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Original article

# Early ventricular tachyarrhythmias after coronary artery bypass grafting surgery: Is it a real burden?

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ABSTRACT

*Background:* The prevalence of ventricular dysrhythmias (VD) [ventricular premature beats (VPBs), ventricular couplets (Vcouplets), ventricular runs (Vruns)] after coronary artery bypass grafting (CABG) has so far not been examined. The goal of this study is to examine characteristics of VD and whether they precede ventricular tachyarrhythmias (VTA) during a postoperative follow-up period of 5 days using continuous rhythm registrations. In addition, we determined predictive factors of VD/VTA.
*Methods:* Incidences and burdens of VD/VTA were calculated in patients ($N$ = 105, 83 male, 65 ± 9 years) undergoing primary, on-pump CABG. Independent risk factors were examined using multivariate analysis.
*Results:* VPBs, Vcouplets, and Vruns occurred in respectively 100%, 82.9%, and 48.6% with corresponding burdens of 0.05%, 0%, and 0%. Sustained ventricular tachycardia (VT) and ventricular fibrillation (VF) did not occur in our cohort. Independent risk factors for VD included male gender, mitral valve insufficiency, hyperlipidemia, and age ≥60 years.
*Conclusions:* VD are common in patients with coronary artery disease after CABG. Despite high incidences of these dysrhythmias, corresponding burdens are low and sustained VT or VF did not occur. Incidences were highest on the first postoperative day and diminished over time.


## Introduction

Ventricular premature beats (VPB) are common in subjects without apparent heart disease [1–4], occurring in about 6% of the general population [3]. In healthy subjects, VPBs with a frequency of 1–10/h occurred in 79.3%, whereas frequent VPBs (≥30/h) occurred in 8% [2]. Other studies reported incidences of frequent VPBs in general populations ranging between 1.2% and 10.7% [3]. These frequent VPBs are in middle aged and elderly subjects significant predictors of cardiovascular events and are responsible for a 2- to 4.6-fold increased risk of (sudden) cardiac death [3].

In patients undergoing cardiac surgery, postoperative ventricular tachyarrhythmias (VTA), including sustained ventricular tachycardia (VT) and ventricular fibrillation (VF), are rare [5–10] with reported incidences varying from 0.95% to 5% depending on study design, cut-off values and patient characteristics [7–10]. However, these VTA are associated with an increased mortality [5–11], particularly in patients with reduced left ventricular function after coronary artery bypass grafting (CABG) [12].

Independent risk factors for postoperative VTA include older age, emergent surgery, lower ejection fraction, on-pump surgery, peripheral vascular disease, female gender, body mass index (BMI) >25 kg/m$^2$, unstable angina, need for inotropic agents or an intra-aortic balloon pump, and the combination of ventricular late potentials, ejection fraction ≤38%, and standard deviation of all normal RR intervals ≤28 ms [7–9].

To date, the prevalence of postoperative VTA has only been studied during the first 48 h and other ventricular dysrhythmias (VD), including VPBs, ventricular couplets (Vcouplets), and ventricular runs (Vruns) have not been taken into account [7–10].

The aim of this study is to examine the occurrence of VPBs, Vcouplets, Vruns, and whether they precede VT or VF during a postoperative follow-up period of 5 days in patients undergoing

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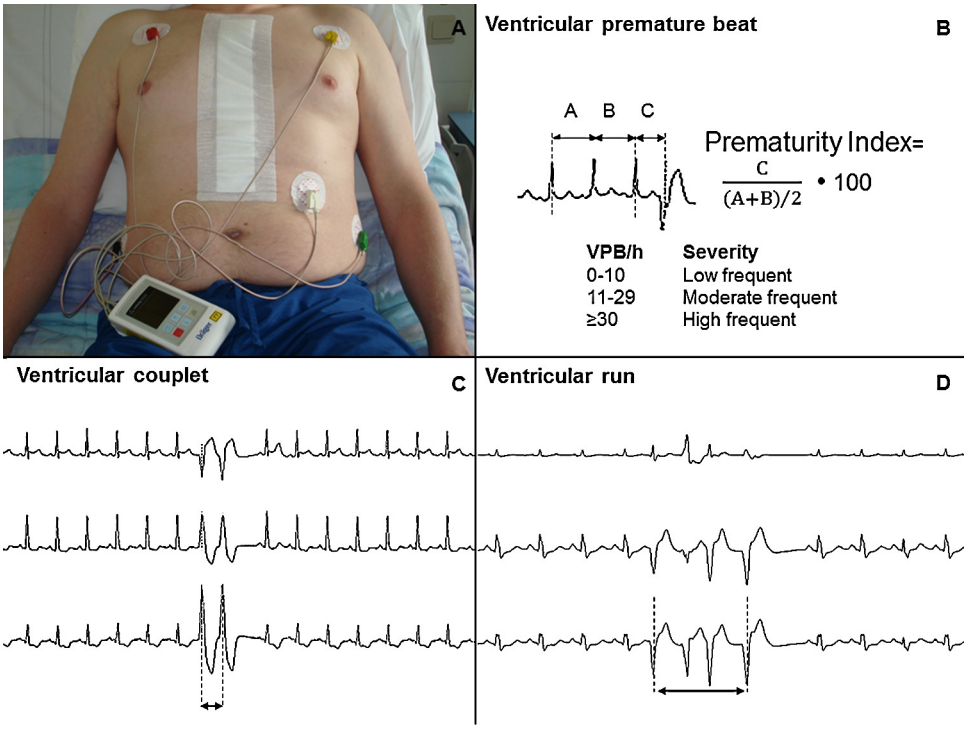


