial fibrillation, Ventricular fibrillation, Ventricular tachycardia, Bradyarrhythmia, Junctional bradycardia, Medical critically ill patient*

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Cardiac arrhythmias are reported as the important complication during the critically ill period and are associated with higher mortality rate[1]. The incidence of arrhythmia ranges from 6% in post-traumatic patients[2], 9% in general intensive care unit (ICU)[3], 10-24% among acute coronary syndrome patients[4,5] and approaches 78% among perioperative patients[1]. The wide range of arrhythmia incidences may be influenced by the natural history of the disease itself, the patients' age group, and the baseline structural heart disease of the study population, as well as the definition of index arrhythmia evaluated in the individual studies. Apart from sinus tachycardia, atrial fibrillation is the leading arrhythmia among perioperative, both cardiac and non-cardiac, patients, while ventricular fibrillation and ventricular tachycardia are considered as the leading arrhythmias in post myocardial infarction patients[4]. Compared with

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tachyarrhythmia, bradyarrhythmia due to various degrees of atrioventricular conduction defects have been reported at lower incidence rate among critically ill patients. A large cohort study from the previous decade showed that the presence of arrhythmia during ICU admission was associated with higher mortality rate[1] and this information was then confirmed by a multicenter cohort study from France in 2008[6]. Although the incidences of arrhythmia have clear evidence of significant impacts on patient's prognosis, the study about the predictive factors for developing of tachyarrhythmia and bradyarrhythmia have but limited information. The objective of the present study is to identify the predictive factors, the incidence and the prognosis of both requiring treatment tachyarrhythmia and bradyarrhythmia in medical, non-coronary critically ill patients during admitted in a medical ICU.

## Material and Method

This is a prospective, single center, cohort study, conducted in a 15-bed medical intensive care unit of Siriraj Hospital, a University tertiary care hospital in Bangkok, Thailand. Due to the situation of separated surgical intensive care units, coronary intensive care units and respiratory care unit, the main population admitted in the medical ICU were multi-organ dysfunction, mostly caused by any causes of shock rather than particularly cardiogenic shock. The patients, admitted in the medical ICU during a 13 months period, starting from the 1st of September 2010 and ending on the 31st of August 2011 whose age was over 18 years and who agreed to sign the participation form either by themselves or for whom their legally approved relatives signed were included in the present study. The patients with a history of major operation within 2 weeks, recent myocardial infarction within 2 weeks and in terminal stage of disease, unexpected to survive longer than 48 hours were not included. The information, including patient's characteristics (age, sex, body weight, height, underlying conditions, APACHE II score in the first 24 hours after ICU admission), ICU admission diagnosis, laboratory investigation in the first 24 hours after ICU admission, treatment modality and patient's outcome were recorded.

### *EKG monitoring*

Standard ICU monitoring, including continuous EKG, blood pressure, respiratory rate, pulse-oxymetry and other essential hemodynamic parameters were recorded via the IntelliVue information center of Phillips Patient Care System. For detection of cardiac arrhythmia, alarm alert system was set; depending on the patient's condition and the preference of attending physician, this was usually about 50-60 beats per minute for the bradycardia limit and 100-120 beats per minute for the tachycardia limit. For detect the irregularity of heart rate, direct visualization by one of the critical care team members was used as the initiation point for further investigation. After detection of abnormal rate or rhythm, the standard 12 leads surface EKG recording was performed immediately. The interpretation of EKG and diagnosis of specific type of arrhythmia was performed by a cardiologist, following the standard definition[7,8]. For tachyarrhythmia; it was new onset atrial fibrillation, atrial flutter, supraventricular tachycardia, sustain ventricular tachycardia and ventricular fibrillation, and for bradyarrhythmia; it was symptomatic sinus bradycardia, junction bradycardia, 2nd and 3rd degree atrioventricular (AV) block. These were the indexes arrhythmia for the present study.

### *Ethical consideration*

The present study was reviewed and approved by the Siriraj hospital ethics committee, according to the Declaration of Helsinki.

