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Incidence and Prognosis of Sustained Arrhythmias in Critically Ill Patients

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***Rationale*: Sustained arrhythmias are common in postoperative and cardiac intensive care units (ICUs), but their incidence and prognosis in general ICUs have never been reported.**

***Objectives*: To estimate the incidence and prognosis of sustained arrhythmias in a general ICU population.**

***Methods*: Prospective, multicenter, 1-month inception cohort study.**

***Measurements and Main Results*: A total of 1,341 patients were included: 12% (163/1,341) had sustained arrhythmias, including 8% (113/1,341) and 2% (30/1,341) with supraventricular and ventricular arrhythmias, respectively, and 2% (30/1,341) with conduction abnormalities. In-hospital death rates were 17% (205/1,178) in patients without arrhythmia and 29% (33/113) in patients with supraventricular arrhythmias (odds ratio [OR], 1.95; 95% confidence interval [CI], 1.27–3.01), 73% (22/30) in patients with ventricular arrhythmias (OR, 13.20; 95% CI, 5.79–30.10), and 60% (18/30) in patients with conduction abnormalities (OR, 7.46; 95% CI, 3.52–15.82). Neurological sequel rates were 6% (55/973) in arrhythmia-free survivors and 15% (12/80) in survivors with supraventricular arrhythmias (OR, 2.92; 95% CI, 1.45–5.89), 38% (3/8) in survivors with ventricular arrhythmias (OR, 7.53; 95% CI, 1.60–35.50), and 17% (2/12) in survivors with conduction abnormalities (OR, 8.77; 95% CI, 1.65–46.57). After adjusting for prognosis factors and propensity scores, ventricular arrhythmias still increased mortality (OR, 3.53; 95% CI, 1.19–10.42) but supraventricular arrhythmias and conduction abnormalities did not.**

***Conclusions*: Sustained arrhythmias are observed in 12% of patients admitted to general ICUs. Ventricular arrhythmias increase the risk of death.**

Keywords: arrhythmia; critical illness; hospital mortality; neurological sequel; propensity score

Cardiac arrhythmias are frequently observed after cardiac (1) and noncardiac (2) surgery. Atrial fibrillation is the most common feature, but all types of arrhythmias can be observed. Known risk factors include age, male sex, history of arrhythmias, congestive heart failure or hypertension, bicaval venous cannulation, pulmonary vein venting, prolonged cross-clamp times, intraaortic balloon pump, postoperative atrial pacing, postoperative pneumonia, mechanical ventilation for more than 24 hours, and return to the intensive care unit (ICU) (3, 4). Although transient, postoperative arrhythmias may have a major economic impact with increased hospital length of stay (3, 4). Critically ill patients often have underlying heart disease, are frequently submitted to metabolic, ischemic, or neurohormonal stressors, and are therefore particularly at risk for cardiac arrhythmias (5). In a single-center retrospective study performed on 2,820 critically ill patients over a 12-year period, the prevalence of arrhythmias was 78%, with atrial fibrillation being the prominent clinical problem (6). Arrhythmias were more likely to occur in patients admitted in the ICU for cardiovascular disorders and were associated with an increased risk of death. In a single-center prospective 32-month cohort study performed on 756 critically ill patients with predominantly cardiac diseases, the annual incidence of arrhythmias was approximately 17%, with atrial fibrillation and monomorphic ventricular tachycardia as the most common features (7). However, similar data are lacking for patients admitted to general ICUs. Thus, the purpose of our study was to prospectively assess the incidence and prognosis of sustained arrhythmias in a general ICU population.

AT A GLANCE COMMENTARY

Scientific Knowledge on the Subject

Sustained arrhythmias are common in postoperative and cardiac intensive care units (ICUs), but their incidence and prognosis in general ICUs have never been reported.

What This Study Adds to the Field

This study estimates a 12% prevalence of sustained arrhythmias in general ICU patients. Ventricular arrhythmias increase the risk of death, and the risk of neurological sequelae.

