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Abstract Objective: Incidence, types, and factors associated with new onset tachyarrhythmias (TA) in surgical intensive care patients. Design: Pairwise-matched case-controlled study. Setting: Surgical intensive care unit (ICU) with nine intensive care beds. Patients: During a 1-year period, all TA patients (n = 89) were included in the study. Control patients (n = 82) without TA were matched according to age, sex, and surgical region. Methods: TA workup included: 12-lead ECG, arterial blood gas, serum electrolyte (K+, Mg2+), and serum CK/CKMB isoenzyme analysis. Pre-existing cardiovascular and pulmonary disease, cardiovascular risk factors, preoperative regular medication, and admission SAPS were recorded in all patients. A multiple organ dysfunction syndrome (MODS) score, the presence or absence of SIRS or sepsis, and hemodynamics (MAP and CVP) before onset of TA were evaluated in TA patients, while in control patients highest MODS-score, the presence or absence of SIRS or sepsis, mean hemodynamic and laboratory values calculated from highest and lowest readings during ICU stay were used for statistical comparison. Logistic regression analysis was performed to identify variables multivariately associated with TA. Results: Eighty-nine (14.8%) of 596 patients developed TA. Atrial fibrillation was most frequent (60.7%). Presence of SIRS or sepsis (adj. OR = 36.45; 95% CI: 11.5–115.5), high admission SAPS (adj. OR = 1.25; point; 95% CI: 1.08–1.44), high CVP (adj. OR = 1.27; mmHg; 95% CI: 1.09–1.48), and low arterial oxygen tension (adj. OR = 0.97; mmHg); 95% CI: 0.95–0.99) were found to be significant predictors for development of TA. Conclusions: In surgical patients hypoxia, high cardiac filling pressures, a greater degree of physiologic derangement at admission, and the presence of SIRS and sepsis are independent risk factors for the development of TA.

Key words
Tachyarrhythmias · Surgical intensive care · Case control study · Incidence · Risk factors

Introduction

Tachyarrhythmias are well-known complications of critical illness and may contribute significantly to morbidity and mortality of intensive care patients [1, 2]. The reported rate of occurrence varies widely depending on the patient population studied and on defined patient selection criteria [3, 4, 5, 6]. It has been reported that advanced age, male sex, a history of previous cardiac arrhythmias, pre-existing cardiorespiratory disease, acute myocardial ischemia, and perioperative factors are significant risk factors for the development of tachy-
arrhythmias in surgical patients [6, 7, 8, 9]. In addition, in the clinical situation in the intensive care ward physicians often associate new onset tachyarrhythmias with the presence of hypoxia or electrolyte disturbances, e.g., hypokalemia or hypomagnesemia, although their pathophysiological importance for the development of new onset tachyarrhythmias in the perioperative period is still unclear [10, 11]. In theory, proper identification of patients at risk of postoperative tachyarrhythmias, and subsequent prophylactic therapy, may reduce the length of hospitalization, costs and probably patient mortality. A recent report has shown that preoperative amiodarone prophylactics in patients undergoing complex cardiac surgery significantly reduced the incidence of postoperative atrial fibrillation and the duration and cost of hospitalization [12].

In the present study we investigated the incidence, types, and factors associated with the development of new onset tachyarrhythmias in a pairwise-matched (1:1) case-control study. TA patients were matched according to age, gender, and surgical region. Using a multiple logistic regression analysis, significant predictors for the development of TA in surgical intensive care patients were identified.

### Patients and methods

The study was approved by the university hospital ethical committee. Over a 1-year period (15 March 1997–15 March 1998) we prospectively evaluated all patients (n = 596) admitted to a nine-bed surgical intensive care unit (SICU) for development of new onset tachyarrhythmias. The (ICU) receives patients from all types of major elective and emergency surgical procedures. The majority of patients, approximately two-thirds, are admitted after major cardiothoracic and abdominal surgery.

