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ORIGINAL ARTICLE

Malignant ventricular arrhythmias after off-pump coronary artery bypass

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KEYWORDS
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Background/Purpose: Sustained ventricular tachycardia and ventricular fibrillation (VT/VF) are rare complications after coronary surgery. Off-pump coronary artery bypass (OPCAB) was developed to decrease postoperative complications. No studies to date have specifically addressed VT/VF after OPCAB. We sought to assess the incidence, risk factors, and outcome of VT/VF after OPCAB.

Methods: The study included a retrospective review of 1010 patients undergoing OPCAB between 2000 and 2012. Data were compared between the VT/VF patients and control patients who were the first cases of OPCAB in each month during the study period and did not have VT/VF.

Results: Twenty-three patients (2.3%) developed VT/VF after OPCAB. The hospital mortality rate was 17.4%. In univariate analysis, the risk factors for VT/VF were old age, rapid heart rate, prolonged corrected QT interval, severe congestive heart failure, poor left ventricular ejection fraction, large left ventricular end-diastolic diameter, chronic kidney disease, preoperative dialysis, low blood hemoglobin level, preoperative intubation, recent myocardial infarction, high European System for Cardiac Operative Risk Evaluation, urgent/emergent operation, use of intra-aortic balloon pump, conversion to on-pump beating heart, postoperative dialysis, and no use of beta-blockers after operation. Multivariate analysis identified preoperative corrected QT interval $>$ 426 milliseconds [odds ratio (OR) $=$ 4.501; 95% confidence interval (CI) $=$ 1.153 $-$17.570] and estimated glomerular filtration rate $<$ 30 mL/minute/1.73 m^2 (OR $=$ 4.876; 95% CI $=$ 1.112$-$21.374) as independent risk factors.

Conclusion: Postoperative VT/VF was rare after OPCAB but was associated with high mortality. Prolonged corrected QT interval and chronic kidney disease were independent risk factors. Recognition of these risk factors, proper prevention, and early intervention may improve survival.

Conflicts of interest: All contributing authors declare no conflicts of interest.

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Introduction

Malignant ventricular arrhythmias, including sustained ventricular tachycardia and ventricular fibrillation (VT/VF), are rare but serious complications after coronary artery bypass graft (CABG) surgery.[1–8] Identification of the risk factors and further preventive strategy are important for patient survival. However, their mechanisms and clinical implications remain uncertain. CABG is one of the most common types of cardiac surgery performed in adult patients. It has traditionally been performed with the use of cardiopulmonary bypass. Cardiopulmonary bypass has been suggested to be related to the development of many postoperative complications. The technique of operating on a beating heart or off-pump coronary artery bypass (OPCAB) was developed to decrease postoperative complications, some of which are related to the use of cardiopulmonary bypass.[9] No studies to date have specifically addressed the occurrence of VT/VF after OPCAB. The purpose of this study was to assess the incidence, risk factors, and outcome of VT/VF after OPCAB.

Methods

Patients

This was a retrospective, observational, cohort study of prospectively collected data. We included all consecutive unselected patients who were planned to undergo OPCAB performed by a single surgeon (Dr Hsu) between December 2000 and January 2012 at the National Taiwan University Hospital. Patients simultaneously undergoing valvular or aortic surgery were excluded. No patient with coronary artery disease was excluded from the off-pump method because of the pattern of coronary artery disease, presence of cardiogenic shock, or emergency of surgery. Patients with a previous history of VT/VF before OPCAB were included.

The National Taiwan University Hospital is a 2200-bed tertiary care hospital. It serves an urban population of 2 million as both first-line and tertiary facilities. It serves also as a referral center for other hospitals in the country with a population of 23 million people. All data were collected by retrospective chart review. The local institutional medical ethics committee approved the study and waived the need for informed consent.

Operation

Beginning from December 2000, we stared a systematic approach to treat all coronary artery disease patients with OPCAB.[10] The operation was performed through a median sternotomy. The heparin dose is two-thirds of the standard dose for cardiopulmonary bypass. The target-activated clotting time is more than 400 seconds. This is partially reversed with one-half of the calculated protamine dose after the completion of coronary anastomosis. Cardiopulmonary bypass was on standby without priming the pump. Distal anastomoses were performed using a suction-type coronary stabilizer and intracoronary shunt. Pericardial traction suture and apical suction device were not used for assistance. Only table tilting was used to help position the heart.The usual order of bypass was anterior wall, posterior wall, and lateral wall. The operation was converted to on-pump beating heart CABG if there was hemodynamic compromise during the procedure.[11]

Definition

The cases of VT/VF were defined as patients who required advanced cardiac life support interventions to terminate the malignant ventricular arrhythmia and to stabilize them in the postoperative period before discharge.[1–8,12] Sustained VT was defined as a uniform tachyarrhythmia of ventricular origin that had a duration $>$ 20 seconds, unless terminated early because of hemodynamic collapse.[1–8] VT/VF appearing after discharge was not included in this study.

Risk factor

During the study period, 134 patients who were the first cases of OPCAB in each month by time line during the study period and did not have VT/VF were selected as the control patients. Data were compared between the study patients and control patients.

Statistical analysis

SPSS 20.0 for Windows was used for analysis (SPSS Inc., Chicago, IL, USA). All data were presented in form of a median with interquartile range. Differences between patients with and without postoperative VT/VF were analyzed with Chi-square test for categorical variables and Mann–Whitney *U* test for continuous variables. The diagnostic cutoff value for continuous variables was calculated by receiver-operating characteristic curves. The cutoff value was used as a new categorical data. A multivariate logistic regression analysis was performed on variables that were considered as risk factors in the univariate analysis with $p < 0.05$. When two or more risk factors in the same field were strongly correlated, only one factor that most strongly associated with VT/VF was retained in the final model. A p value < 0.05 was considered statistically significant. Follow-up information was obtained by chart review and telephone contact. Survival in VT/VF patients was estimated by the Kaplan–Meier method.

Results

VT/VF

Twenty-three patients suffered VT/VF (2.3%) after OPCAB. Patient characteristics are listed in Table 1. There were 19 men and four women with the median age of 71 years (range: 44–90). Three patients (13%) had VT/VF before operation. Nineteen patients had triple vessel disease, and nine patients had significant left main disease. Seven patients had impaired left ventricular ejection fraction $<$ 30%. Mode of surgical intervention was elective in 10 patients, urgent in nine patients, and emergent in