### *Statistical analysis*

The continuous variables were reported as mean $\pm$ standard deviation (SD). To compare between non-arrhythmic group, tachyarrhythmia group and bradyarrthymia group, One-Way ANOVA was used. The independent sample t-test was used to compare between two groups. The categorical variables were reported as percentage per group. To compare the difference between groups, the Pearson's Chi square test or the Fisher's exact test was used when suitable. To identify the predictive factor for develop tachyarrhythmia and bradyarrhythmia, the parameters that have significant difference in proportion for categorical variations, and in mean for continuous variations were underwent univariate analysis. The difference parameters with p-value $< 0.1$ were included into the multiple logistic regression model to perform the multivariate analysis. The P value of less than 0.05 was accepted as statistically significant. The statistical analysis was performed by the SPSS version 17.

## Results

During the study period between the 1st of September 2010 and the 31st of August 2011, 250

patients were admitted in the medical intensive care unit. Of these, one patient didn't agree to participate to the study, another two patients had undergone abdominal surgery before admission; finally a total of 247 non acute coronary syndrome, medical critically ill patients were included in the study. The mean age was 58.5 $\pm$ 20.0 year-old, 60% were male and the mean APACHE II score in the 1st 24 hours after admission was 20.1 $\pm$ 9.8. Septic shock was the leading ICU admission diagnosis, following with acute respiratory failure due to severe pneumonia and acute respiratory distress syndrome (ARDS). Every participant need respiratory support by mechanical ventilator and 13.4% of patients required renal replacement therapy during ICU admission. The mean ICU admission date was 13.6 $\pm$ 19.8 days and the mean hospital length of stay was 37.0 $\pm$ 84.9 days. The ICU mortality, 28 days mortality and hospitality mortality were 37.2%, 37.2% and 42.1%, respectively. The index cardiac arrhythmia was detected in 98 patients (39.7%). The most common tachyarrhythmia was new onset atrial fibrillation, while the leading bradyarrhythmia was junctional bradycardia. The information of detected arrhythmia during ICU admission and prognosis of each arrhythmia is shown in the Table 1. Most of cardiac arrhythmia occurred in the first week after ICU admission (71.7% of bradyarrhymia and 75.6% of tachyarrhythmia, Fig. 1) which more than half of the arrhythmia developing within the first 3 days of ICU admission.

The patient's characteristics are illustrated in Table 2. Comparing with the non-arrhythmic group, the patients who developed tachyarrhythmia during ICU admission were older, had higher APACHE II score and were associated with higher proportion of hypertension, diabetes mellitus and previous coronary artery disease. The bradyarrhythmic patients had higher APACHE II score, but were associated with lower proportion of hypertension and diabetes mellitus, when compared with the non-arrhythmic group. Septic shock and ARDS were observed in higher proportion among tachyarrhythmic and bradyarrhythmic groups than in the non-arrhythmic group. Concerning the receiving of vasoactive agents, the arrhythmic patients received vasoactive agents, including dopamine, norepinephrine, adrenaline and dobutamine, in higher proportion than the non-arrhythmic group. For the basic laboratory investigation, as shown in Table 3, both tachyarrhythmic and bradyarrhythmic groups had higher mean serum Potassium and Magnesium levels but lower arterial blood pH than the non-arrhythmic group.

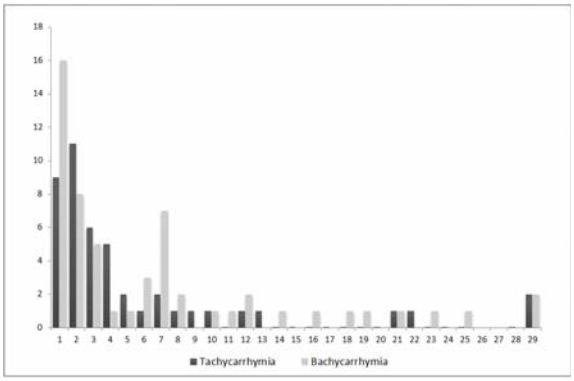


**Fig. 1** Illustrates the number of arrhythmic events according to the date after ICU admission. The X-axis represents day after ICU admission and Y-axis represents number of arrhythmic events. Arrhythmic events which occurred beyond 28 days are shown in day-29