METHODS

This was a prospective, multicenter, 1-month (from December 1 to January 1) inception cohort study performed in 26 European general ICUs. The protocol was approved as a minimal risk protocol by the ethics committee at each participating center and informed consent was waived.

Study Population and Data Collection

Upon admission, we recorded the following for all adults with an expected ICU stay of more than 24 hours: sex, age, body mass index, admission category (medical, emergency, or scheduled surgery), past

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medical history, McCabe classification (8), ICU diagnosis, Simplified Acute Physiology Score II (SAPS II) (9), vital signs, standard biological data, and a 12-lead electrocardiogram. At onset of any arrhythmia, we recorded vital signs, Glasgow coma score, standard biological data, plasma levels for magnesium and thyroid hormones, pulse oxymetry, any concomitant drug or invasive procedure (e.g., antiarrhythmic or catecholamine administration, insertion of central venous or intracardiac catheter, tracheal intubation or suctioning, bronchial or gastric fibroscopy, pleural or postural drainage), and a 12-lead electrocardiogram.

Follow-up

Patients were evaluated from inclusion to hospital discharge or up to 90 days (whichever occurred first). Daily recordings included vital signs, standard biological data, and interventions (as above). All arrhythmias were systematically recorded and sheets were forwarded to the coordinating center for blinded evaluation.

Definitions

Diagnosis of arrhythmias was made, using standard definitions (10), by three experts (academic cardiologists, board-certified electrophysiologists) who independently analyzed all recordings. Any discrepancy between experts was solved by consensus. In case of chronic arrhythmia, only new types of arrhythmias were considered. Sustained ventricular arrhythmias were defined by runs lasting more than 30 seconds or requiring termination for hemodynamic collapse. In case of discrepancies between the three experts in the diagnosis of broad QRS complex tachycardia, consensus was reached according to a predefined algorithm (11). Admission ECG was always used to help clarifying wide QRS complex tachycardia. Electrocardiographic criteria favoring ventricular tachycardia included the following:

1. Atrioventricular dissociation
2. A width of QRS greater than 0.14 second in right bundle branch block (BBB) or greater than 0.16 second in left BBB (particularly in absence of preexistent BBB on admission ECG, absence of known accessory auriculo-ventricular [AV] pathway, and in absence of treatment with class IC drug)
3. A superior QRS axis in the frontal plane in patients with right BBB–shaped QRS or an inferior axis in left BBB–shaped QRS tachycardia
4. Concordant pattern in the precordial leads (particularly negative concordance)
5. Presence of a qR or an R complex on lead V1 in right BBB–shaped tachycardia or an R:S ratio less than 1 in V6 lead or a qR in V6 during left BBB–shaped tachycardia or, in left BBB–shaped tachycardia, in lead V1 an initially positive QRS (positivity $>$ 0:03 s), slurring or notching of the down stroke of the S wave, and an interval between the onset of the QRS and the nadir of the S wave $\geqslant$ 0.07 second
6. R nadir S greater than 100 milliseconds in one or more precordial leads in absence of treatment with class IC drug, known accessory AV pathway, or preexistent left BBB
7. Tachycardia QRS more narrow than sinus QRS
8. Presence of QR complex.

Sudden cardiac death was defined by abrupt change in clinical status (i.e., arrhythmias, hypotension, chest pain, dyspnea), followed within 1 hour by abrupt coma and sudden cardiovascular collapse resulting in biological death (12).

Endpoints

The primary outcome was in-hospital mortality. Secondary outcomes included hospital length of stay and neurological sequelae at hospital discharge or up to 90 days (whichever occurred first), using the Glasgow Outcome Score (1: death; 2: vegetative state; 3 and 4: severe disability; 5 and 6: moderate disability; 7 and 8: good recovery) (13). In addition, we asked the physicians in charge of patients to give their opinion on whether death or neurological sequelae were definitely not, probably not, probably, or definitely related to arrhythmia.

