

# Silent cardiac abnormalities in medical ICU patients: Egyptian experience

Elham S. Said<sup>a</sup> and Maggie B. Abadeer<sup>b</sup>

<sup>a</sup>Department of Internal Medicine, Kasr El Ainy Hospital, Cairo University and <sup>b</sup>Embaba General Hospital, Egyptian Ministry of Health, Giza, Egypt

Correspondence to Elham S. Said, Department of Internal Medicine, Kasr El Ainy Hospital, Cairo University, 94 Ouray Street El Mohandseen, Giza, Egypt  
Tel: +20 100 578 1440;  
e-mail: elhamsobhy61@hotmail.com

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## Background

Patients hospitalized in medical ICUs (MICUs) with acute noncardiac illnesses may have underlying cardiovascular abnormalities, especially in Egypt where rheumatic heart disease is still frequently encountered. This may affect the diagnosis and/or plan of management. Routine cardiac examination may not be informative because of the acuteness of the illness and the need for frequent concurrent mechanical ventilation.

## Purpose

The purpose of this study was to utilize transthoracic echocardiography to define cardiac abnormalities, especially rheumatic valve disease that may be present in noncardiac patients.

## Materials and methods

Over a 4-month period, 75 patients without primary cardiac diagnoses admitted to the MICU of Kasr El Ainy hospital underwent transthoracic echocardiography (TTE). The MICU mortality rates and length of stay were compared in patients with and without significant cardiac abnormalities.

## Results

One or more cardiac abnormalities were observed in 61.3% patients of the studied group. Of these abnormalities, 15% were rheumatic in origin. Right atrial and right ventricular dilatation were the most encountered lesions, followed by left ventricular hypertrophy and pulmonary hypertension. Although there was no correlation between the presence of cardiac abnormalities and the length of ICU stay or mortality, the plan of management was affected in 14.67% of patients.

## Conclusion

A significant proportion of patients admitted to the MICU with noncardiac illness had underlying cardiac abnormalities, and this affected the plan of management in a significant number of patients.

## Keywords:

cardiac diagnoses, critical care, echocardiography, ICU, rheumatic heart disease, transthoracic

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## Introduction

In the modern world, cardiovascular disease represents a pandemic causing high morbidity and mortality. Traditionally, morbidity and mortality rates are directly attributable to the original cardiovascular disease, such as myocardial infarction and congestive heart failure. In addition to coronary artery disease and hypertension, which constitute the major brunt of cardiovascular disease, rheumatic heart disease is still frequently encountered in Egypt.

However, the impact of cardiovascular disease on the course of a major medical illness, when it occurs concurrently, has not been fully elucidated.

The patient population admitted to medical ICUs (MICUs) is inhomogeneous, consisting of both sexes and with variable ages. The noncardiac diseases responsible for admission to the MICU are diverse and usually include infection; shock; pneumonia and other forms of respiratory failure; acute and chronic renal or hepatic insufficiency;

cerebrovascular diseases; hematological and autoimmune crises such as lupus, encephalitis, or nephritis; and severe metabolic problems such as diabetic ketoacidosis.

The cardiovascular abnormalities that may be concurrent with noncardiac illness can be missed and may pass undiagnosed if the physician depends solely on the clinical exam because of acuteness of the illness and the need for frequent concurrent mechanical ventilation.

## Purpose

The aim of this study was to evaluate the prevalence of cardiovascular abnormalities present in a series of patients who were admitted to the MICU and also to relate the presence of cardiovascular abnormalities to the clinical outcomes.

TTE and Doppler techniques were used to detect and characterize the underlying cardiac abnormalities, with special attention to rheumatic lesions.

## Materials and methods

Patients who were admitted with primary noncardiac diagnoses over a 4-month period to the Intensive Care Unit of the Internal Medicine Department (MICU) at Kasr El Ainy Hospital, which is a 11-bed ICU, constitute the study population.

Within 24–36 h of MICU admission, all patients underwent a complete transthoracic two-dimensional echocardiographic and Doppler examination using commercially available ultrasound equipments (Esaouti My Lab 30 CV, 7300; Esaouti Company, Genoa, Italy).

The process was one of the routine procedures undertaken for patient care; therefore, no consent was deemed necessary.

