BENHA MEDICAL JOURNAL bmj

Print ISSN 1110-208X.

Online ISSN 2357-0016

Original article

Prevalence, Outcomes, and Risk Factors of New-Onset Atrial Fibrillation in Critically Ill Patient with Sepsis and Septic Shock

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Received:
Accepted:

Abstract:

Background: Sepsis is known as a life-threatening organ dysfunction that results from a dysregulated host response to infection. This study aimed to evaluate the impact on hemodynamics and patient outcome of new onset atrial fibrillation (NOAF) during sepsis and septic shock, determine the prevalence of NOAF, and identify the factors associated with it. **Methods:** The study was a prospective observational study that was carried out on 80 patients who were admitted to the intensive care unit (ICU) with diagnosis of sepsis or septic shock at Benha University Hospital from June 2023 to May 2024. **Results:** Hospital stay of the studied patients ranged from 3 to 28 days with a mean of 11.81± 5.71 days and median (IQR) 10 (8 to 15). The mortality rate in the current study was 20 (25%). **Conclusion:** About 30% of intensive care unit (ICU) patients with sepsis or septic shock experienced NOAF, according to our study's findings. This occurred most frequently in the initial days after admission. Patients experiencing atrial fibrillation often needed medication or electrical interventions to lower their heart rates. A longer time spent in the hospital and an increase in complications like renal damage and respiratory failure were both linked to AF. In order to improve outcomes for septic patients, these findings emphasize the significance of early detection and management of AF.

Keywords: Prevalence; Outcomes; Risk factors; New-onset atrial fibrillation; Critically Ill.

Introduction

An uncontrolled immune response to infection can lead to sepsis, a potentially fatal malfunction of vital organs [1]. The operational definition of sepsis has been updated since 2016, and systemic inflammatory response syndrome is no longer considered. A two-point sudden shift in sequential organ failure assessment (SOFA) indicates that an infection and organ dysfunction are necessary [2].

Severe sepsis, failure of the circulatory system, and an increased risk of mortality following adequate fluid resuscitation constitute septic shock. A serum lactate level above 2 mmol/L and low blood pressure are symptoms of this condition. In order to keep the MAP at 65 mmHg or higher, vasopressor medication is needed.

In the event that serum lactate determination is unavailable, alternative markers of tissue hypoperfusion, including altered mental status, oliguria, or delayed capillary renewal, may be employed [3].

The most common kind of arrhythmia seen in an intensive care unit (ICU) is atrial fibrillation (AF) [4]. New onset atrial fibrillation (NOAF) is one of the most prevalent complications of sepsis and septic shock. The adverse effects of sepsis on the heart are not restricted to ventricular relaxation and contractile function; they also impact the electric function [5].

Inflammation appears to play a significant role, although the exact mechanisms are still not fully understood. It was previously thought that electrolyte disturbances and the use of vasopressor drugs were to blame for the electrical instability of cardiomyocytes in sepsis patients. New evidence suggests, however, that inflammation-induced necrosis and fibrosis may actually be the cause of AF [6]. Inducing an arrhythmia through a change in the myocardial cells' membrane potential is the goal of these alterations [7].

In septic shock patients, the onset of NOAF is contingent upon the existence of an arrhythmogenic substrate, as well as trigger and modulation factors, including inflammation and the autonomic nervous system. It has been noted that the atrial musculature displays triggered activity. One possible explanation for the occurrence of NOAF in septic patients is a decrease in heart rate variability caused by an imbalance between sympathetic and vagal tone [8]. Normally, vagal stimulation reduces the inflammatory response [9].

The pacemaker current has been observed to be partially blocked in human atrial cardiomyocytes following exposure to gram-negative bacteria. endotoxin [10], Which may result in a diminished sensitivity to both sympathetic and vagal stimuli (11) physiological signals This would cause the heart rate to increase, which is common in people who have septic shock. Increased calcium influx through the L-type Ca 2+ channel shortens the atrial refractory period and action potential duration, triggers triggered activity, and makes it easier for atrial fibrillation to begin during unopposed sustained tachycardia [12, 13].

Beta-adrenergic stimulation following endotoxin administration has been demonstrated to further enhance this process [14] which increases channel activity by lowering Ca2+ channel close times and increasing open times. These results may help explain how cardiac pacemaker cells react to the inotropic positive effect of adrenergic stimulation and how often atrial fibrillation episodes occur, particularly in the early phases of sepsis [15].

