Incidence and type of cardiac arrhythmias in critically ill patients: a single center experience in a medical-cardiological ICU

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Abstract Objective: To determine the frequency and types of significant, sustained arrhythmias in a mixed ICU.
Design and setting: Prospective, observational study in a medical-cardiological-postoperative ICU at a university hospital.
Patients: 133 consecutive patients with arrhythmias.
Measurements and results: All patients had continuous ECG monitoring and automatic arrhythmia detection. We assessed: (a) sustained (> 30 s) tachyarrhythmias; (b) all tachyarrhythmias requiring therapy; (c) bradycardias of fewer than 40 beats/min or requiring intervention. There were 310 arrhythmia episodes: 278 tachyarrhythmias (108 narrow-QRS complex, 168 wide-QRS complex; 179 regular, 97 irregular) and 32 bradycardias. Of the 278 tachycardias in 54 patients, 135 (48.6 %) were ventricular. There were 13 episodes of torsade de pointes (4.67 %) in five patients. Of the 278 tachycardiac episodes 83 were atrial fibrillation (29.8 %, 63 patients), 10 atrial flutter (3.6 %, 8 patients), 21 supraventricular tachycardias (7.55 %, 7 patients), and 2 ectopic junctional tachycardia (0.72 %, 1 patient). The number of patients showing significant arrhythmias was comparable over the years (1996: 4/28 [14.3 %], 1997: 52/302 [17.2 %], 1998: 55/286 [19.2 %], 22/140 [15.7 %] 1-7/1999). The ICU stay was significantly longer in arrhythmia patients than in 623 patients without arrhythmias (median 4 vs. 14 days), and there was a trend towards higher mortality (40/133, 30.8 %, vs. 132/623, 21.2 %, P = 0.061, log-rank).
Conclusion: Only one-fifth of patients in this mixed ICU had significant arrhythmias, taking a contemporary definition of arrhythmias. Ventricular tachycardia and atrial fibrillation were the most frequent arrhythmias.

Keywords Arrhythmias · Intensive care unit · Incidence · Atrial fibrillation · Ventricular tachycardia

Introduction
Critically ill patients frequently develop cardiac arrhythmias, and electrocardiography is the sine qua non in the monitoring of such patients [1]. Despite clinical knowledge and this widely held belief, data in support of this view are available only in selected cohorts of patients. Arrhythmias are well defined in patients after myocardial infarction, in patients with underlying heart disease [2, 3, 4, 5] or pulmonary disease [6, 7], and in patients after cardiac transplantation [8, 9]. There are numerous studies on the therapy of arrhythmias in the ICU, particularly on the therapy of postoperative atrial fibrillation (AFIB) [10, 11, 12, 13, 14, 15, 16]. There are also data on the incidence of atrial and ventricular arrhythmias after cardiac surgery [17, 18, 19, 20], of cardi-
ac “arrhythmias” during postural drainage and chest percussion [21], and of arrhythmias during pulmonary artery catheter removals [22]. The incidence of sinus node dysfunction has been extensively studied in orthotopic cardiac transplant recipients [8, 23].

As to the incidence of arrhythmias in a mixed ICU there is a single, extensive epidemiological survey available [25]. The weakness of this and other previous studies are their wide inclusion criteria. For example, ventricular extrasystoles, couplets, or triplets are currently not regarded as significant arrhythmias. Likewise, nonsustained and sustained ventricular tachycardia (VT) are approached differently. Contemporary criteria for arrhythmias were not applied in some studies [21, 22], and one study has been criticized since the tachycardia mechanism was not established [24].

Prospective data on the epidemiology of cardiac arrhythmias in a general ICU are lacking. We felt that arrhythmias are not very frequent even in our cardiologicaly oriented medical ICU when more contemporary criteria of significant arrhythmias are applied. To test this hypothesis the present study prospectively obtained data on arrhythmia incidence and type of arrhythmias in a medical-cardiological ICU that also admits patients after cardiac and thoracic surgery.