Statistical Analysis

Analyses were performed using SAS version 8.2 (SAS Institute, Cary, NC). All analyses were adjusted for the type of ICU (medical or surgical/mixed) and the presence of a cardiologist. Additional details on statistical analyses are provided in the online supplement. Continuous variables were expressed as medians and interquartile ranges (IQRs) and categorical variables as numbers of patients in each category with corresponding percentages. Patients' characteristics upon ICU admission were compared between groups with Student t or Mann-Whitney U tests (for continuous variables) and χ^2 or Fisher exact tests (for categorical variables) as appropriate. Propensity scores (14) were constructed using multivariable logistic regression analyses for each type of arrhythmia using supraventricular arrhythmia, ventricular arrhythmia, or conduction abnormality as the dependent variable (*see* the online supplement). Independent predictors of mortality were investigated using multiple logistic regressions adjusting for variables associated with mortality in univariate analyses and propensity scores. Similar analyses were performed to investigate associations between arrhythmias and neurological sequelae. Results were expressed as relative risks (RR) and odds ratios (OR) together with their 95% confidence intervals (CI). All reported P values were two-sided.

RESULTS

Study Population

Participating ICUs were medical ICUs (n = 14), surgical ICUs (n = 3), or mixed, medical and surgical, ICUs (n = 9) (*see* Table E1 of the online supplement). A total of 1,341 patients were enrolled (Table 1). Most patients were nonsurgical (1,016/1,341, 76%), and admitted for noncardiac diseases (1,166/1,341, 87%). Only 9 patients were admitted for acute myocardial infarction and 18 patients were admitted for cardiogenic shock. Patients' severity of illness was witnessed by high SAPS II scores (33; IQR, 26) and by the high proportions of patients on ventilator (757/1,341, 56%) or on vasopressors (416/1,341, 31%). All patients in whom anticoagulation was not contraindicated were receiving prophylactic doses of low-molecular-weight heparin or unfractionated heparin for the prevention of venous thromboembolic disease. The crude proportion of patients with new onset of arrhythmia was 163 of 1,341 (12%). Overall, patients with arrhythmias were older, were more likely to have past medical history of cardiovascular, pulmonary, or endocrine diseases, had higher McCabe class, were more likely to present with sepsis/septic shock or other acute cardiovascular disorder, had higher SAPS II score, and were more likely to be on ventilator or on vasopressors. Hospital length of stay was 3 (IQR, 6) days in patients without arrhythmias and 6 (IQR, 12) days in patients with arrhythmias.

Description of Arrhythmias

One hundred and forty-six episodes of supraventricular arrhythmias were recorded in 8% (113/1,341) of the patients, with atrial fibrillation as the commonest arrhythmia (Table 2). There were 45 episodes of ventricular arrhythmias in 2% (30/1,341) of the patients, and 39 episodes of cardiac conduction abnormality in 2% (30/1,341) of the patients. The incidence of specific arrhythmias slightly decreased when excluding patients with primary cardiac diagnoses or chronic arrhythmias (*see* Table E2). Cardiac arrhythmias occurred mainly within the first 48 hours of ICU admission; 0.4% (5/1,341) of patients had sudden cardiac death. Univariate analysis of risk factors yielded roughly similar results for the three different types of arrhythmias (*see* Table E3). Risk factors included age, past medical history of cardiovascular or endocrine diseases, high SAPS II, need for ventilator, and need for vasopressors.