This study was conducted to evaluate the impact of NOAF on the hemodynamics and outcome of patients, as well as to evaluate the prevalence of NOAF during sepsis and septic shock and to identify the associated factors.

Patients and methods

The prospective observational study was conducted at Benha University Hospital from June 2023 to May 2024 on 80

patients who were admitted to the ICU with a diagnosis of sepsis or septic shock.
The patients provided written consent that was informed. Each patient was provided with a secret code number and an explanation of the study's purpose. The study was done after being approved by the Research Ethics Committee, Faculty of Medicine, and Benha University.
Inclusion criteria were adult patients with age more than 18 years old who are admitted to the ICU for more than 24 hours, satisfying criteria for sepsis, SOFA (sepsis-related organ failure assessment) score of more than 2 points and approval of patient or one of immediate relatives.
Exclusion criteria were patient with pre-existing or chronic AF, with a history of any cardiac disease and refusal of patient or one of immediate relatives.
All studied cases were subjected to the following: **History taking including** [Age, gender, ethnicity, and BMI], presenting illness: the primary reason for ICU admission (e.g., sepsis, trauma), symptom duration, recent infections/surgeries, and calculated severity scores (APACHE II, SAPS, and SOFA), past medical history: chronic conditions (e.g., CKD, hypertension, and diabetes), liver disease, malignancy, and autoimmune diseases, medication history: nephrotoxic drugs, diuretics, ACE inhibitors ARBs (Angiotensin receptor blockers), and herbal medicine use, family and social history: kidney disease, genetic disorders, substance use, and toxin exposure and fluid balance and urine output. **Examination including:** General appearance**:** the level of consciousness (e.g., alert, confused, comatose) and look for signs of distress (e.g., dyspnea, diaphoresis), vital signs: heart rate, blood pressure (hypotension may indicate shock), respiratory rate, oxygen saturation, and temperature (fever or hypothermia), cardiovascular examination: pulse regularity, heart sounds (e.g., murmurs, gallops), jugular venous distension (JVD), and peripheral perfusion (capillary refill), respiratory examination: abnormal breath sounds (e.g., crackles, wheezes) and assess for pulmonary edema or effusion, abdominal examination: tenderness, distension, organomegaly, and bowel sounds, neurological examination: mental status (e.g., confusion, delirium) and check for focal neurological deficits and skin examination: rashes, petechiae, infections (e.g., cellulitis), or cold, clammy skin (sign of shock). **Laboratory investigations including** [Complete blood count, c - reactive protein, pan culture, random blood sugar, arterial blood gases, electrolyte tests: serum potassium, serum calcium, and serum sodium, renal function tests: blood urea (mg/dL) and serum creatinine (mg/dL) and liver function tests: SGOT, SGPT, serum albumin, and serum bilirubin (total and direct)]. **Imaging:** chest x-ray and cardiac evaluations**:** Standard 12-lead Electrocardiogram (ECG), and Echocardiogram (ECHO).

Diagnosis of NOAF

Heart rhythm was continuously monitored for all eligible ICU patients using bedside patient monitors (General Electric, Carescape B850, GE Healthcare, and Chicago, IL, USA). Using the GE monitor's software (CSCS-CARESCAPE Software Control System version 2.4), ECG tracings (12-lead) were reviewed for the previous 72 hours, and a 12-lead ECG was conducted on a daily basis. Based on the presence of erratic atrial activity and irregular ventricular activity without distinct P waves, the diagnosis of new-onset AF was confirmed.

Definition of sepsis and septic shock

Both septic shock and sepsis were defined using the Sepsis-3 criteria. Patients with signs of infection, dysfunctional organs, and circulatory failure were diagnosed with septic shock. It was necessary to administer vasopressor therapy (norepinephrine >0.1 μg/kg/min for >5 hours) to keep the mean arterial pressure (MAP) of 65 mmHg or higher even after adequate fluid resuscitation.

It was believed that the characteristics of sepsis included the presence of septic shock or sepsis itself, a suspicion of infection confirmed by the use of parenteral antibiotics, and the sampling of physiological fluids for culture before admission to the intensive care unit. Upon admission to the intensive care unit, diagnostic procedures, such as laboratory testing and cultures, were implemented to confirm the suspected infection.

After 48 hours of hospital or intensive care unit admission, secondary infections like bloodstream infections (BSIs), ventilator-associated pneumonia (VAP), and urinary tract infections (UTIs) were identified using culture results and diagnostic tests.