Echocardiographies were performed from multiple transthoracic ultrasound windows. Attempts were made to acquire the parasternal long-axis and short-axis, apical four-chamber and two-chamber, subcostal, and suprasternal views. Pulsed and continuous wave Doppler interrogations were performed for all four cardiac valves to evaluate the spectral profile of the flow during both diastole and systole. The lesions in the valves are considered rheumatic when there is thickening and deformities with or without calcification.

All echocardiograms were interpreted by senior, experienced medical staff working in the ICU.

When one or more abnormalities were observed, the physician responsible for the patient's care was notified of the abnormality.

ECGs were reviewed for all patients for underlying rhythm, the presence of chamber enlargement, and evidence of myocardial infarction, ischemia, or major repolarization abnormalities. Patients with persistent abnormal rhythms other than sinus rhythm, e.g., AF, or evidence of myocardial ischemia or infarction were excluded from the study.

The severity of the illness at the time of admission to the MICU was determined using the Acute Physiology and Chronic Health Evaluation (APACHE) II score. Patients with similar admitting diagnoses were pooled into six diagnostic groups composed of five to 22 patients each. Patients ( $n = 11$ ) with infrequent admitting diagnoses that did not fall into one of the six diagnostic groups were pooled as 'other'.

## Statistical analysis

Data were statistically described in terms of mean  $\pm$  SD, median and range, or frequencies (number of cases) and percentages, when appropriate. Comparison of the numerical variables between the study groups was carried out using the Student *t*-test for independent samples when comparing two normally distributed groups and with the Mann–Whitney *U*-test for independent samples when not normally distributed. For comparing categorical data, the  $\chi^2$ -test was performed. The exact test was used when the expected frequency was less than 5. *P* values less than 0.05 were considered statistically significant. All statistical calculations were performed using the Statistical Package for the Social Science (SPSS Inc., Chicago, Illinois, USA) computer program, version 15 for Microsoft Windows.

## Results

### Patient population

Over a 4-month period, 75 patients without histories of clinically pertinent cardiac disease underwent two-dimensional echocardiography and Doppler studies within 24–36 h of admission to the MICU. The mean age was  $47.69 \pm 16.65$  (range from 16 to 76 years); 38 were female patients and 37 were male patients. The patient demographics are presented in Table 1.

The patient population according to the admitting diagnosis is presented in Table 2.

The Prevalence of Specific Cardiac Abnormalities and the percentage of the affected patients are presented in Table 3.

Rheumatic heart lesions were encountered in seven patients, representing 9% of the studied population and 15% of the patients with abnormal echocardiograms; five were female patients and two were male patients with an age range of 16–56 years. The lesions were characterized with thickened deformed leaflets, and calcification was encountered in some patients; seven patients were excluded from the diagnosis of being rheumatic because of uncertainties on the nature of the valve lesion. These patients were older in age and the thickening and calcification revealed in their echocardiograms could be attributed to a degenerative process instead being of a rheumatic origin.

Figure 1 represents the percentage of patients with abnormal echocardiograms compared with those with normal ones.

**Table 1 Patient demographics**

Variables	Patients with significant cardiac lesions ( $N=46$ )	Patients with no cardiac lesions ( $N=29$ )	Significance
Age	$50.04 \pm 16.53$	$44.03 \pm 16.44$	NS
Sex			
Male	22	14	NS
Female	24	15	NS
APACHE II score	$21.07 \pm 9.535$	$16.66 \pm 9.0$	Significant ( $P < 0.05$ )
Predicted % mortality	$37.24 \pm 22.94$	$26.55 \pm 21.54$	Significant ( $P < 0.05$ )
LOS (days)	8.2	10.34	NS
Number of deaths [ $N$ (%)]	27 (58.7)	18 (62.1)	NS

APACHE, Acute Physiology and Chronic Health Evaluation; LOS, length of hospital stay.

**Table 2 Patient population according to the admitting diagnosis**

Diagnostic group	Number of patients	Percentage of the study group	APACHE II score	Predicted percentage ICU mortality	Percentage of affected patients from the diagnostic group
Neurological	22	29.3	15.9	28.73	45.45
Respiratory failure	10	13.3	18.7	29.3	90
Septic shock	7	9.3	27.29	55.71	71.4
Endocrine	6	8	18.67	28.33	16.7
ESRD	13	17.3	26.92	48.46	76.9
Liver cell failure	5	6.6	21.8	28	40
Others	12	16	12.67	19	75

APACHE, Acute Physiology and Chronic Health Evaluation; ESRD, end stage renal disease.