Among variables recorded at onset of arrhythmias, antiarrhythmic drugs, catecholamines, hyperglycemia, or hypoxia were the main possible precipitating factors (*see* Table E4). Torsades

TABLE 1. PATIENTS' CHARACTERISTICS UPON INTENSIVE CARE UNIT ADMISSION

	Patients without Arrhythmia (*n = 1,178*)	Patients with Arrhythmia (*n = 163*)	All Patients (*n = 1,341*)	*P* Value
Male sex	649 (55)	91 (56)	740 (55)	0.830
Age, yr	59; 30	70; 15	62; 29	<0.001
Body mass index, kg/m^2	23.8; 6.3	24.3; 5.7	23.9; 6.3	0.078
Admission category				
Medical	892 (76)	124 (76)	1016 (76)	
Emergency surgery	158 (13)	28 (17)	186 (14)	0.154
Scheduled surgery	128 (11)	11 (7)	139 (10)	
Past medical history				
Cardiovascular diseases	665 (56)	140 (86)	805 (60)	<0.001
Pulmonary diseases	391 (33)*	68 (42)	459 (34)	0.035
Endocrine diseases	259 (22)*	54 (33)	313 (23)	0.001
Other comorbidity	300 (25)	50 (31)	350 (26)	0.138
McCabe				
0 = nonfatal	736 (62)	83 (51)	819 (61)	
1 = ultimately fatal	307 (26)	50 (31)	357 (27)	0.009
2 = rapidly fatal	135 (11)	30 (18)	165 (12)	
Intensive care unit diagnosis				
ALI/ARDS	175 (15)	16 (10)	191 (14)	
Exacerbation of CRF	133 (11)	15 (9)	148 (11)	
Severe sepsis/septic shock	120 (10)	32 (20)	152 (11)	
Trauma	63 (5)	3 (2)	66 (5)	<0.001
Central nervous diseases	151 (13)	12 (7)	163 (12)	
Cardiovascular diseases	124 (11)	51 (31)	175 (13)	
Poisoning	123 (10)	6 (4)	129 (10)	
Other acute conditions	289 (25)	28 (17)	317 (24)	
SAPS II	30; 23	46; 26	33; 26	<0.001
Patients on ventilator	628 (53)	129 (79)	757 (56)	<0.001
Patients on vasopressor	317 (27)	99 (61)	416 (31)	<0.001

Definition of abbreviations: ALI/ARDS = acute lung injury/acute respiratory distress syndrome; CRF = chronic respiratory failure; SAPS II = Simplified Acute Physiology Score II.

Continuous variables are medians; interquartile ranges. Categorical variable are numbers (percentages). Student *t* or Mann-Whitney *U* tests (for continuous variables) and χ^2 or Fisher exact tests (for categorical variables) were used as appropriate.

* Data are missing for one patient.

de pointes occurred in patients with unstable coronary artery disease. Ventricular arrhythmias and conduction abnormalities were more often associated with cardiovascular collapse and persistent coma than supraventricular arrhythmias (*see* Table E5). Anticoagulants were given in 21% of supraventricular arrhythmias, 4% of ventricular arrhythmias, and 10% of conduction abnormalities (*see* Table E5).

Outcomes

In-hospital death rates were 17% (205/1,178) in patients without arrhythmia and 29% (33/113) in patients with supraventricular arrhythmias (OR, 1.95; 95% CI, 1.27–3.01), 73% (22/30) in patients with ventricular arrhythmias (OR, 13.20; 95% CI, 5.79–30.10), and 60% (18/30) in patients with conduction abnormalities (OR, 7.46; 95% CI, 3.52–15.82) (Tables 3 and 4). In-hospital death rates were roughly unchanged when excluding patients with primary cardiac diagnoses or chronic arrhythmias (*see* Table E6). As compared with survivors, nonsurvivors were older and were more likely admitted for acute medical illness than for surgical problems; to have a past medical history of cardiovascular diseases; to have sepsis, central nervous system, or cardiovascular diseases; to have