AF management

A "wait-and-see" strategy, pharmacological treatment, electrical cardioversion, or both were considered by the attending clinician following the diagnosis of new-onset AF. Nevertheless, new-onset AF episodes were typically treated with amiodarone (600–750 mg daily) following a priming dose of 150–300 mg, in accordance with ICU practice Standards. At first, beta-blockers were commonly given to patients to control their heart rate.

Hemodynamic instability, defined as a significant rise in vasopressor needs after the start of atrial fibrillation (AF), was reserved for patients who required direct electrical cardioversion. After the amiodarone preload dose had been given, clinicians were instructed to delay electrical cardioversion. Unless there was a reason not to, such as active bleeding, thrombocytopenia, or coagulopathy, all patients were given prophylactic anticoagulation.

Outcome measures

The primary outcome was hospital mortality and secondary outcomes included: ICU length of stay, hospital length of stay, duration of mechanical ventilation, incidence of thromboembolic events and need for long-term anticoagulation post-ICU discharge.

Approval code: MS 15-8-2023

Statistical analysis

We used SPSS v27, developed by IBM and located in Armonk, NY, USA, to evaluate the data. The data distribution was checked for normality using the Shapiro-Wilks test and histograms. The mean and standard deviation (SD) were used to display the quantitative parametric data. Quantitative non-parametric data was shown using the median and interquartile range (IQR). Displayed were the qualitative traits' frequencies and percentages (%).

Results

According to demographic data in the studied patients, the age of the studied patients ranged from 33 to 88 years with a mean of 64.53± 11.04 years. There were 32 (40%) males and 48 (60%) females. Regarding the associated comorbidities, 69 (86.25%) patients had hypertension, 60 (75%) patients had DM, 27 (33.75%) patients had CKD, 31 (38.75%) patients had IHD, 11 (13.75%) patients had COPD, 14 (17.5%) patients had cirrhotic liver and 10 (12.5%) patients had other comorbidities. All the studied patients were diagnosed with sepsis and only 25 (31.25%) patients were diagnosed with septic shock diagnosis and the SOFA score of the studied patients ranged from 2 to 11 with a mean of 4.86± 2.12 and a median (IQR) of 4.5 (3 to 6). (**Table 1)**

(Table 2) shows vital signs, laboratory investigation, serum electrolytes and kidney function tests and arterial blood gas analysis of the studied patients.

Table 1: Demographic data, comorbidities, diagnosis, source of sepsis and SOFA score of the studied patients

		Total (n= 80)
Age (years)	**Mean± SD**	64.53± 11.04
	Range	33-88
Gender	Male	32 (40%)
	Female	48 (60%)
Comorbidities	HTN	69 (86.25%)
	DM	60 (75%)
	CKD	27 (33.75%)
	IHD	31 (38.75%)
	COPD	11 (13.75%)
	Cirrhotic liver	14 (17.5%)
	Other comorbidities	10 (12.5%)
Diagnosis	Sepsis	80 (100%)
	Septic shock	25 (31.25%)
Source of sepsis	Pneumonia	24 (30%)
	UTI	11 (13.75%)
	Diabetic foot	4 (5%)
	SBP	4 (5%)
	Cellulitis	3 (3.75%)
	UTI & pneumonia	3 (3.75%)
	CRBSI	3 (3.75%)
	Lung abscess	3 (3.75%)
	Infective endocarditis	3 (3.75%)
	Bilateral cellulitis	2 (2.5%)
	UTI & infected bed sores	2 (2.5%)
	Catheter associated UTI	2 (2.5%)
	Infected bed sores	2 (2.5%)
	Infected stump & chest infection	2 (2.5%)
	Septic arthritis	2 (2.5%)
	Foot gangrene & osteomyelitis	2 (2.5%)
	Neglected DJ associated UTI	1 (1.25%)
	UTI, pyelonephritis & pneumonia	1 (1.25%)
	Cellulitis & diabetic foot	1 (1.25%)
	Cellulitis, diabetic foot, bed sores & chest infection	1 (1.25%)
	Cellulitis & infected bed sores	1 (1.25%)
	Acute pancreatitis	1 (1.25%)
	Aspiration pneumonia & infected bed sores	1 (1.25%)
	Pyelonephritis	1 (1.25%)
SOFA score	Mean± SD	4.86 ± 2.12
	Range	2 - 11
	Median (IQR)	4.5 (3 - 6)

HTN: hypertension, DM: Diabetes mellitus, CKD: Chronic Kidney Disease, IHD: ischemic heart disease, COPD: Chronic obstructive pulmonary disease. UTI: Urinary tract infection, DJ: Double-J, CRBSI: Catheter-related bloodstream infection, SBP: Spontaneous bacterial peritonitis. SOFA: sequential organ failure assessment, IQR: interquartile range.

