

## ORIGINAL RESEARCH

# Prevalence of myocardial infarction in congestive heart failure patient at emergency room of Rajavithi Hospital

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## Abstract

**Background:** Congestive heart failure is a common condition and along with myocardial ischemia is a global public health problem. In the emergency room, myocardial infarction and uncontrolled hypertension are also found among patients who present with dyspnea from congestive heart failure. Therefore, the researchers chose to study the prevalence of acute myocardial infarction in congestive heart failure patients who presented at the emergency room of Rajavithi Hospital. Improving the screening of patients presenting at the emergency room with congestive heart failure will produce better treatment in the future.

**Objectives:** To determine the prevalence of acute myocardial infarction and prevalence of preserved left ventricular function of patients who present at the emergency room of Rajavithi Hospital.

**Method:** The study enrolled 91 heart failure patients who presented at the emergency room of Rajavithi Hospital from 1 July 2011 to 31 August 2012. A cross-sectional descriptive study was conducted to determine the prevalence of acute myocardial infarction based on universal definition of myocardial infarction and prevalence of heart failure with preserved left ventricular function. The data were collected from medical records of patients. Statistics and data analysis included percentage, mean and standard deviation using the SPSS version 11.5.

**Results:** Of the patients, 91 were female (53.8%), mean age was  $66.406 \pm 12.52$  years, main underlying diseases were hypertension and diabetes mellitus. The prevalence of myocardial infarction in this study was 14.13% (13 patients), and patients with an acute myocardial infarction association were male. The overall body height was higher than in subjects having diabetic mellitus with chronic kidney disease. Patients and CK-MB enzyme level elevations were higher compared with those without myocardial infarction. Mean left ventricular ejection fraction was  $44.996 \pm 18.894\%$ , and preserved left ventricular function was 51.6% (47 patients). Therefore, depressed left ventricular function was significantly found among male patients when compared with the preserved left ventricular function group.

**Conclusion:** The prevalence of myocardial infarction in congestive heart failure patients was studied. Male patients having diabetes mellitus or chronic kidney disease should be more concerned about myocardial infarction than other population groups. Preserved left ventricular function was associated with a few heart failure cases. Males require earlier detection of the left ventricular function than females.

## Key words

Congestive heart failure (CHF), Myocardial infarction (MI), Preserved Left Ventricular Systolic function (LVEF)

## 1 Introduction

Congestive heart failure is a common condition and a worldwide public health problem. Currently with more than 20 million patients and it continues increasing especially among elderly populations<sup>[1]</sup>. In Thailand, relatively little data is available. However, patients with heart failure are often hospitalized with symptoms of dyspnea. Heart failure patients can be divided into two groups:

- 1) Heart failure with depressed left ventricular function of the left ventricular (LVEF <40%)
- 2) Heart failure with preserved left ventricular function (LVEF  $\geq$  40%). Heart failure with normal left ventricular function comprises 40%-60% of all patients with heart failure. In addition, myocardial ischemia is a common problem in public health worldwide. The majority of patients with symptoms of acute myocardial infarction<sup>[1]</sup> often have problems in terms of chest pain, chest discomfort and angina pectoris. However, patients with myocardial infarction present no angina pectoris and myocardial ischemia can present without symptoms (silent myocardial ischemia or asymptomatic myocardial ischemia).

Patients presenting dyspnea come to the emergency room for many reasons but the most common is myocardial infarction and high blood pressure.

Therefore, the researcher has conducted this study to examine the prevalence of acute myocardial infarction in patients from the emergency room with heart failure. Detecting myocardial ischemia follows the Criteria of Universal Definition<sup>[2]</sup> in patients with dyspnea at the emergency room and heart failure is diagnosed, according to the Framingham criteria<sup>[3]</sup>. In 1993, Kalon KL and colleagues studied the epidemiology of heart failure patients in the Framingham study (The Epidemiology of Heart Failure: The Framingham Study) and found that heart failure in patients over age 45 years in males occurred in 7.2 cases per 1,000 patients and for female patients 4.7 cases per 1000 patients. The criteria for a diagnosis of heart failure using the Framingham criteria is based on either two major criteria or one major criterion with two minor criteria in the diagnosis of congestive heart failure<sup>[3]</sup>. In 1998, Mihai G and the Board conducted a review of research related to heart failure (Chronic Heart Failure in the United States a Manifestation of Coronary Artery Disease), a randomized multicenter trial published in NEJM from BC<sup>[4]</sup>. In 1986, a total of 13 issues reported that the prevalence of myocardial infarction was 68% in patients with congestive heart failure<sup>[5]</sup>. In 1999, Ramachandran S, *et al.* conducted a study of 73 patients with heart failure using the Framingham Heart Study (Congestive Heart Failure in Subjects with Normal Versus Reduced Left Ventricular Ejection Fraction Prevalence and Mortality in a Population-Based Cohort) reporting that 51% of the compression of the left ventricular was normal (normal LVEF) and found more often in women than men<sup>[6]</sup>.