**Table 3 Prevalence of specific cardiac abnormalities**

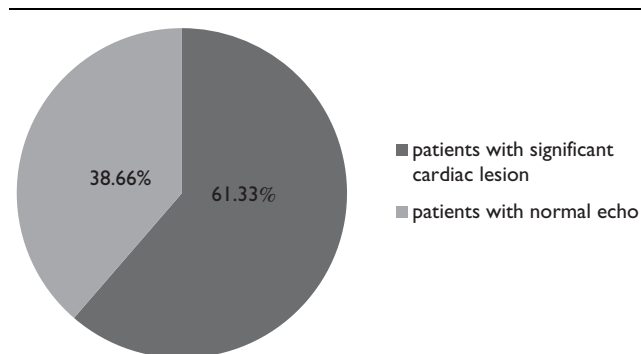
Echocardiographic abnormality	Affected patients among all studied patients (N=75) [N (%)]
Dilated right atrium and ventricle	18 (24)
Pulmonary hypertension EPAP > 35 mmHg	15 (20)
Left ventricle hypertrophy	15 (20)
Aortic regurge	5 (6.67)
Mitral regurge	13 (17.33)
Moderate-to-severe tricuspid valve regurgitation	10 (13.33)
Dilated left atrium > 4 cm	6 (8)
Dilated aortic root > 3.7	5 (6.67)
Valve vegetations	4 (5.33)
Left ventricle systolic dysfunction ejection fraction < 40%	4 (5.33)
Moderate-to-severe pericardial effusion	3 (4)
Patent foramen ovale	2 (2.67)
Pericardial deposits	1 (1.33)

EPAP, estimated pulmonary arterial pressure.

(20%), and patent foramen ovale, which was detected in one patient (10%).

The following highest incidences were detected in the group of patients with end-stage renal disease, with 76.4% of patients affected. The cardiac lesions included dilated left atrium in four patients (30%); LVH in three (23%); moderate-to-severe pericardial effusion, moderate-to-severe MR, and moderate-to-severe pulmonary hypertension in two patients each (15.3%); and mitral valve endocarditis and a profile suggestive of ischemic cardiomyopathy in one patient each (7.6%).

Five patients (71.4%) of the seven in the group of patients with septic shock had abnormal echocardiograms. The lesions included pulmonary hypertension and dilated right side of the heart in four of the five patients, dilated left atrium in three patients, and dilated left ventricle in two, with impaired contractility in one.

**Figure 1**

Percentage of patients with significant cardiac lesions to those with normal echocardiograms.

Neither the length of hospital stay nor the mortality was significantly different between the two groups. Nevertheless, the plan of management was altered in about 14% of patients.

The highest incidence of rheumatic heart disease was detected in patients with respiratory failure (90%). In addition to pulmonary hypertension, which occurred in seven of 10 patients (70%), the other abnormalities included left ventricular hypertrophy (LVH) and dilated aortic root, which were detected in two patients each

## Discussion

Bedside TTE provides rapid and noninvasive hemodynamic assessment of critically ill patients. Cardiac abnormalities are common in critically ill patients and may be unsuspected on clinical grounds despite their hemodynamic significance [1].

Echocardiography can noninvasively elucidate cardiac structure and mechanical function. It can help in the diagnosis of a wide spectrum of cardiovascular abnormalities and guide therapeutic management [2].

The easiest and least invasive method for imaging cardiac structures is echocardiography by the transthoracic approach. This noninvasive imaging modality is of great value in the critical care setting because of its portability, widespread availability, and rapid diagnostic capability [2]. It also allows for procedures at the bedside that previously required transport to the radiology unit. This is an important advantage in the critically ill patient as it prevents many of the potential complications that are known to occur during patient transport out of the ICU [3].

In the ICU, TTE may in certain cases fail to provide adequate image quality because of factors that can potentially hinder the quality of the ultrasound signal [4]. However, significant improvements in transthoracic imaging with the advent of harmonics and contrast and digital technologies have resulted in a lower failure rate.

As a result of the significantly improved technical quality of TTE imaging, the majority of ICU patients can be satisfactorily studied using this modality [2].