Table 2: Vital signs, laboratory investigation, serum electrolytes and kidney function tests and arterial blood gas analysis of the studied patients

			Total (n= 80)
Vital signs	**HR (beats/min)**	**Mean± SD**	84.09± 8.16
		Range	70-100
	SBP (mmHg)	**Mean± SD**	101.06± 23.16
		Range	60-160
	DBP (mmHg)	**Mean± SD**	83.38± 7.95
		Range	70-100
	Temperature (^{o} c)	**Mean± SD**	38.3± 0.8
		Range	36-40
	Oxygen saturation (%)	**Mean± SD**	90.98± 4.31
		Range	79-99
Laboratory investigation	**Hb (g/dL)**	**Mean± SD**	9.69± 1.82
		Range	6.3-15
	WBCs (*10^{9}/L)	**Mean± SD**	18.98± 6.67
		Range	2.4-37.8
	Platelets (*10^{9}/L)	**Mean± SD**	223.7± 109.83
		Range	70-476
	Random blood sugar (mg/dL)	**Mean± SD**	240.89± 107.91
		Range	87-465
	CRP (mg/dL)	**Mean± SD**	113.29± 47.99
		Range	48-240
	SGOT (U/L)	**Mean± SD**	46.2± 54.91
		Range	6-422
	SGPT (U/L)	**Mean± SD**	51.19± 62.68
		Range	15-487
	Serum albumin (g/dL)	**Mean± SD**	3.32± 0.48
		Range	2.3-4.6
	Serum bilirubin (µmol/L)	**Mean± SD**	64.53± 11.04
		Range	33-88
Serum electrolytes	**Serum sodium (mEq/L)**	**Mean± SD**	135.05± 7.42
		Range	123-153
	Serum potassium (mEq/L)	**Mean± SD**	4.14± 0.75
		Range	2.9-6.1
	Serum calcium (mg/dL)	**Mean± SD**	8.15± 0.83
		Range	6.8-10.2
kidney function tests	**Serum creatinine (mg/dL)**	**Mean± SD**	2.84± 1.77
		Range	1.1-8.7
	Urea (mg/dL)	**Mean± SD**	111.36± 59.15
		Range	24-280
Arterial blood gas	**pH**	**Mean± SD**	7.34± 0.09
		Range	7.15-7.52
	HCO_3 (mEq/L)	**Mean± SD**	19.36± 5.19
		Range	8-31
	PaO_2 (mmHg)	**Mean± SD**	71.42± 15.14
		Range	49-131
	$PaCO_2$ (mmHg)	**Mean± SD**	35.17± 10.07
		Range	19-60
	Lactate level (mmol/L)	**Mean± SD**	2.93± 1.21
		Range	0.7-5.3

HR: heart rate, SBP: systolic blood pressure, DBP: diastolic blood pressure. Hb: Hemoglobin, WBCs: white blood cells, PLT: platelet count, CRP: C - reactive protein, SGOT: Serum Glutamic-Oxaloacetic Transaminase, SGPT: Serum glutamate pyruvate transaminase. PH: Acid-base balance of blood, HCO3: bicarbonate, Pao2: Partial pressure of oxygen, Paco2: Partial pressure of carbon dioxide