All patients developing TA during ICU stay were enrolled in the study (n = 89). TA was defined as heart rate (HR) ≥ 130 bpm for at least 1 h in hemodynamically stable patients, or as HR ≥ 100 bpm in hemodynamically unstable patients requiring immediate antiarrhythmic therapy. Patients developing more than one episode of TA were included only at their first TA-episode. Control patients (n = 82) were selected among SICU-patients according to following criteria: Admittance to the ICU during the study period; no episode of TA; same sex; same age (± 5 years); same surgical region. Matching was adequate in 92.1 %.

The following data were collected from all patients: (a) demographic data, including age, sex, weight, height, and preoperative cardiac rhythm; (b) SAPS was calculated in all patients based on data obtained within the first 24 h after ICU admission [13]. In patients developing TA within the first 24 h, SAPS was calculated from data obtained before onset of TA; (c) premorbidity factors, including history of coronary artery disease, myocardial infarction, heart insufficiency, cardiomyopathy, other cardiac disease (e.g., valvular heart disease), hypertension, diabetes mellitus, chronic obstructive pulmonary disease, smoking, and previous arrhythmia episodes; (d) preoperative regular medication, including cardiac glycosides, β-blocking agents, calcium channel blockers, ACE-inhibitors, diuretics, nitrates, other cardiovascular medication, intake of aminophyllin-containing preparations, and regular use of inhalative β2-adrenoceptor agonists; (e) premorbidity factors and preoperative regular medication were recorded in a binary fashion (1 = presence or history of a defined disease or intake of a certain group of drugs; 0 = no specified disease, no use of a certain group of drugs).

In TA patients, the multiple organ dysfunction syndrome (MODS) (Table 1) score was calculated from the worst physiologic data before onset of tachyarrhythmia. In control patients, the highest daily MODS score during ICU stay was used for statistical comparison [14].

TA patients were evaluated for the presence or absence of the clinically defined syndromes of SIRS and sepsis specifically during

<table>
<thead>
<tr>
<th>Function</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary Renal</td>
<td>PaO2/FiO2 &gt; 300 Creatinine &lt; 2.0 mg%</td>
<td>PaO2/FiO2 &gt; 250 Creatinine &gt; 2.0 mg%; doubling of creatinine in patients with previous compensated renal failure</td>
<td>PaO2/FiO2 &lt; 250 acute hemofiltration; acute hemodialysis</td>
</tr>
<tr>
<td>Hepatic</td>
<td>Bilirubin &lt; 2.0 mg%; SGOT/SGPT within normal range</td>
<td>bilirubin 2–5 mg%; SGOT/SGPT &lt; 3 times normal value</td>
<td>bilirubin &gt; 5.0 mg%; SGOT/SGPT &gt; 3 times normal value</td>
</tr>
<tr>
<td>Hematologic</td>
<td>Thrombocytes within normal range; normal coagulation</td>
<td>Thrombocytes decrease &gt; 25%; abnormal PT/aPTT with and without bleeding</td>
<td>hemorrhagic diathesis; massive transfusion 5 blood products/h or &gt; 10 blood products/24 h</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>No gastrointestinal bleeding</td>
<td>Ileus &gt; 7 days or gastrointestinal bleeding with transfusion &lt; 6 blood products/24 h</td>
<td>gastrointestinal bleeding requiring transfusion &gt; 6 blood products/24 h</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>Normal blood pressure; no vasodilative drugs except dopamine &lt; 5 µg kg min</td>
<td>Fluid resuscitation &gt; 50% of normal need and/or dopamine &gt; 5 µg kg'1 min'1; dobutamine &lt; 10 µg kg'1 min'1, phenylephrine</td>
<td>Dobutamine &gt; 10 µg/kg/min, epinephrine, norepinephrine, combination of catecholamines, IABP, VAD</td>
</tr>
<tr>
<td>Central nervous system</td>
<td>Glasgow coma score &gt; 12</td>
<td>Glasgow coma score 11–9</td>
<td>Glasgow coma score &lt; 8</td>
</tr>
</tbody>
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