TABLE 2. DESCRIPTION OF SPECIFIC ARRHYTHMIAS DURING INTENSIVE CARE UNIT STAY

	No. of Patients (*n = 1,341*)	No. of Episodes	Episodes/ Patient (n)	Time from Admission (*d*)	Duration (*min*)
SV arrhythmia	113 (8.4)	146	1; 0	1; 4	120; 630
Atrial fibrillation	87 (6.5)	103	1; 0	1; 4	180; 672
Atrial flutter	25 (1.9)	28	1; 0	2; 4.5	120; 330
Paroxysmal SV tachycardia	14 (1.0)	15	1; 0	1; 5	30; 130
Ventricular arrhythmia	30 (2.2)	45	1; 0	1; 3	10; 13
Ventricular tachycardia	17 (1.3)	19	1; 0	1; 3	12; 43
Ventricular fibrillation	13 (1.0)	17	1; 0	1; 5	5; 13
Torsades de Pointe	8 (0.6)	9	1; 0	1; 2	10; 10
Conduction abnormality	30 (2.2)	39	1; 0	0; 3	25; 113
Sinus pause > 3 s	2 (0.1)	2	1; 0	6.5; 3	8.5; 13
Second-degree AV bloc	3 (0.2)	3	1; 0	0; 5	15; 710
Third-degree AV block	24 (1.8)	25	1; 0	0; 2	60; 113
Sudden cardiac death	5 (0.4)	5	1; 0	0; 0	15; 20*
Unknown	4 (0.3)	4	1; 0	5.5; 13	127.5; 352

Definition of abbreviations: AV = auriculo-ventricular; SV = supraventricular.

Continuous variables are medians; interquartile ranges. Categorical variable are numbers (percentages).

* Duration corresponds to the time from first onset of symptoms and cardiac arrest.

TABLE 3. HOSPITAL MORTALITY AND MORBIDITY OF SPECIFIC ARRHYTHMIAS

	No Arrhythmia (*n = 1,178*)	Supraventricular Arrhythmia (*n = 113*)	Ventricular Arrhythmia (*n = 30*)	Conduction Abnormality (*n = 30*)
Hospital mortality rate				
Survivors	973 (83)	80 (71)	8 (27)	12 (40)
Nonsurvivors	205 (17)	33 (29)*	22 (73)*	18 (60)*
Definitely not related to arrhythmia	192 (94)	18 (55)	3 (14)	2 (11)
Probably not related to arrhythmia	2 (1)	10 (30)	5 (23)	7 (39)
Probably related to arrhythmia	10 (5)	2 (6)	4 (18)	5 (28)
Definitely related to arrhythmia	1 (1)	3 (9)	10 (45)	4 (22)
Neurological sequelae (survivors)	n = 973	n = 80	n = 8	n = 12
Neurological sequelae, no	918 (94)	68 (85)	5 (63)	10 (83)
Neurological sequelae, yes	55 (6)	12 (15)*	3 (38)*	2 (17)
Definitely not related to arrhythmia	53 (96)	7 (58)	2 (67)	2 (100)
Probably not related to arrhythmia	0 (0)	1 (8)	0 (0)	0 (0)
Probably related to arrhythmia	2 (4)	2 (17)	0 (0)	0 (0)
Definitely related to arrhythmia	0 (0)	2 (17)	1 (33)	0 (0)
Diffuse anoxic injury	18 (33)	8 (67)	3 (100)	2 (100)
Focal events	37 (67)	4 (33)	0 (0)	0 (0)

Data are numbers (percentages); χ^2 or Fisher exact tests were used as appropriate.
* Versus patients without arrhythmia, $P \leq 0.050$.

higher SAPS II; and to be on ventilator or on vasopressors (*see* Table E7). After adjusting for these covariates and for propensity scores, only ventricular arrhythmias remained significantly associated with increased risk of hospital death (OR, 3.53; 95% CI, 1.19–10.42) (Table 4). We computed standardized mortality rates from SAPS II values in patients with or without arrhythmias (*see* Table E8). Standardized mortality rates were higher in patients with ventricular arrhythmias (standardized mortality rate, 1.29; 95% CI, 1.05–1.54) than in patients without ventricular arrhythmias (standardized mortality rate, 0.76; 95% CI, 0.69–0.83). In contrast, there was no difference in standardized mortality rates between patients with or without supraventricular arrhythmias and between those with or without conduction abnormalities.