**Fig. 1.** Methods. (A) Patient connected to a bedside monitor with leads I, II, and III after coronary artery bypass grafting surgery. (B) Rhythm registration demonstrating the calculation of the prematurity index of a ventricular premature beat (VPB). Determination of the duration of a ventricular couplet (C) or ventricular run (D), defined as the time between the first and last R wave (arrow).

CABG using continuous rhythm registrations. In addition, we determined which risk factors predict the occurrence of these arrhythmias.

## Methods

### *Study population*

The study population consisted of 105 successive patients undergoing elective, primary on-pump CABG in the Erasmus MC Rotterdam. This study is part of the Rotterdam Rhythm Monitoring Project (AMOR), which was approved by the institutional medical ethical committee (MEC2012-481). As AMOR is an observational study, written consent was not required. Preoperative electrocardiographic (ECG) and clinical data were extracted from electronic patient files.

### *Postoperative continuous rhythm registrations*

Postoperative rhythm registrations were obtained from bedside Infinity® monitors (Draeger, Lubeck, Germany) and stored on a hard disk using a custom-made program (Taperec, Rotterdam, the Netherlands) with a sampling rate of 200 Hz as CPZ-files (compressed monitoring data) [12].

All recordings were analyzed using multichannel Holter scanning software Synescope™ (Sorin Group, Ela Medical, Clamart, France). In order to analyze continuous rhythm registrations in Synescope™, all registrations were converted into International Society for Holter and Noninvasive Electrocardiology (ISHNE) files, a standard Holter output file format. Conversion was performed by another custom-made program with preservation of the characteristics of the original data [13]. The ISHNE files could not contain over 24 h of data in order to be compatible with Synescope™. Therefore, longer ISHNE files were split into smaller files each containing rhythm registrations for a maximum period of 24 h.

For this purpose, successive obtained cpz-files were uncompromised by Taperec and converted by AutoIt Script (AutoIt Consulting Ltd, Birmingham, UK) into ISHNE files, which were then successively imported into Synescope™. Analyzed data were exported from Synescope™ as ASCII files and imported into Excel 2010 for calculations using macros programmed in Visual Basic™ 2010.

### *Analysis of cardiac arrhythmias*

ECG holter recordings were available from the moment of arrival on the intensive care unit until hospital discharge. The ECG holter recordings of the first 5 postoperative days were used for analyses of VD. Analyses of VPB, Vcouplet, Vrun sustained VT, and VF were performed using 2 leads, selected from leads I, II, and III, as precordial leads are not available during routine postoperative monitoring (Fig. 1).

Vcouplets consisted of two consecutive VPBs. Vruns were defined as a minimum of three consecutive VPBs with a maximum duration of 29 s and sustained VT as a series of ventricular premature beats lasting ≥30 s. Traditional cut-off lines of 10 and 30 VPB/h [2] were used to divide severity classes into low, moderate, and high frequent, as shown in panel B of Fig. 1.

The total number of VPBs, Vcouplets, and Vruns was determined in all registrations of every patient. The VPB burden per day was calculated for every patient separately by dividing the total number of VPBs by the total number of QRS complexes on that day, whereas the Vcouplet and Vrun burden was calculated as the total duration of Vcouplets (ms) or Vruns (s) divided by the total recording time on that day. VPBs were identified based on their morphology. The degree of prematurity of VPBs was defined as the coupling interval of the VPB divided by the average cycle length of the two preceding beats, as demonstrated in panel B of Fig. 1. VPBs with a prematurity index ≥30% and <100% were considered reliable for analysis of the distribution of prematurity indices, which was verified by manually checking all VPBs.

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