**Table 1.** Incidence and prognosis of cardiac arrhythmia in medical, non-cardiac, critically ill patients

| Cardiac arrhythmia | n (% of total) | Hospital mortality (% per group) | Neurologic sequelae (% per group) |
|---|---|---|---|
| No arrhythmic event | 149 (60.3%) | 27 (18.1%) | 3 (2.0%) |
| Tachyarrhythmia | 45 (18.2%) | 30 (66.7%) | 2 (4.4%) |
| -Atrial fibrillation | 34 (13.8%) | 22 (64.7%) | 2 (5.9%) |
| -Ventricular tachycardia | 9 (3.6%) | 7 (77.8%) | 0 |
| -Supraventricular tachycardia | 2 (0.8%) | 1 (50%) | 0 |
| Bradyarrhythmia | 53 (21.5%) | 47 (88.7%) | 1 (1.9%) |
| -Junctional bradycardia | 34 (13.8%) | 32 (94.1%) | 1 (2.9%) |
| -Symptomatic sinus bradycardia | 15 (6.1%) | 14 (93.3%) | 0 |
| -3rd degree AV block | 3 (1.2%) | 1 (33.3%) | 0 |
| -2nd degree AV block | 1 (0.4%) | 0 (0%) | 0 |

**Table 2.** Patients' baseline characteristics

| Patients' parameters | No arrhythmia (n = 149) | Tachyarrhythmia (n = 45) | p-value | Bradyarrhythmia (n = 53) | p#-value |
|---|---|---|---|---|---|
| Age (years) | 58.0 ± 21.3 | 64.1 ± 17.0 | 0.04 | 55.3 ± 18.0 | 0.39 |
| Sex (% of male) | 54 | 62.2 | 0.39 | 56.6 | 0.75 |
| Body weight (kg) | 62.0 ± 12.7 | 60.3 ± 12.5 | 0.45 | 61.2 ± 14.3 | 0.71 |
| Height (cm) | 158.4 ± 6.8 | 158.9 ± 6.3 | 0.67 | 158.2 ± 9.3 | 0.86 |
| Body mass index (kg/m$^2$) | 24.8 ± 5.5 | 24.0 ± 9.4 | 0.34 | 25.1 ± 9.8 | 0.68 |
| APACHE II score | 17.0 ± 8.3 | 24.4 ± 9.4 | < 0.001 | 25.1 ± 9.8 | < 0.001 |
| Underlying conditions (%) | | | | | |
| -Hypertension | 41.6 | 51.1 | 0.09 | 28.3 | 0.03 |
| -Diabetes mellitus | 31.5 | 46.7 | 0.02 | 20.8 | 0.04 |
| -Chronic kidney disease | 21.5 | 17.8 | 0.68 | 20.8 | 1.00 |
| -Previous stroke | 13.4 | 13.3 | 0.6 | 7.5 | 0.33 |
| -Chronic atrial fibrillation | 13.4 | 4.4 | 0.16 | 5.7 | 0.21 |
| -Chronic liver disease | 10.1 | 17.8 | 0.19 | 13.2 | 0.61 |
| -Coronary artery disease | 8.1 | 20.0 | 0.04 | 13.2 | 0.28 |
| -Malignancy | 6.7 | 15.6 | 0.12 | 9.4 | 0.55 |
| ICU admission diagnosis (%) | | | | | |
| -Septic shock | 50.3 | 64.4 | 0.09 | 69.2 | 0.02 |
| -Severe sepsis | 8.7 | 8.9 | 1.0 | 5.7 | 0.40 |
| -ARDS | 16.8 | 37.8 | 0.04 | 39.6 | 0.001 |
| -Acute kidney injury | 10.7 | 13.3 | 0.6 | 20.8 | 0.10 |
| Vasoactive agents (%) | | | | | |
| -Norepinephrine | 11.4 | 66.7 | < 0.001 | 79.2 | < 0.001 |
| -Adrenaline | 1.3 | 13.3 | 0.002 | 28.3 | < 0.001 |
| -Dopamine | 5.4 | 35.6 | < 0.001 | 32.1 | < 0.001 |
| -Dobutamine | 2.0 | 13.3 | 0.007 | 7.5 | 0.43 |