Table 3: ECG finding and atrial fibrillation of the studied patients

		Total (n= 80)
1st degree AV block		2 (2.5%)
1st degree heart block		2 (2.5%)
RBBB		3 (3.75%)
AF		18 (22.5%)
Sinus rhythm		25 (31.25%)
Sinus rhythm with frequent extra systoles		2 (2.5%)
Sinus rhythm with PACS		2 (2.5%)
Sinus rhythm with prolonged PR interval		2 (2.5%)
Sinus rhythm with PVCS		3 (3.75%)
Sinus rhythm with RBBB		1 (1.25%)
Sinus tachycardia		15 (18.75%)
MAT		2 (2.5%)
SVT		3 (3.75%)
Atrial fibrillation		
Time of development of AF	**1st day of admission**	11 (13.75%)
	2nd day of admission	4 (5%)
	3rd day of admission	2 (2.5%)
	4th day of admission	2 (2.5%)
	5th day of admission	4 (5%)
	6th day of admission	1 (1.25%)
	None	56 (70%)
Type of AF	**Paroxysmal**	18 (22.5%)
	Persistent	6 (7.5%)
	None	56 (70%)
Heart rate during AF (beats/min)	**Mean± SD**	146.75± 16.05
	Range	120-185
Duration of AF (hrs.)	**Mean± SD**	21.82± 42
	Range	1-192
	Median (IQR)	6 (2-20)
Type and dose of medications needed to terminate AF	**Amiodarone 300 mg then 900 mg over 24h**	14 (17.5%)
	DC shock	2 (2.5%)
	Electrical cardioversion	3 (3.75%)
	Verapamil	5 (6.25%)
	None	56 (70%)

RBBB: Right bundle branch block, AF: Atrial fibrillation, PACS: Premature atrial contractions, MAT: Multifocal atrial tachycardia, SVT: Supraventricular tachycardia.

The ECG findings showed that 2 (2.5%) patients had 1st degree AV block, 2 (2.5%) patients had 1st degree heart block, 3 (3.75%) patients had RBBB, 18 (22.5%) patients had AF, 25 (31.25%) patients had sinus rhythm, 2 (2.5%) patients had sinus rhythm with frequent extra systoles, 2 (2.5%) patients had sinus rhythm with PACS, 2 (2.5%) patients had sinus rhythm with prolonged PR interval, 3 (3.75%) patients had sinus rhythm with PVCS, 1 (1.25%) patients had sinus rhythm with RBBB, 15 (18.75%) patients had sinus tachycardia, 2 (2.5%) patients had MAT and 3 (3.75%) patients had SVT. Regarding the time of development of AF, AF was developed at the 1st day of admission in 11 (13.75%) patients, at the 2nd day of admission in 4 (5%) patients, at the 3rd day of admission in 2 (2.5%) patients, at the 4th day of admission in 2 (2.5%) patients and at the 5th day of

admission in 4 (5%) patients, and at the 6th day of admission in 1 (1.25%) patients, whereas 56 (70%) patients had no AF. The type of AF was paroxysmal in 18 (22.5%) patients and was persistent in 6 (7.5%) patients. The heart rate during AF ranged from 120 to 185 beats/min with a mean of 146.75± 16.05 beats/min. The duration of AF ranged from 1 to 192 hours with mean of 21.82± 42 hours. The AF was terminated by Amiodarone 300 mg then 900 mg over 24h in 14 (17.5%) patients, DC shock in 2 (2.5%) patients, electrical cardioversion in 3 (3.75%) patients and with Verapamil in 5 (6.25%) patients. (**Table 3)**

Hospital stays of the studied patients ranged from 3 to 28 days with a mean of 11.81± 5.71 days and median (IQR) 10 (8 to 15). The mortality rate in the current study was 20 (25%). Regarding morbidity, AKI occurred in 17 (21.25%) patients, respiratory failure occurred in 7 (8.75%) patients, AKI & respiratory failure occurred in 4 (5%) patients, surgical emphysema occurred in 2 (2.5%) patients, liver dysfunction occurred in 2 (2.5%) patients, MOF occurred in2 (2.5%) patients, CVS disorder occurred in 2 (2.5%) patients, respiratory and heart failure occurred in 2 (2.5%) patients, AKI & CVS occurred in 1 (1.25%) patient and AKI & liver dysfunction occurred in 1 (1.25%) patient, while 40 (50%) patients had no morbidities. (**Table 4)**

Table 4: Hospital stay, morbidity and mortality of the studied patients

		Total (n= 80)
Hospital stay (days)	**Mean± SD**	11.81± 5.71
	Range	3-28
	Median (IQR)	10(8-15)
Morbidity	**AKI**	17 (21.25%)
	Respiratory failure	7 (8.75%)
	AKI & respiratory failure	4 (5%)
	Surgical emphysema	2 (2.5%)
	Liver dysfunction	2 (2.5%)
	MOF	2 (2.5%)
	CVS disease	2 (2.5%)
	Respiratory and heart failure	2 (2.5%)
	AKI & CVS	1 (1.25%)
	AKI & liver dysfunction	1 (1.25%)
	No	40 (50%)
Mortality	**Yes**	20 (25%)
	No	60 (75%)

MOF: Multiple organ failure, AKI: Acute kidney injury, CVS: cardiovascular system.