Bossone *et al.* [5] studied 467 patients in medical ICUs with noncardiac complaints and reported that 36% of them had significant cardiac lesions. Physician notification on the basis of a major cardiovascular abnormality was deemed necessary in a total of 52 patients (11%). The echocardiographies were done by experienced cardiologists. In our study, 61% of the studied group had significant cardiac lesions and the diagnosis and/or the plan of management was changed in 14% of patients. The percentage of patients with abnormal echocardiograms is almost double than that reported in the previous study.

This may be due to the tolerability of the general Egyptian population to disease manifestations which is probably higher than that of the studied population. Ethnic differences in the perception, experience, and impact of pain have received growing attention in recent years. People in general perceive pain but react to it with their own individual emotions and behaviors. Cognitive processes involving attention, anxiety, sociocultural learning, and experiences exert a powerful influence on the pain process [6]. Pain tolerance seems to have more clinical utility because medical attention is sought more often for intolerance of pain and discomfort than for pain perception or threshold [7]. We should also take into consideration the socioeconomic level of a large sector of the Egyptian population that renders seeking medical help an unaffordable luxury. The second possible attributing factor is rheumatic heart disease, which still represents a danger to Egyptians.

Joseph *et al.* [8] reported that a comprehensive TTE resulted in a change of management in 51% of patients who were in shock. Similarly, Kaul *et al.* [9] reported that a formal TTE had a high level of agreement with the pulmonary artery catheter findings in patients with hemodynamic compromise and provided complementary information in cases with discordance.

The most commonly encountered lesion was right atrial and ventricular dilatation, which was detected in 18 patients, followed by elevated pulmonary artery pressure, which was detected in 15 patients. The presence of dilated right cardiac chambers without concomitant pulmonary hypertension can be explained by the occurrence of intermittent pulmonary hypertension. This pulmonary hypertension may occur during transient hypoxia, as that resulting from sleep apnea syndrome [10], or during exercise [11]. This can result in episodic elevation of pulmonary pressure leading to dilatation of the right cardiac chambers. The resting pulmonary pressure in these patients may be normal.

The group of patients with respiratory failure had the highest prevalence of cardiac disorders (90%). These patients were included in the study, although right ventricular enlargement and pulmonary hypertension were expected because ischemic heart disease (IHD) and chronic obstructive pulmonary disease (COPD) often coexist. In COPD, the greatest period of vulnerability to

morbidity and mortality occurs during acute exacerbations [12]. Importantly, it is during lung attacks that patients are more susceptible to heart attacks. Cardiac failure during acute COPD exacerbations can be difficult to diagnose clinically, particularly when the changes are mild.

Echocardiography can be used as a diagnostic aid for determining the ejection fraction and diagnosing heart failure [13].

In our group of patients, we did not encounter patients with echocardiographic findings suggestive of IHD (e.g. wall motion abnormality and systolic failure). Other significant lesions that were found in addition to pulmonary hypertension and right ventricular dilatation were LVH, which was detected in three patients, dilated aortic root in two, and patent foramen ovale in one.

The second group that had a higher prevalence of abnormality included patients with end-stage renal disease (76.9%). Kidney disease is a large and growing healthcare concern. Morbidity and mortality in the population undergoing dialysis remain unacceptable despite the many advances made in the technical aspects of dialysis care. The largest contributor to this mortality continues to be cardiac disease [14]. Progressive left ventricular (LV) growth occurs because of anemia, hypertension, and diabetes mellitus, which are also risk factors for cardiomyopathy and IHD. The presence of these disorders varies from patient to patient, and they frequently overlap [15].

The most common symptom of cardiomyopathy in chronic kidney disease patients is pulmonary edema or, in the setting of dialysis, sudden intradialysis hypotension. These clinical manifestations of pump failure may result from systolic dysfunction, diastolic dysfunction, or a combination of both [16].

These patients are also prone to sepsis due to multiple samplings and invasive maneuvers that are frequently applied.

In our group of patients, three had LVH; two had moderate-to-severe pericardial effusion, which necessitated intervention; one had a profile of ischemic cardiomyopathy; and one patient had mitral valve endocarditis on the native valve.