* p-value of comparison between non-arrhythmia and tachyarrhythmia group
# p-value of comparison between non-arrhythmia and bradyarrhythmia group

***Risk factors for develop cardiac arrhythmia in ICU***

To evaluate the predicting factors for develop tachyarrhythmia and bradyarrhythmia among the medical critically ill patients, univariate analysis was performed to detect different parameters between arrhythmia and non-arrhythmia groups. The continuous variables, including patients' age, APACHE II score and laboratory result were categorized into two groups. The different parameters between tachyarrhythmic, bradyarrhythmic and non-arrhythmic groups with p-value less than 0.1 were included in the logistic regression analysis model to perform multivariate analysis. Table 4 shows the parameters including in univariate and multivariate analysis for detecting the predictive factors for developing cardiac arrhythmia. Only APACHE II score ≥ 25 in the first 24 hours after ICU admission and receiving of norepinephrine were significant risk factors associated with tachyarrhythmia. The receiving of norepinephrine, arterial pH < 7.3 and $HCO_3$ ≥ 18 mmol/l were the predictive factors associated with bradyarrhythmia (Table 5).

***The prognosis of cardiac arrhythmia***

Table 1 shows the association of cardiac arrhythmia during ICU admission and the higher in-hospital mortality rate and the neurological sequenlae among medical critically patient. To determine the impact of tachyarrhythmia and bradyarrhythmia on the patients' outcome, the univariate analysis, comparing the parameters between hospital survivor and non-survivor groups, was performed. The patients' baseline characteristics that were significantly different between groups with p-value < 0.1 were included in the logistic regression analysis to perform the multivariate analysis. Table 6 illustrates the patients' characteristics that determine the patients' outcome. Tachyarrhythmia, especially ventricular tachycardia, and bradyarrhythmia, including junctional bradycardia and symp-

**Table 3.** Laboratory investigation in the first 24 hours after ICU admission

| Laboratory results | No arrhythmia (n = 149) | Tachyarrhythmia (n = 45) | p*-value | Bradyarrhythmia (n = 53) | p#-value |
|---|---|---|---|---|---|
| BUN (mg/dL) | 34.6 ± 25.9 | 42.6 ± 30.2 | 0.1 | 42.9 ± 24.1 | 0.07 |
| Creatinine (mg/dL) | 2.3 ± 2.8 | 2.5 ± 2.0 | 0.67 | 2.0 ± 1.1 | 0.41 |
| Sodium (mmol/L) | 138.6 ± 6.8 | 139.6 ± 7.1 | 0.38 | 139.8 ± 6.3 | 0.28 |
| Potassium (mmol/L) | 3.9 ± 0.7 | 4.3 ± 1.3 | 0.06 | 4.2 ± 0.9 | 0.01 |
| Chloride (mmol/L) | 103.6 ± 8.9 | 102.7 ± 9.8 | 0.57 | 106.5 ± 9.8 | 0.16 |
| $HCO_3$ (mmol/L) | 19.7 ± 6.4 | 18.5 ± 6.4 | 0.28 | 17.4 ± 7.7 | 0.04 |
| Magnesium (mg/dL) | 2.1 ± 0.4 | 2.3 ± 0.6 | 0.06 | 2.3 ± 0.6 | 0.02 |
| Blood sugar (mg/dL) | 179.1 ± 72.7 | 201.3 ± 92.4 | 0.12 | 173.1 ± 78.7 | 0.61 |
| pH | 7.39 ± 0.11 | 7.31 ± 0.15 | 0.001 | 7.27 ± 0.14 | < 0.001 |
| $pCO_2$ | 33.5 ± 12.4 | 33.0 ± 9.1 | 0.83 | 39.2 ± 18.0 | 0.03 |
| $pO_2$ | 128.6 ± 67.5 | 111.4 ± 65.0 | 0.2 | 113.0 ± 81.7 | 0.25 |