Discussion

The present study revealed that according to demographic data in the studied patients, the age of the studied patients ranged from 33 to 88 years with a mean of 64.53± 11.04 years. There were 32 (40%) males and 48 (60%) females included in the current study.

Our results in consistent with Zakynthinos et al., [16] We aimed to determine the frequency of NOAF and identify risk factors for its development by evaluating a group of septic patients who were mechanically ventilated at least at admission. The mean age of patients who developed NOAF was 65.3 ± 7.1 years, suggesting that they were an older subgroup. Females comprised the plurality (67.3%).

Regarding the associated comorbidities, 69 (86.25%) patients had hypertension, 60 (75%) patients had DM, 27 (33.75%) patients had CKD, 31 (38.75%) patients had IHD, 11 (13.75%) patients had COPD,

14 (17.5%) patients had cirrhotic liver and 10 (12.5%) patients had other comorbidities. Our findings in line with Zakynthinos et al., [16] showed that hypertension was present in 48.2% of the NOAF group, suggesting a significant association between elevated blood pressure and the development of AF in this setting.

All the studied patients were diagnosed with sepsis and only 25 (31.25%) patients were diagnosed with septic shock diagnosis. Our findings in agreement with Zakynthinos et al., [16] The results showed that out of 1330 patients screened, 685 were eligible for statistical analysis, and 110 patients (16.1%) developed NOAF. Septic episodes occurred at a significantly higher rate in the NOAF group (92.7% vs. 58.1%, $p < 0.001$) when contrasted with the no-NOAF group. Notably, a septic episode, which often develops from secondary infections, was experienced by 80% of NOAF patients at the same time as AF. Furthermore, 85.3% of patients presented with septic shock.

In the current study we reported that, the source of sepsis was pneumonia in 16 (20%) patients, UTI in 11 (13.75%) patients, lobar pneumonia in 6 (7.5%) patients, diabetic foot in 4 (5%) patients, SBP in 4 (5%) patients, cellulitis in 3 (3.75%) patients, UTI & pneumonia in 3 (3.75%) patients, CRBSI in 3 (3.75%) patients, lung abscess in 3 (3.75%) patients, infective endocarditis in 3 (3.75%) patients, bilateral cellulitis in 2 (2.5%) patients, UTI & infected bed sores in 2 (2.5%) patients, catheter associated UTI in 2 (2.5%) patients, infected bed sores in 2 (2.5%) patients, infected stump & chest infection in 2 (2.5%) patients, septic arthritis in 2 (2.5%) patients and foot gangrene & osteomyelitis in 2 (2.5%) patients. Also, neglected DJ associated UTI, UTI, pyelonephritis & pneumonia, Cellulitis & diabetic foot, cellulitis, diabetic foot, bed sores & chest infection, cellulitis & infected bed sores, acute pancreatitis, aspiration pneumonia, aspiration pneumonia & infected bed sores, bronchopneumonia and pyelonephritis were sources of sepsis; each of them was the cause in 1 (1.25%) patient.

Our results in concordance with Arunachalam et al., [17] demonstrated that the main source of sepsis was the lungs (40%) The relatively high percentage of pulmonary infections may reflect a potential association between respiratory illness and the development of AF in septic patients.

In our study we found that the SOFA score of the studied patients ranged from 2 to 11 with a mean of 4.86± 2.12 and a median (IQR) of 4.5 (3 to 6). Our results in concordance with Li et al., [18] revealed that the median SOFA score was 5.00 (IQR: 3.00–7.00), reflecting a moderate degree of organ dysfunction in this cohort, commonly seen in septic populations. While, Zakynthinos et al., [16] showed that in sepsis at admission, patients with NOAF had a mean SOFA score of 8.5 ± 6.1, indicating a considerable degree of organ dysfunction.

Regarding vital signs, the HR of the studied patients ranged from 70 to 100 beats/min with a mean of 84.09± 8.16 beats/min. The SBP ranged from 60 to 160 mmHg with a mean of 101.06± 23.16 mmHg and the DBP ranged from 70 to 100 mmHg with a mean of 83.38± 7.95 mmHg. The temperature ranged from 36 to 40o c with a mean of 38.3± 0.8o c and the oxygen saturation ranged from 79 to 99 % with a mean of 90.98± 4.31%.