As regards the septic shock patients, four patients (57.14%) had pulmonary hypertension and a dilated right atrium and/or ventricle. There is growing evidence that sepsis-associated cardiac dysfunction is not limited to the left ventricle but often involves the right ventricle as well [17]. This can be explained by the fact that in critical states, right ventricular function is commonly altered by increased right ventricular afterload or a depressed contractility. However, severe sepsis can be associated with both [17]. Right ventricular afterload can be increased as a result of pulmonary hypertension related to the release of various mediators, hypercarbia, acidosis, decreased nitrous oxide, and the development of microthrombi within the pulmonary circulation [18]. Myocardial depression is a relatively early event in the course of septic shock, even when the cardiac output is normal or elevated. The release of mediators, myocardial

edema, and decreased coronary perfusion has been incriminated [19]. The left ventricle is also depressed during severe sepsis. Parker *et al.* [20] were the first to describe LV hypokinesis in septic shock, in which patients with severely depressed LV ejection fraction (LVEF) in whom an adequate LV stroke output could be maintained through acute LV dilatation. Jardin *et al.* [21] studied 90 patients with septic shock with daily bedside assessment of the LV volume and LVEF using TTE and observed that LVEF was significantly depressed in all patients, resulting in severe reduction in the LV stroke volume. In our group of patients, two had a dilated left ventricle, one of whom had an impaired systolic function and the other had an apparently normal systolic function.

This study showed that there is a significant prevalence of underlying structural cardiac abnormalities in patients admitted to a MICU. This is somehow representative of the Egyptian society, and thus elucidating the importance to launch surveying studies to detect lesions that can be dealt with before irreversible damage occurs. In the ICU, these lesions can be detected using TTE performed by well-trained medical staff rather than an echocardiographer who are limited in number. The ability to perform and repeat bedside examination is vital in assessing the adequacy and efficacy of the therapy. Adoption of this policy is safe, cost-effective, and can save lives.

### Limitations

The number of the patients in some groups was relatively small and thus may be not fully representative for the types of lesions in such groups. Lesions due to rheumatic heart disease, although borne in mind at the beginning of the study, were not encountered as expected in our group of patients. This may also be attributed to the relatively small number of patients admitted during the limited time of the study. This can be overcome by surveying the patients of the unit for longer periods and reweighing the results. Furthermore, the results of previous studies have suggested an increased detection rate for transesophageal echocardiography compared with TTE [4,5]. Our study relied exclusively on TTE and, consequently, may have underestimated the true prevalence of the underlying cardiac pathology in these patients.

### Acknowledgements

#### Conflicts of interest

There are no conflicts of interest.

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## المخلص العربي

قد يعاني المرضى في الرعاية المركزه الباطنيه- والذين تم حجزهم بغير مرض قلبي ابتدائي-من تشوهات قلبيه قد تؤثر علي التشخيص و\او العلاج خاصه في مصر التي لازالت تعاني من مرض روماتيزم القلب . قد لا يكفي الفحص العادي لاكتشاف هذه التشوهات نظرا لحده المرض والاحتياج للتنفس الصناعي في كثير من الأحوال الغرض من هذه الدراسة استخدام تخطيط صدى القلب عبر الصدر لتعريف تشوهات القلب خاصة الروماتيزمية ، التي قد تكون موجودة في المرضى بغير مرض قلبي ابتدائي.

أساليب و المواد: خلال فترة 4 أشهر، 75 مريضاً دون تشخيص مرض قلبي ابتدائي حجزوا في الرعاية المركزه بمستشفى قصر العيني ؛ خضعوا لتخطيط صدى القلب عبر الصدر. وقورنت معدلات الوفيات ، فضلا عن طول فترة الإقامة في المرضى مع أو بدون تشوهات قلبية كبيرة.

النتائج: لوحظت تشوهات قلبية واحدة أو أكثر في 61.3% من المرضى. 15% منهم كانوا نتيجة روماتيزم القلب .

كان تضخم الأذنين و البطين الأيمن اكثر التشوهات الموجوده يليها تضخم البطين الأيسر و ارتفاع الضغط الرئوى

لم توجدعلاقه بين التشوهات القلبيه و مده الاقامه في الرعاية او نسبه الوفيات ولكنها غيرت خطه العلاج في 14.67% من المرضى

الخاتمه: نسبه معتبره من مرضى الرعاية المركزه الباطنيه بغير مرض قلبي اولى يعانون من تشوهات قلبيه قد تؤثر فى تشخيصهم و علاجهم ..