* p-value of comparison between non-arrhythmia and tachyarrhythmia group
\# p-value of comparison between non-arrhythmia and bradyarrhythmia group

**Table 4.** Factors associated with tachyarrhythmia

| Clinical parameters | Uni-variated analysis | | | Multi-variated analysis | | |
|---|---|---|---|---|---|---|
| | Odds ratio | 95% CI | p | Odds ratio | 95% CI | p |
| Age ≥ 60 years old | 2.3 | 1.2-4.5 | 0.02 | 2.0 | 0.6-6.3 | 0.16 |
| APACHE II ≥ 25 | 3.0 | 1.5-5.8 | 0.001 | 3.2 | 1.1-9.3 | 0.04 |
| Hypertension | 1.7 | 0.9-3.3 | 0.09 | 1.6 | 0.5-5.6 | 0.48 |
| Diabetes mellitus | 2.2 | 1.1-4.2 | 0.02 | 1.3 | 0.4-4.2 | 0.70 |
| Coronary artery disease | 2.4 | 1.0-5.7 | 0.04 | 1.1 | 0.3-4.5 | 0.91 |
| Septic shock | 1.8 | 0.9-3.6 | 0.09 | 0.9 | 0.3-2.8 | 0.86 |
| ARDS | 2.1 | 1.0-4.1 | 0.04 | 1.4 | 0.5-4.0 | 0.58 |
| Dopamine | 3.9 | 1.9-8.2 | < 0.001 | 1.6 | 0.5-5.4 | 0.09 |
| Norepinephrine | 4.8 | 2.4-9.7 | < 0.001 | 4.2 | 1.4-13.0 | 0.01 |
| Adrenaline | 3.2 | 1.0-10.5 | 0.002 | 0.5 | 0.1-2.5 | 0.39 |
| Dobutamine | 4.3 | 1.4-13.4 | 0.007 | 1.4 | 0.3-7.4 | 0.70 |
| Potassium ≥ 4.5 mmol/L | 1.8 | 0.8-3.8 | 0.13 | 1.2 | 0.3-4.5 | 0.82 |
| Magnesium ≥ 2 mg/dL | 1.7 | 0.8-3.4 | 0.14 | 2.2 | 0.7-6.7 | 0.15 |
| pH < 7.3 | 1.9 | 0.8-4.2 | 0.12 | 1.1 | 0.4-3.3 | 0.89 |

tomatic sinus bradycardia, high APACHE II score ≥ 25, receiving of dobutamine and arterial blood pH < 7.3 were all significant predictors associated with worse hospital outcomes. Permanent neurological damage was detected in 6 patients, 3 (2.0%) patients in non-arrhythmic group, 2 (4.4%) in tachyarrhythmic group and 1 (1.9%) in bradyarrhythmic group.

## Discussion

The above data could be summarized that the incidence of arrhythmia in non-coronary medical ICU was substantial and this was associated with high mortality. Most arrhythmia occurred during the first week. Patients with arrhythmias were sicker on admission with higher APACHE II score, higher proportion of septic shock and ADRS. They had lower arterial blood pH and they needed more vasoactive medications including norepinephrine, dopamine and adrenaline to restore their hemodynamic status. The presence of ventricular tachycardia, junctional bradycardia and symptomatic sinus bradycardia were associated with death. Also, an APACHE II score greater than 25 and a blood pH of less than 7.3 were associated with hospital mortality.

The findings from the present study concurred with the previous one, a large cohort study,