Klein Klouwenberg et al., [19] who aimed to determine the incidence, risk factors, and outcomes of AF in a cohort of critically ill patients with sepsis. They determined that in patients with NOAF, the median temperature was 37.9°C (IQR: 37.1–38.7).

Regarding laboratory investigation, the Hb concentration ranged from 6.3 to 15 g/dL with a mean of 9.69± 1.82 g/dL. WBCs ranged from 2.4 to $37.8*10^9$/L with a mean of 18.98± 6.67 $*10^9$/L and the platelet

count ranged from 70 to 476 *10^9/L with a mean of 223.7± 109.83*10^9/L. Random blood sugar ranged from 87 to 465 mg/dL with a mean of 240.89± 107.91 mg/dL. CRP level ranged from 48 to 240 mg/dL with a mean of 113.29± 47.99 mg/dL. Regarding the liver enzymes, SGOT ranged from 6 to 422 U/L with a mean of 46.2± 54.91 U/L and SGPT ranged from 15 to 487 U/L with a mean of 51.19± 62.68 U/L. The serum albumin ranged from 2.3 to 4.6 g/dL with a mean of 3.32± 0.48 g/dL and serum bilirubin ranged from 33 to 88 µmol/L with a mean of 64.53± 11.04 µmol/L.

Li et al., [18] revealed that the median WBC count was 13.40 × 10^9/L, indicating leukocytosis often seen in infections or inflammation. Hemoglobin levels were consistent across cohorts with a median of 114 g/L. Platelet count showed a median of 156 × 10^9/L, within the lower-normal range. Serum creatinine and blood urea nitrogen medians were 80.44 µmol/L and 7.20 mmol/L, respectively.

Regarding serum electrolytes and kidney function tests, serum sodium ranged from 123 to 153 mEq/L with a mean of 135.05± 7.42 mEq/L, serum potassium ranged from 2.9 to 6.1 mEq/L with a mean of 4.14± 0.75 mEq/L and serum calcium ranged from 6.8 to 10.2 mg/dl with a mean of 8.15± 0.83 mg/dl. Serum creatinine ranged from 1.1 to 8.7 mg/dL with a mean of 2.84± 1.77 mg/dL and blood urea ranged from 24 to 280 mg/dL with a mean of 111.36± 59.15 mg/dL.

Our findings in agreement with Zakynthinos et al., [16] showed that the potassium level was 3.8 ± 0.9 mmol/L.

Regarding arterial blood gas analysis (ABG), the ABG analysis showed that pH ranged from 7.15 to 7.52 with a mean of 7.34± 0.09. HCO_3 ranged from 8 to 31 mEq/L with a mean of 19.36±5.19 mEq/L. PaO_2 ranged from 49 to 131 mmHg with a mean of 71.42± 15.14 mmHg. $PaCO_2$ ranged from 19 to 60 mmHg with a mean of 35.17± 10.07 mmHg. Serum lactate level ranged from 0.7 to 5.3 mmol/L with a mean of 2.93± 1.21 mmol/L.

This came in accordance with Li et al., [18] revealed that the median lactate level was 4.40 mmol/L (IQR: 3.69–5.11), indicating a state of significant tissue hypoperfusion or metabolic stress, which is commonly observed in septic patients.

2 (2.5%) patients had 1st degree AV block, 2 (2.5%) patients had 1st degree heart block, 3 (3.75%) patients had RBBB, 18 (22.5%) patients had AF, 25 (31.25%) patients had sinus rhythm, and 2 (2.5%) patients had sinus rhythm with frequent extra systoles, according to the ECG findings. 2 (2.5%) patients exhibited sinus rhythm with PACS, 2 (2.5%) patients exhibited sinus rhythm with prolonged PR interval, 3 (3.75%) patients exhibited sinus rhythm with PVCS, 1 (1.25%) patient exhibited sinus rhythm with RBBB, 15 (18.75%) patients developed sinus tachycardia, 2 (2.5%) patients developed MAT, and 3 (3.75%) patients developed SVT.

Our findings in agreement with Zakynthinos et al., [16] showed that sinus rhythm (SR) was restored in 60.9% of NOAF patients within 48 h and in 49.1% of patients within the first 24 h.