In 2000, Barry FU and colleagues conducted a study (Autopsy in Heart Failure Patients with Sudden Death Results from the Assessment of Treatment with Lisinopril and Survival (ATLAS) trial) to check the operation of acute coronary syndrome among autopsies of patients who died suddenly. The study reported that the conditions of acute coronary syndrome totaled 33%, and those who had vascular disease and coronary heart disease comprised 54% of all 171 patients examined. The study found that the risk of acute coronary syndrome is common and often asymptomatic, making diagnosis difficult in patients with congestive heart failure especially in patients who died suddenly<sup>[7]</sup>. In 2004, Karen H and the Board reviewed research data from ten patients with heart failure who experienced a squeeze (Heart Failure with Preserved Left Ventricular Systolic Function, Epidemiology, Clinical Characteristics, and Prognosis). Left ventricular function was usually between 40% and 71% and compression of the left ventricles was on average 56%<sup>[5]</sup>.

In 2007 and 2012, Kristian T *et al.* provided new diagnostic criteria shared between ESC/ACCF/AHA/WHF Task Force to determine the criteria for the diagnosis of myocardial infarction (the Universal Definition of Myocardial Infarction). Huxley also shared a similar finding <sup>[2, 9]</sup>.

Our study aimed to improve the screening and treatment of patients presenting at the emergency room with heart failure.

### 1.1 Primary objective

To study the prevalence of myocardial infarction in congestive heart failure patients who present at the emergency room of Rajavithi Hospital

### 1.2 Secondary objective

To study the prevalence of heart failure with normal left ventricular function at the emergency room of Rajavithi Hospital.

Definition: Congestive heart failure was diagnosed using the Framingham criteria <sup>[3]</sup>.

### 1.3 Major criteria

The major criteria include: Paroxysmal nocturnal dyspnea, neck vein distension, rales, radiographic cardiomegaly (increasing heart size on chest X-ray film), acute pulmonary edema, third sound gallop, increased central venous pressure (>16 cm water at the right atrium), circulation time  $\geq 25$  seconds, hepatojugular reflux, pulmonary edema, visceral congestion or cardiomegaly at autopsy and weight loss  $\geq 4.5$  kg in five days in response to treatment of CHF.

### 1.4 Minor criteria

Minor criteria include bilateral ankle edema, nocturnal cough, dyspnea on ordinary exertion, hepatomegaly, pleural effusion, decrease in vital capacity by 33% from maximal value record and tachycardia (rate  $\geq 120$  beats/min).

The diagnosis of heart failure must have at least two major criteria or one major criterion with two minor criteria by which the minor criteria must not have any other medical disease or cause for the minor criteria.

Myocardial infarction was diagnosed using the Universal Definition of Myocardial Infarction and was diagnosed when any of the following occurred <sup>[2]</sup>:

- 1) An increase or reduction of cardiac biomarkers (should be troponin) that was detected at least once higher than 99th percentile of the upper reference limit (URL) together with evidence of the occurrence of myocardial ischemia following at least one item listed below.
  - a) Symptoms of ischemia
  - b) Changes in the electrocardiogram (ECG) to suggesting new ischemia (new ST-T)
  - c) Changes or new left bundle branch block, LBBB
  - d) Caused pathological Q wave in the ECG
  - e) Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality
- 2) Sudden unexpected cardiac death, including cardiac arrest with symptom of myocardial ischemia and new ST elevation or new LBBB and fresh thrombus confirmed by coronary angiography or autopsy.
- 3) Patients are treated by percutaneous coronary interventions (PCI), where the baseline troponin is usually the addition of biomarkers beyond the 99th percentile of the URL. It indicates peri-procedural myocardial necrosis, when more than five times the 99th percentile of the URL. It is a PCI-related myocardial infarction involving stent thrombosis.

When the PCI patients' baseline troponin does not come down to normal, it may be useful to increase the levels of biomarkers, particularly troponin or CK-MB levels before PCI more than 50%.