**Table 5.** Factors associated with bradyarrhythmia

| Clinical parameters | Uni-variated analysis | | | Multi-variated analysis | | |
|---|---|---|---|---|---|---|
| | Odds ratio | 95% CI | p | Odds ratio | 95% CI | p |
| Age < 60 years old | 1.6 | 0.9-3.0 | 0.12 | 2.5 | 0.6-9.4 | 0.19 |
| APACHE II ≥ 25 | 2.3 | 1.2-4.3 | 0.01 | 0.7 | 0.2-2.8 | 0.59 |
| Hypertension | 0.5 | 0.3-0.9 | 0.03 | 0.5 | 0.1-2.5 | 0.39 |
| Diabetes mellitus | 0.5 | 0.3-0.9 | 0.04 | 1.2 | 0.2-6.8 | 0.84 |
| Septic shock | 2.1 | 1.1-4.0 | 0.03 | 1.2 | 0.3-4.8 | 0.80 |
| ARDS | 2.3 | 1.2-4.4 | 0.01 | 1.6 | 0.5-5.3 | 0.50 |
| Acute kidney injury | 2.0 | 0.9-4.4 | 0.09 | 4.0 | 0.8-20.9 | 0.09 |
| Dopamine | 3.2 | 1.6-6.6 | 0.001 | 2.2 | 0.5-10.0 | 0.24 |
| Norepinephrine | 12.5 | 6.0-26.2 | < 0.001 | 14.3 | 3.6-57.0 | < 0.001 |
| Adrenaline | 8.9 | 3.5-22.4 | < 0.001 | 3.3 | 0.5-20.0 | 0.19 |
| Potassium ≥ 4.5 mmol/L | 3.5 | 1.7-7.2 | < 0.001 | 3.6 | 0.8-15.8 | 0.09 |
| Magnesium ≥ 2 mg/dL | 2.2 | 1.1-4.5 | 0.03 | 1.0 | 0.3-3.8 | 1.00 |
| pH < 7.3 | 4.6 | 2.2-9.7 | < 0.001 | 4.5 | 1.0-20.6 | 0.05 |
| $pCO_2$ ≥ 45 | 3.5 | 1.5-8.2 | 0.003 | 1.4 | 0.3-8.5 | 0.72 |
| $pO_2$ <120 | 2.3 | 1.0-5.2 | 0.04 | 1.9 | 0.5-7.7 | 0.36 |
| $HCO_3$ < 18 mmol/L | 1.8 | 1.0-3.4 | 0.06 | 0.2 | 0.1-0.9 | 0.03 |

**Table 6.** Factors associated with Hospital mortality

| Clinical parameters | Uni-variated analysis | | | Multi-variated analysis | | |
|---|---|---|---|---|---|---|
| | Odds ratio | 95% CI | p | Odds ratio | 95% CI | p |
| APACHE II ≥ 25 | 6.2 | 3.3-11.6 | < 0.001 | 5.9 | 2.3-15.5 | < 0.001 |
| Septic shock | 2.1 | 1.2-3.5 | 0.006 | 1.2 | 0.5-2.9 | 0.70 |
| ARDS | 1.9 | 1.1-3.4 | 0.027 | 0.4 | 0.1-1.2 | 0.12 |
| Acute kidney injury | 2.1 | 1.0-4.3 | 0.05 | 1.5 | 0.4-5.0 | 0.51 |
| Dopamine | 4.2 | 2.0-8.8 | < 0.001 | 2.5 | 0.7-9.0 | 0.15 |
| Norepinephrine | 6.3 | 3.6-11.3 | < 0.001 | 0.8 | 0.2-2.8 | 0.73 |
| Adrenaline | 11.1 | 3.2-38.5 | < 0.001 | 0.4 | 0.1-3.6 | 0.38 |
| Dobutamine | 5.0 | 1.3-18.5 | 0.009 | 9.6 | 1.1-82.0 | 0.04 |
| Tachyarrhythmia | 3.5 | 1.7-6.8 | < 0.001 | 4.9 | 1.4-17.3 | 0.01 |
| Atrial fibrillation | 2.9 | 1.4-6.2 | 0.004 | 1.8 | 0.5-6.7 | 0.35 |
| Ventricular tachycardia | 5.1 | 1.0-25.0 | 0.027 | 12.6 | 1.1-147.7 | 0.04 |
| Bradyarrhythmia | 19.6 | 7.9-48.3 | < 0.001 | 20.0 | 4.2-94.4 | < 0.001 |
| Junctional bradycardia | 31.3 | 7.3-134.4 | < 0.001 | 32.2 | 4.1-254.6 | 0.001 |
| Symptomatic sinus bradycardia | 11.0 | 2.4-49.4 | < 0.001 | 11.3 | 1.3-96.3 | 0.03 |
| Potassium ≥ 4.5 mmol/L | 3.3 | 1.7-4.6 | < 0.001 | 2.2 | 0.8-6.2 | 0.14 |
| pH < 7.3 | 8.6 | 3.8-19.3 | < 0.001 | 5.2 | 1.8-15.4 | 0.003 |
| $pO_2$ < 120 | 2.5 | 1.3-4.7 | 0.004 | 1.3 | 0.5-2.9 | 0.61 |
| $HCO_3$ < 18 mmol/L | 1.9 | 1.1-3.2 | 0.016 | 0.9 | 0.4-2.2 | 0.82 |