Regarding the time of development of AF, AF was developed at the 1st day of admission in 11 (13.75%) patients, at the 2nd day of admission in 4 (5%) patients, at the 3rd day of admission in 2 (2.5%) patients, at the 4th day of admission in 2 (2.5%) patients and at the 5th day of admission in 4 (5%) patients, and at the 6th day of admission in 1 (1.25%) patients, whereas 56 (70%) patients had no AF. The type of AF was paroxysmal in 18 (22.5%) patients and was persistent in 6 (7.5%) patients. The heart rate during AF ranged from 120 to 185 beats/min with a mean of 146.75± 16.05 beats/min. The duration of AF ranged from 1 to 192 hours with mean of 21.82± 42 hours. The AF was terminated by Amiodarone 300 mg then 900 mg over 24h in 14 (17.5%) patients, DC shock in 2 (2.5%) patients, electrical

cardioversion in 3 (3.75%) patients and with Verapamil in 5 (6.25%) patients.

Our findings in agreement with Zakynthinos et al., [16] This study demonstrated that the incidence of NOAF during the ICU stay was 18.03% among the patients who had sepsis at admittance (33 out of 183 patients). amiodarone infusion was administered to nearly all NOAF patients, except for nine. Electrical cardioversion was administered to six patients with severe hemodynamic instability who were diagnosed with NOAF.

The present study found that hospital stay of the studied patients ranged from 3 to 28 days with a mean of 11.81± 5.71 days and median (IQR) 10 (8 to 15). The mortality rate in the current study was 20 (25%).

Our findings in line with Zakynthinos et al., [16] This study revealed that 177 patients (25.8%) experienced ICU mortality during the three-year period observed. The NOAF group had a significantly higher mortality rate than the control group (39 patients (35.5%) versus 138 patients (24%), p = 0.01).In addition, Huo et al., [20] who aimed to determine who is at risk for developing atrial fibrillation (AF) in sepsis patients and what effects new-onset AF has on both short- and long-term outcomes while hospitalized. At 30 days after admission, 2,299 patients (9.38%) who had sepsis but no AF and 2,292 patients (29.80%) who had sepsis with new-onset AF died in the hospital.

Regarding morbidity, AKI occurred in 17 (21.25%) patients, respiratory failure occurred in 7 (8.75%) patients, AKI & respiratory failure occurred in 4 (5%) patients, surgical emphysema occurred in 2 (2.5%) patients, liver dysfunction occurred in 2 (2.5%) patients, MOF occurred in2 (2.5%) patients, CVS disorder occurred in 2 (2.5%) patients, respiratory and heart failure occurred in 2 (2.5%) patients, AKI & CVS occurred in 1 (1.25%) patient and AKI & liver dysfunction occurred in 1 (1.25%) patient, while 40 (50%) patients had no morbidities.

Our findings in agreement with Huo et al., [20] As compared to patients without atrial fibrillation and sepsis, those with both conditions were more likely to require hospitalization after discharge for heart failure or myocardial infarction (adjusted HR: 1.81; 95% CI: 1.67-1.97 for heart failure and 1.25, 95% CI: 1.13-1.38 for myocardial infarction, respectively).

This study has several limitations include small sample size, single-center study, short follow-up period and no control group.

Conclusion

From the findings of our study, it can be concluded that NOAF occurred in about 30% of ICU patients with sepsis or septic shock, most commonly within the first few days of admission. Patients with AF had higher heart rates and required treatment with medications or electrical interventions. AF was associated with longer hospital stays and increased complications such as kidney injury and respiratory failure. These findings highlight the importance of early detection and management of AF in septic patients to improve outcomes.

Recommendations were monitor ICU patients with sepsis closely for signs of AF, especially in the first few days, treat AF early to help stabilize the patient and avoid complications, check the heart with further tests (like echocardiogram) if AF develops, keep infection, fluids, and electrolytes well controlled to reduce the risk of AF, do more studies with more patients and in different hospitals to confirm these results and follow patients for a longer time to see the full impact of AF after sepsis.

Sources of funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of interest

No conflicts of interest

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To cite this article: Mona A. Elhadad, Yousry E. Rezk, Mustafa M. Khames, Engy A. Okab. Prevalence, Outcomes, and Risk Factors of New-Onset Atrial Fibrillation in Critically Ill Patient with Sepsis and Septic Shock. BMFJ XXX, DOI: 10.21608/bmfj.2025.401755.2524.