- 4) For patients receiving coronary artery bypass grafting (CABG), the baseline troponin usually shows an increase in the biomarker over the 99th percentile of the URL indicating peri-procedural myocardial necrosis, particularly if more than 10 times. The 99th percentile of the URL is associated with a new pathological Q wave, new LBBB or when injection angiography was found to have occlusion of graft or native coronary artery or imaging, and evidence of loss was found of viable myocardial count as CABG-related myocardial infarction.
- 5) Pathological results compatible with the diagnosis of acute myocardial infarction<sup>[8]</sup>.

## 1.5 Prior myocardial infarction

The criteria for diagnosis require any of the following<sup>[2]</sup>:

- 1) A new pathological Q wave (with or without any symptoms).
- 2) Detected imaging evidence of a region loss of viable myocardial (thin and without compression) without nonischemic cause.
- 3) Pathological examination revealing healed or healing myocardial infarction.

## 1.6 Detection of the ejection fraction

The results of the echocardiogram from the examination of the Heart Unit of Rajavithi Hospital evaluated ejection fraction using the Teicholz technique. Heart attack symptoms are checked before in a period not exceeding one year, or after the onset of cardiac arrest in a period not exceeding one month.

- 1) The ejection fraction of the left ventricular greater than or equal to 40% to be Preserved Ejection fraction.
- 2) Values ejection fraction of the left ventricular less than 40% is considered Depressed Ejection fraction<sup>[1, 3, 5, 8]</sup>.

## 2 Method

The retrospective cross-sectional descriptive study enrolled a total of 102 patients with symptoms of heart failure, who attended the emergency room at Rajavithi Hospital from 1 July 2011 to 31 August 2012.

Selection Criteria Volunteer Program: Inclusion criteria included patients aged 40 years or more, diagnosis of dyspnea or other symptoms diagnosed with heart failure and admitted to the emergency room at Rajavithi Hospital 1 July 2011 to 31 August 2012. Criteria included distinguished volunteers from the project. Exclusion criteria included fatigue or other symptoms or signs of doubt in the diagnosis of heart failure. Diagnostic criteria considered conditions or prohibitions in the diagnosis of myocardial ischemia. Subjects willingly gave their consent to participate and could freely withdraw consent to participate. The selection criteria were provided for patients participating in this research. Patients received a description of the research objectives and explanation of treatment benefits and adverse effects. Patients that participated in the study signed the informed consent form using a code number instead of name data. Tests included Cardiac enzyme Troponin-T, CPK, CK-MB in patients with congestive heart failure to detect myocardial infarction and the result was recorded in the patient record form. Data regarding the heart (echocardiogram) was collected by maintaining compression of the left ventricular (ejection fraction) standard to detect early symptoms of heart attacks in a period not exceeding one year or postnatal heart. Attack in a period not exceeding one month, was noted in the patient record form. After collecting data from all the subjects, statistical analysis using SPSS version 11.5 for window was performed and the findings were presented in the form of a number, percentage, mean, standard deviation, median and range as appropriate. Different data were compared using chi square and independent *T*-test.

### 3 Results

Of a total of 102 patients, 11 were excluded shown in Figure 1. The majority, 91 patients, were female 53.8%, mean age  $66.41 \pm 12.52$  years, mean weight  $59.96 \pm 12.21$  kg, mean height  $156.75 \pm 8.07$  cm and mean BMI  $24.42 \pm 4.71$  kg/m<sup>2</sup>. Systolic Blood Pressure averaged  $128.53 \pm 23.88$  mmHg, while Diastolic Blood Pressure averaged  $76.79 \pm 17.29$  mmHg for patients with controlled blood pressure criteria. Patients with diabetes or renal disease with blood pressure controlled favorably had scores less than 130/80 mmHg while patients with other diseases had a threshold blood pressure controlled favorably at less than 140/90 mmHg. In addition, 62.6% of the co-morbidities of the patients were found to be the main associated factor. Regarding disease, hypertension was found among 64.8%, while 51.6% had diabetes as shown in Table 1.

In this study of the prevalence of acute myocardial infarction in patients from Rajavithi Hospital 13 subjects had congestive heart failure (14.13%) while patients with left ventricular function averaged  $44.99 \pm 18.89\%$ . Comparing depressed left ventricular function with those without acute myocardial infarction  $35.85 \pm 14.98$  vs.  $46.52 \pm 19.13$ , did not show significant difference. Preserved left ventricular ejection fraction comprised 47 patients (51.6%). The group with acute myocardial infarction usually tended to have decompressed left ventricular function less than those without acute myocardial infarction (38.5% vs. 53.8%) but without significance. Comparing patients with heart failure, the acute myocardial infarction was usually associated with men, height of the body, having diabetes, renal failure and CK-MB elevations were significantly higher compared with those without myocardial ischemia. Table 1 shows the baseline characteristics. The group with preserved left ventricular ejection fraction  $\geq 40\%$  and above and the group with the depression of the left ventricular ejection fraction below normal were the two groups that had similar baseline characteristics. Male patients were significantly more likely to have the depression of the left ventricular ejection fraction as shown in Table 2.