Among survivors at hospital discharge, neurological sequel rates were 6% (55/973) in patients without arrhythmia, and 15% (12/80) in patients with supraventricular arrhythmias (OR, 2.92; 95% CI, 1.45–5.89), 38% (3/8) in patients with ventricular arrhythmias (OR, 7.53; 95% CI, 1.60–35.50), and 17% (2/12) in patients with conduction abnormalities (OR, 8.77; 95% CI, 1.65–46.57) (Tables 3 and 4). Among the 87 patients with atrial fibrillation, 10 had neurological sequelae including 4 patients with focal neurological deficit and 6 with diffuse anoxic injury. The risk of focal neurological events was associated with supraventricular arrhythmia but not with anticoagulation, and the interaction between supraventricular arrhythmia and anticoagulation was not significant (*see* Table E9). As compared with survivors without neurological sequelae, survivors with neurological sequelae were more likely to have past medical history of hypertension, trauma or central nervous system disease, higher SAPS II, and to be on ventilator (*see* Table E7). After adjusting for these covariates and for propensity scores, only ventricular arrhythmias remained associated with increased risk of neurological sequelae (OR, 10.40; 95% CI, 1.84–58.93) (Table 4).

DISCUSSION

This large multicenter trial established the incidence of sustained arrhythmias and/or conduction abnormalities as approximately

TABLE 4. ASSOCIATION BETWEEN ARRHYTHMIAS AND MORTALITY AND NEUROLOGICAL SEQUELS

	Odds Ratio (95% CI), *P* Value		
	Odds Ratios for Mortality		
	Unadjusted	Covariate Adjusted*	Covariate and Propensity Score Adjusted†
Supraventricular arrhythmia	1.95 (1.27–3.01), $P = 0.003$	0.69 (0.38–1.26), $P = 0.226$	0.72 (0.40–1.30), $P = 0.277$
Ventricular arrhythmia	13.20 (5.79–30.10), $P < 0.001$	2.37 (0.78–7.18), $P = 0.128$	3.53 (1.19–10.42), $P = 0.023$
Conduction abnormality	7.46 (3.52–15.82), $P < 0.001$	2.16 (0.76–6.08), $P = 0.147$	1.88 (0.66–5.33), $P = 0.236$
	Odds Ratios for Neurological Sequelae		
	Unadjusted	Covariate Adjusted‡	Covariate and Propensity Score Adjusted§
Supraventricular arrhythmia	2.92 (1.45–5.89), $P = 0.003$	2.64 (1.19–5.84), $P = 0.017$	2.04 (0.89–4.67), $P = 0.091$
Ventricular arrhythmia	7.53 (1.60–35.50), $P = 0.011$	8.41 (1.57–45.15), $P = 0.013$	10.40 (1.84–58.93), $P = 0.008$
Conduction abnormality	8.77 (1.65–46.57), $P = 0.011$	6.91 (1.10–43.30), $P = 0.039$	6.82 (0.91–51.17), $P = 0.062$

Definition of abbreviation: CI = confidence interval.
* Adjusted for variables associated with mortality at the 0.15 level: age; admission category, surgical; past medical history (unstable coronary artery disease, acute myocardial infarction < 3 mo, supraventricular arrhythmia, ventricular arrhythmia, conduction abnormality, mitral or aortic valve disease, hypertension, congestive heart failure, myopericarditis, nonthoracic surgery); intensive care unit diagnosis (exacerbation of chronic respiratory failure, severe sepsis/septic shock, central nervous disease, cardiovascular disease); SAPS II; ventilator support; use of vasopressor.
† Adjusted for variables associated with mortality at the 0.15 level not already included in the propensity score model.
‡ Adjusted for variables associated with neurological disability at the 0.15 level: admission category, surgical; past medical history (hypertension); intensive care unit diagnosis (trauma, central nervous disease); SAPS II; ventilator support.
§ Adjusted for variables associated with neurological disability at the 0.15 level not already included in the propensity score model.