conducted from a multicenter, non-cardiac, non-surgical, general ICU, which reported the incidence of cardiac arrhythmia of 12%[6]. New onset atrial fibrillation is the leading rhythm disturbance, followed by ventricular arrhythmia and conduction abnormality. The arrhythmia incidence of ours is significantly higher than others but new onset atrial fibrillation still characterizes the majority, followed by ventricular arrhythmia. For the bradyarrhythmia, our study disclosed higher proportions of junctional bradycardia and symptomatic sinus bradycardia. The differences in the arrhythmia incidences might be explained by the differences in the

severity of illness, the presence of sepsis, the presence of ARDS and the occurrence of multiorgan failure which might be more in our patients. When compared with patients with active coronary artery disease, the incidences of arrhythmia were comparable but the arrhythmia types were different. Ventricular fibrillation and ventricular tachycardia were found more among acute myocardial infarction patients, with reported incidences 4.4% to 20%[4,5], following by atrial fibrillation and bradycardia due to atrioventricular blockage. However, in ours, the proportion of ventricular tachycardia was 3.6%. Again, the differences in the arrhythmia types between the studies could be from differences in arrhythmia pathogenesis among patient populations.

One interesting point from our data was that the presence of cardiac arrhythmia was associated with hospital mortality. It must be considered whether the presence of arrhythmia contributed to mortality or whether this was just an epiphenomenon in the patients' devastating condition. Acute atrial fibrillation results in substantial decrement of cardiac output[9,10] and so do other tachyarrhythmias and bradyarrhythmias. Therefore, acute alteration from normal sinus rhythm would affect hemodynamics in certain extent. Already, these patients' conditions were more severe, as judged by their higher APACHE II scores. A higher score itself is generally known to be associated with higher mortality. The conclusion, for this part, was that acute arrhythmia was the consequence of critical illness and it also worsened patients' condition.

The findings of more patients with septic shock and ARDS in arrhythmia group and the association between the presence of arrhythmia and patients' condition including low arterial pH and the uses of vasoactive medications supported the pathogenesis of acute arrhythmia. Septic shock is characterized by generalized inflammation, high cytokine level, decreased coronary blood flow and increasing uses of vasopressors. All of these predisposed patients' arrhythmias. The presence of ARDS indicated serious pulmonary inflammation from local or systemic causes. Mechanical ventilation and high PEEP decrease venous return and subsequently affect cardiac output and possibly coronary perfusion. Thus, extreme physiologic changes during critically ill period, systemic inflammation, hypoxemia, metabolic disturbance, including alteration in serum potassium level[11], and the organ support measures including vasoactive agents and mechanical ventilation were the causative factor for arrhythmia. This give rise to more understanding in the nature of arrhythmia in our patients; which further, would render management plan to treat patients' causative conditions rather than terminating the altered rhythm only.

In conclusion, cardiac arrhythmia in non coronary, non surgical patients is not uncommon. The arrhythmic patients were sicker on admission and more of them had the diagnoses of septic shock and ARDS. The presence of arrhythmia was associated with increased hospital mortality and factors associated with death included severity of illness and blood pH of less than 7.3. Recognition of the nature of these conditions would emphasize to physicians the importance of better management of the patients.

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**Potential conflicts of interest**

None.