**Table 1.** Baseline characteristics of patients

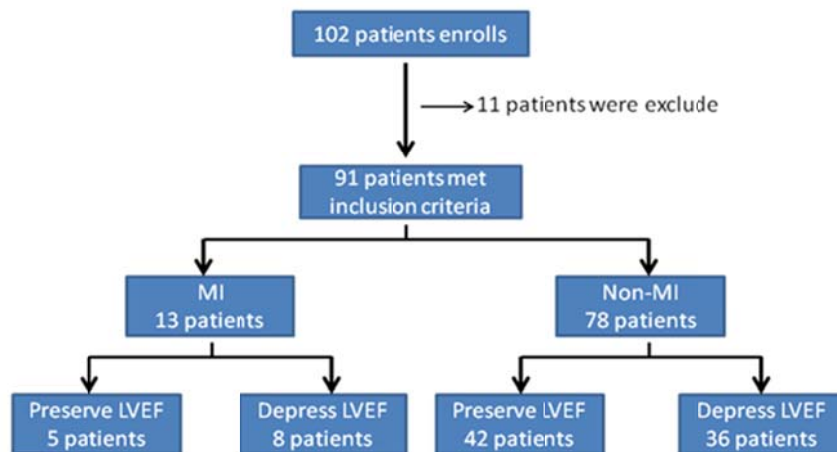
	MI (13)	No MI (78)	Mean (91)	p-value
Age	65.54±8.42	66.55±13.11	66.41±12.52	.829
Female	2 (15.4%)	47 (60.3%)	49 (53.8%)	<b>.003</b>
Weight	63.96±10.25	59.29±12.43	59.96±12.21	.152
Height	163.69±6.68	155.59±7.73	156.75±8.07	<b>.029</b>
Body mass index	23.82±3.087	24.52±4.93	24.42±4.71	.423
Overweight (BMI>23)	6 (46.2%)	44 (56.4%)	50 (54.9%)	.696
Average SBP	131.62±29.91	128.01±22.91	128.53±23.88	.314
Average DBP	74.77±18.53	77.13±17.17	76.79±17.29	.309
Average pulse	96.23±19.27	87.19±21.98	88.48±21.74	.499
Well controlled BP	7 (53.8%)	41 (52.6%)	48 (52.7%)	.932
Hypertension	11 (84.6%)	48 (61.5%)	59 (64.8%)	.107
DM	10 (76.9%)	37 (47.4%)	47 (51.6%)	<b>.049</b>
Dyslipidemia	3 (23.1%)	21 (26.9%)	24 (26.4%)	.771
CKD	9 (69.2%)	17 (21.8%)	26 (28.6%)	<b>&lt; .001</b>
CAD	6 (46.2%)	23 (29.5%)	29 (31.9%)	.232
Valvular heart	1 (7.7%)	12 (15.4%)	13 (14.3%)	.463
Average CPK	481.54±531.14	92.47±64.48	148.05±244.77	.315
Average CK-MB	59.62±63.43	24.45±11.72	29.47±28.41	<b>.028</b>
Average LVEF	35.85±14.98	46.52±19.13	44.99±18.89	.825
Preserved LVEF	5(38.5%)	42 (53.8%)	47(51.6%)	.304

Note. SBP = Systolic blood pressure, BP = Blood pressure, DBP = Diastolic blood pressure

DM = diabetes mellitus, CKD = Chronic kidney disease, CAD = Coronary artery disease

**Table 2.** Preserved LVEF and Depress LVEF

	Preserved LVEF (47)	Depress LVEF (44)	Mean (91)	p-value
Age	70.26±12.03	62.30±11.81	66.41±12.52	.135
Female	35 (74.5%)	14 (31.8%)	49 (53.8%)	< .001
Weight	59.25±10.99	60.72±13.47	59.96±12.21	.222
Body mass index	24.85±4.91	23.96±4.49	24.42±4.71	.395
Overweight (BMI>23)	26 (55.3%)	24 (56.8%)	50 (54.9%)	.156
Well control BP	24 (51.1%)	24 (54.5%)	48 (52.7%)	.740
Hypertension	34 (72.3%)	25 (56.8%)	59 (64.8%)	.121
DM	27 (57.4%)	20 (45.5%)	47 (51.6%)	.253
Dyslipidemia	13 (27.7%)	11 (25.0%)	24 (26.4%)	.774
CKD	10 (21.3%)	16 (36.4%)	26 (28.6%)	.111
CAD	12 (25.5%)	17 (38.6%)	29 (31.9%)	.180
Valvular heart	8 (17.0%)	5 (11.4%)	13 (14.3%)	.441
Average CPK	128.81±227.96	168.61±262.63	148.05±244.77	.442
Average CK-MB	29.23±35.67	29.73±18.12	29.47±28.41	.313
Average LVEF	60.23±12.89	28.72±6.66	44.99±18.89	<.001
Myocardial ischemia	5 (10.6%)	8 (18.2%)	13 (14.3%)	.304