12% of the general ICU population, with atrial fibrillation as the main rhythmic event. Of note, although the current study was performed in nonsurgical, noncardiac ICU patients, the observed incidence of arrhythmias was lower than after coronary artery bypass graft surgery (15, 16), and was close to the incidence of arrhythmias reported in cardiac ICU patients (7) and surgical ICU patients (17–20). There are other points of likeness between cardiac arrhythmias occurring in the general ICU population and those occurring in postoperative patients. Cardiac arrhythmias were more likely to occur within the first 48 hours of ICU admission, and were reported to be more frequent on Postoperative Day 2 (3, 4, 15, 17). Risk factors included age, past medical history of cardiovascular or endocrine diseases, and severity of illness as assessed by SAPS II and the need for mechanical ventilation or vasopressor therapy. All these factors were previously reported in postoperative patients (3, 4). Nevertheless, the incidence of sustained ventricular arrhythmias of 2% was higher than the frequency rate of 0.6 to 1.2% reported after cardiac surgery (21–23). This might be explained by the ICU environment, which is characterized by abundant and active metabolic, ischemic, and neurohormonal stressors, as witnessed, for example, by the high proportion of patients on ventilator or requiring vasopressor therapy. The diagnosis of broad QRS complex tachycardia remains difficult at bedside. The diagnosis of ventricular tachycardia or supraventricular tachycardia was made independently by three board-certified cardiologists who were experts in the field of cardiac arrhythmias. They used established predefined algorithms. There were no discrepancies between them and thus misdiagnosed ventricular tachycardia was very unlikely.

Supraventricular arrhythmias did not significantly impact on hospital survival in ICU patients, in contrast to previous reports from single-center studies (6, 7, 19). In fact, in the previous studies, there were no attempts to control for differences in other prognosis factors. Thus, it cannot be ruled out that the observed increased mortality rates in these studies may have been explained by factors other than arrhythmias. Indeed, in our study, adjustment for age, past medical history of cardiovascular diseases, admission category, severity of illness (i.e., SAPS II and need for mechanical ventilation or vasopressors), admission diagnosis, and propensity scores erased the difference in risk of death observed in univariate comparison between patients with or without supraventricular arrhythmias. Thus, it is likely that supraventricular arrhythmias are a marker of critical illness severity rather than a direct cause of death (19). As previously reported in trauma patients, the standardized mortality ratio was similar in patients with or without supraventricular arrhythmias (19). In contrast, ventricular arrhythmias were strongly associated with an increased risk of death and the standardized mortality ratio was significantly greater in patients with than in those without ventricular arrhythmias. Both supraventricular and ventricular arrhythmias significantly increased the risk of neurological sequelae, as reported for postoperative sustained arrhythmias (24). However, the increased risk of neurological sequelae remained constant regardless of covariate and propensity score adjustments only for ventricular arrhythmias. Of note, inference (exact small-sample inference was performed) was based on 923 without neurological sequelae (among which only 5 had ventricular tachycardia [VT]) and on 58 patients with neurological sequelae (among which only 3 had VT) and thus should be taken with caution.

In conclusion, this large, prospective, multicenter inception cohort study provides an estimate of the incidence of cardiac arrhythmias in a general ICU population of about 12%. Atrial fibrillation was the most common form of arrhythmia. Ventricular arrhythmias increased the risk of in-hospital mortality and the risk of neurological sequelae. In contrast, supraventricular arrhythmias and conduction abnormalities had no impact on the risk of in-hospital mortality and on the risk of neurological sequelae.

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