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## ปัจจัยเสี่ยงอุบัติการณ์และการพยากรณ์โรคของภาวะหัวใจเต้นผิดจังหวะในผู้ป่วยภาวะวิกฤตทางอายุรกรรม

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***ภูมิหลัง:*** *ภาวะหัวใจเต้นผิดจังหวะเป็นภาวะแทรกซ้อนที่สำคัญในผู้ป่วยภาวะวิกฤต โดยเฉพาะในผู้ป่วยหลังผ่าตัดและผู้ป่วยโรคกล้ามเนื้อหัวใจขาดเลือดเฉียบพลัน แต่ยังขาดข้อมูลเกี่ยวกับปัจจัยเสี่ยง อุบัติการณ์และการพยากรณ์โรคของภาวะนี้ในผู้ป่วยวิกฤตทางอายุรกรรม*

***วัตถุประสงค์:*** *เพื่อศึกษาปัจจัยเสี่ยง อุบัติการณ์และการพยากรณ์โรคของภาวะหัวใจเต้นผิดจังหวะในผู้ป่วยวิกฤตทางอายุรกรรมที่ไม่มีภาวะกล้ามเนื้อหัวใจขาดเลือดเฉียบพลัน*

***วัสดุและวิธีการ:*** *ศึกษาข้อมูลผู้ป่วยวิกฤตที่รับไว้ในหออภิบาลผู้ป่วยวิกฤตทางอายุรกรรม ของโรงพยาบาลศิริราช ระหว่างวันที่ 1 กันยายน พ.ศ. 2553 ถึงวันที่ 31 สิงหาคม พ.ศ. 2554*

***ผลการศึกษา:*** *ผู้ป่วยที่เข้าร่วมการศึกษาทั้งหมด 247 คน อายุเฉลี่ย 58.5 $\pm$ 20.0 ปี, ค่าเฉลี่ย APACHE II score 20.1 $\pm$ 9.8 ภาวะช็อกจากการติดเชื้อเป็นสาเหตุหลักในการรับผู้ป่วยเข้าไว้ในหออภิบาล (ร้อยละ 57.1) พบอุบัติการณ์ของภาวะหัวใจเต้นผิดจังหวะในผู้ป่วยร้อยละ 39.7 โดยผู้ป่วย 45 ราย (ร้อยละ 18.2) มีภาวะหัวใจเต้นเร็วผิดจังหวะ ซึ่งส่วนใหญ่มีสาเหตุจาก atrial fibrillation (ร้อยละ 13.8) ตามด้วย ventricular fibrillation (ร้อยละ 3.6) ผู้ป่วย 53 ราย (ร้อยละ 21.5) มีภาวะหัวใจเต้นช้าผิดจังหวะ ซึ่งส่วนใหญ่เป็น junctional bradycardia (ร้อยละ 13.8) ตามด้วย symptomatic sinus bradycardia (ร้อยละ 6.1) พบว่าการได้รับยากระตุ้นการบีบตัวของหลอดเลือดชนิด norepinephrine และการมี APACHE II score $\geq$ 25 เป็นปัจจัยเสี่ยงที่สำคัญของการเกิดภาวะหัวใจเต้นเร็วผิดจังหวะ ในขณะที่การได้รับยา norepinephrine ภาวะเลือดเป็นกรด (pH < 7.3) และการมี $HCO_3$ $\geq$18 เป็นปัจจัยเสี่ยงของการเกิดภาวะหัวใจเต้นช้าผิดจังหวะ ผู้ป่วยที่มีภาวะ ventricular fibrillation, symptomatic sinus bradycardia และ junctional bradycardia สัมพันธ์กับอัตราตายที่สูงขึ้น*

***สรุป:*** *ภาวะหัวใจเต้นผิดจังหวะเป็นภาวะแทรกซ้อนที่รุนแรงของผู้ป่วยวิกฤตทางอายุรกรรมโดยมีความสัมพันธ์กับอัตราการเสียชีวิตที่สูงขึ้น การรักษาภาวะช็อกอย่างเหมาะสม ร่วมกับการปรับภาวะสมดุลทางเมตาบอลิซึมของร่างกายอาจลดการเกิดภาวะหัวใจเต้นผิดจังหวะและอัตราการเสียชีวิตของผู้ป่วยได้*