**Figure 1.** Population of study flow

**Table 3.** Left Ventricular ejection fraction

	MI (13)	No-MI (78)	Total (91)
LVEF*			
< 20%	1 (7.7%)	3 (3.8%)	4 (4.4%)
20% – 30%	3 (23.1%)	9 (11.5%)	12 (13.2%)
30% – 40%	4 (30.8%)	24 (30.8%)	28 (30.8%)
40% – 50%	2 (15.4%)	10 (12.8%)	12 (13.2%)
50% – 60%	2 (15.4%)	8 (10.3%)	10 (11.0%)
≥ 60%	1 (7.7%)	24 (30.8%)	25 (27.5%)

\* P-value = .552

Comparing the left ventricular ejection fraction in patients in the two groups showed that patients without acute myocardial infarction tended to have good of left ventricular ejection fraction above average, but not significant as shown

in Table 3. Likely to be Preserved left ventricular ejection fraction (LVEF  $\geq$  50%) was more likely but without significance.

## 4 Discussion

The main cause of heart failure is myocardial ischemia. The causes range from 33% to 68% while this study found myocardial infarction at only 14.13% of patients with valvular heart disease. The heart valve disease can cause heart attack and heart failure without associated acute myocardial infarction. Therefore, the numbers of patients with acute myocardial infarction were fewer in this study than other studies. Data was collected only from patients with myocardial ischemia with myocardial enzyme values. For unstable angina patients, this symptom of acute coronary syndrome causes heart attack stimulation. Therefore, the low number of patients with myocardial infarction may have been caused by fewer patients with myocardial infarction in the study than in other studies. Our study revealed the preserved left ventricular normal at 51.6%, and the depressed left ventricular function to be average,  $44.99\% \pm 18.89\%$ . Previous studies have reported these in the range 40 to 71%, similar to this study. However, when comparing the two groups between myocardial ischemia, our study was more likely to have compression of the left ventricular rates less than those without myocardial ischemia but without significance. This study showed that the left ventricular ejection fraction was impossible to separate from myocardial infarction. Moreover, left ventricle ejection fraction normally can occur cause a heart failure, also known as the preserved systolic function heart failure. Patients in the group with depressed left ventricular ejection fraction were below normal and more commonly found in males significantly. It may be due to males having a risk factor in the occurrence atherosclerosis, coronary artery disease and others. The study found that male patients tended to have myocardial infarction more prevalently. Therefore, patients with depression of the left ventricular ejection fraction were lower in this study. Comparing baseline characteristics of patients between myocardial ischemia and those without myocardial infarction revealed the group with myocardial infarction were males, diabetics, presented renal disease with significant association. The subjects were more likely to be male and have diabetes, a risk factor for atherosclerosis in the coronary arteries. That is more likely to cause acute myocardial infarction. In addition, chronic renal failure is a chronic condition that increases the chance of atherosclerosis. Similarly, the high incidence of myocardial infarction is associated with the risk factors for coronary artery disease, and other related conditions such as high blood pressure. It was higher than in the group with acute myocardial infarction, but it did not differ significantly probably due to the small sample size. Further, it was not the primary objective of this study. The values for myocardial enzyme (CK-MB) was found in the group with myocardial infarction were significantly higher. This was because the diagnosis of acute myocardial infarction is according to the universal definition that requires having the enzymes of myocardial infarction higher than the 99th percentile of the upper normal limit, always involving those with myocardial infarction with the enzyme. In this regard they also found that the two groups differed significantly. The group associated with myocardial infarction had greater body height than the other groups. However, because the number of patients with myocardial infarction comprised only 13 cases, of the deviations from the average could be a possible bias. This research did not intend to study height as the main focus.

## 5 Conclusion

The study investigated the prevalence of myocardial infarction in congestive heart failure patients. Male patients presenting diabetes mellitus or chronic kidney disease should be more concerned about myocardial infarction than other populations. Preserved left ventricular function was held a low association to heart failure. Males should to investigate left ventricular function more than females.

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