Methods and materials

Between 18 November 1996 and 17 July 1999 all consecutive arrhythmia episodes in a medical-cardiological ICU were prospectively assessed. Included were all episodes of all patients with new-onset, sustained arrhythmias that were either self-terminated or required intervention. An arrhythmia was considered as sustained if it lasted at least 30 s; it was considered as clinically significant if it was sustained, and/or if intervention/termination was required. The following arrhythmias were included: (a) sustained (≥30 s) monomorphic or polymorphic wideQRS tachycardias that were self-terminated; (b) sustained (≥30 s) monomorphic or polymorphic wide-QRS tachycardias that required medical or electrical termination, including any (even if lasting < 30 s) wide-QRS tachyarrhythmias that required therapy due to degeneration and hemodynamic instability; (c) sustained narrow-QRS tachycardias such as new-onset atrial flutter or fibrillation, atrial tachycardias, and other narrow-QRS tachycardias usually classified as “supraventricular” (AV nodal reentry and AV reentry); and (d) new-onset bradyarrhythmias that required intervention. These included sinus bradycardias of less than 40 beats/min, junctional bradycardias, second- and third-degree AV blocks and iatrogenically induced bradyarrhythmias during procedures or tracheal suctioning. Arrhythmias thought to be related to typical procedures performed in the ICU such as tracheal suctioning were explicitly assessed.

The design of the study and the ICU setting did not allow definite differentiation of AV nodal reentry and AV reentry tachycardias, which is possible only in an electrophysiology laboratory. Also, differentiation between VT and supraventricular tachycardia could not always be made by our means. This is confined also to the electrophysiological laboratory. Extrasystoles, couplets, and triplets were excluded. Likewise, short runs of wide-QRS tachycardia lasting less than 30 s were not included if intervention was not required within that time. Also, chronic tachyarrhythmic AFIB present before admission to our ICU and sinus tachycardia were excluded.

All patients had continuous electrocardiographic monitoring, and all arrhythmias were recorded automatically, including electrocardiography, date and time (Arrhythmia Display/Controller ADC, Hewlett and Packard, Andover, Mass., USA). Thus, systematic arrhythmia detection was ensured according to preset detection parameters. If possible, 12-lead electrocardiography was performed to differentiate possible tachycardiac mechanisms. This, however, was not a prerequisite for inclusion of a tachycardia. Differential diagnosis of wide-QRS tachycardias was carried out according to accepted algorithms [26, 27]. Ventricular fibrillation was classified as an episode of tachycardia but not with respect to QRS width and regularity. If appropriate, increasing doses of adenosine (6, 12, and 18 mg intravenously) were administered for differential diagnosis of tachyarrhythmias. This was performed on clinical grounds at the discretion of the treating physician. If available and deemed necessary, epicardial recordings were obtained via temporary electrodes and were used for differential diagnoses of arrhythmias in postoperative patients.

A standardized questionnaire was used by two of the authors to characterize and classify arrhythmias; differences were resolved by consensus. Wide-QRS tachycardias that could not be classified with certainty as VT or aberration, and upon which no consensus could be achieved were classified as “not determinable.” Recurrent arrhythmias that were self-limited or self-terminated were recorded as distinct, previous arrhythmia episodes. The following arrhythmia characteristics were assessed: bradycardia/tachycardia, wide-/narrow-QRS complex tachycardia, rate of arrhythmia, regularity versus irregularity of arrhythmia, presence of a short-long initiation sequence, duration and outcome of arrhythmia, the use of adenosine for differential diagnosis, medication used for treatment and dosage, use of synchronized or nonsynchronized direct current cardioversion, use of overdrive termination, overpacing protocols to suppress recurrence of arrhythmia, and use of the Zoll pacemaker.

The study followed an episode-based design. First, the number of patients showing “significant” arrhythmias each year was related to the total number of patients treated in this ICU annually. Second, the distribution of the various arrhythmias among patients showing significant arrhythmias is given. This was an uncontrolled study. Only ICU stay and survival were evaluated for the complementary ICU population (n = 623) treated during the time of the study.

Diagnoses in our overall ICU population are presented in Table 1; these data were not part of the study protocol and were not evaluated by the authors and are shown here merely for background characterization. Figure 1 presents the number of patients treated and screened during the study period (n = 756), and the number of patients with and without arrhythmias, and the number of patients who died in each group.

Data are given as means ± standard deviation if normally distributed. Skewed data are presented as median and range and were compared by the Mann-Whitney U test. Survival estimates were calculated by the Kaplan-Meier method, and mortality was compared by the log rank test, which is more sensitive in assessing early survival differences. Categorical data are given as number and percentage and compared using the χ² statistic. A P value less than 0.05 was considered significant in all analyses.