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Prognostic value of ventricular arrhythmia in early post-infarction left ventricular dysfunction: the French nationwide WICD-MI study

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Keywords:

Myocardial infarction; Risk stratification; Sudden cardiac death; Ventricular fibrillation; Ventricular tachycardia; Wearable cardioverter–defibrillator.

Abbreviations

CABG :coronary artery bypass grafting; eGFR :estimated glomerular filtration rate ; ICD : implantable cardioverter–defibrillator; LVEF: left ventricular ejection fraction ;MI :myocardial infarction; NYHA : New York Heart Association; SCD :sudden cardiac death; STEMI : ST-elevation myocardial infarction; VA : ventricular arrhythmia; VA+/WCD : occurrence of VA while on WCD therapy; VA-/WCD : absence of VA while on WCD therapy; VF : ventricular fibrillation; VT : ventricular tachycardia; WCD : wearable cardioverter–defibrillator.

Abstract

Background and aims:

Prophylactic implantable cardioverter-defibrillators (ICDs) are not recommended until left ventricular ejection fraction (LVEF) has been reassessed 40 to 90 days after an acute myocardial infarction. In the current therapeutic era, the prognosis of sustained ventricular arrhythmias (VAs) occurring during this early post-infarction phase (i.e. within 3 months of hospital discharge) has not yet been specifically evaluated in post-myocardial infarction patients with impaired LVEF. Such was the aim of this retrospective study.

Methods:

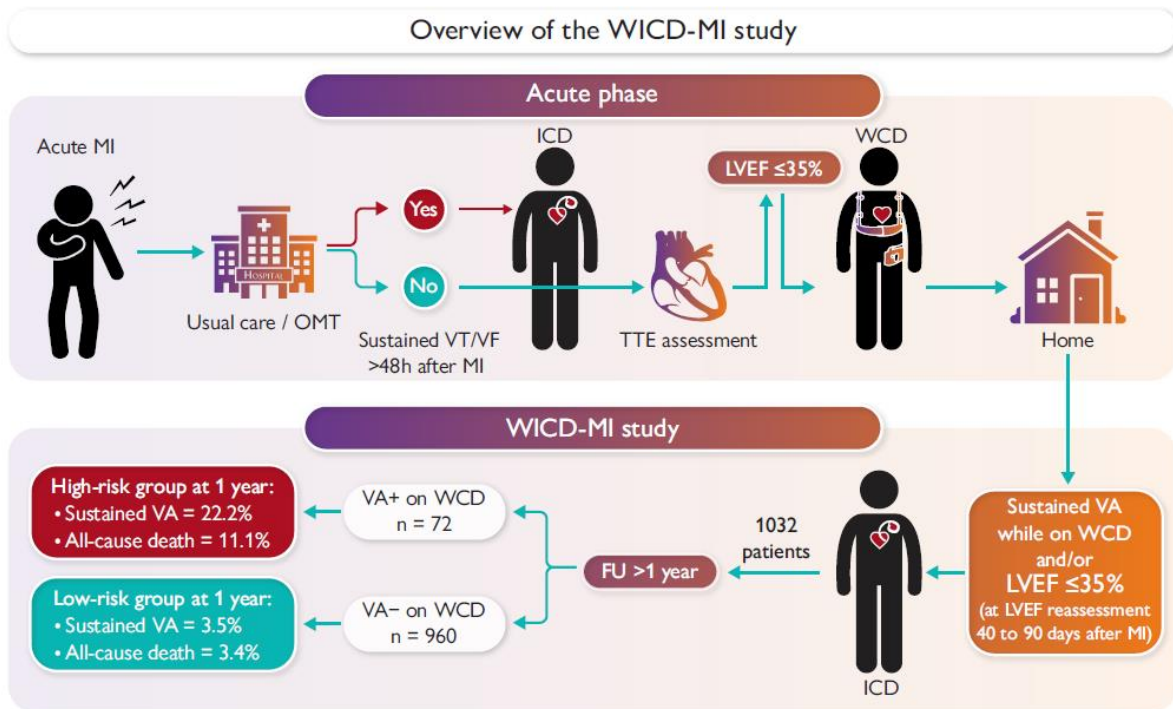
Data analysis was based on a nationwide registry of 1032 consecutive patients with LVEF \leq 35% after acute myocardial infarction who were implanted with an ICD after being prescribed a wearable cardioverter-defibrillator (WCD) for a period of 3 months upon discharge from hospital after the index infarction.

Results:

ICDs were implanted either because a sustained VA occurred while on WCD (VA+/WCD, n = 72) or because LVEF remained \leq 35% at the end of the early post-infarction phase (VA-/WCD, n = 960). The median follow-up was 30.9 months. Sustained VAs occurred within 1 year after ICD implantation in 22.2% and 3.5% of VA+/WCD and VA-/WCD patients, respectively (P < .0001). The adjusted multivariable analysis showed that sustained VAs while on WCD independently predicted recurrence of sustained VAs at 1 year (adjusted hazard ratio [HR] 6.91; 95% confidence interval [CI] 3.73-12.81; P < .0001) and at the end of follow-up (adjusted HR 3.86; 95% CI 2.37-6.30; P < .0001) as well as 1-year mortality (adjusted HR 2.86; 95% CI 1.28-6.39; P = .012).

Conclusions:

In patients with LVEF \leq 35%, sustained VA during the early post-infarction phase is predictive of recurrent sustained VAs and 1-year mortality.



Overview of the WICD-MI study. ICD, implantable cardioverter–defibrillator; LVEF, left ventricular ejection fraction; MI, myocardial infarction; OMT, optimal medical therapy; TTE, transthoracic echocardiography; VA, ventricular arrhythmia; VF, ventricular fibrillation; VT, ventricular tachycardia; WCD, wearable cardioverter–defibrillator

Introduction

Primarily induced by ventricular arrhythmias (ventricular tachycardia [VT]/ventricular fibrillation [VF]), the risk of sudden cardiac death (SCD) after myocardial infarction (MI) is time-dependent. This risk is considered highest in the first month after MI (particularly in patients with impaired left ventricular ejection fraction [LVEF]) and decreases rapidly over the first 6 months to reach a plateau after 12 months.¹

In the current therapeutic era, little is known on the outcome of patients who present with VT/VF in the early post-infarction phase²(see the definition in the Methodology section), as our knowledge is based on former and contradictory studies.^{3,4}Numerous studies have uniformly reported a higher incidence and number of VT/VF events,^{5–8}but no differences in mortality rates,^{6–8}in patients with implantable cardioverter–defibrillators (ICDs) in secondary prevention compared with those in primary prevention. However, none of these studies specifically investigated the early post-infarction phase nor provided details of the time elapsed between myocardial infarction and the occurrence of VT/VF or ICD implantation. Nonetheless, a higher mortality has long been observed in patients with VT/VF events in ICD trials.^{9,10}

Although prophylactic ICDs are recommended for primary prevention of SCD after MI in patients with LVEF $\leq 35\%$,^{2,11} clinical trials have failed to demonstrate a mortality benefit of ICD use in the early post-infarction phase after acute MI^{12,13} in patients with impaired LVEF. Thus, prophylactic ICDs are not recommended^{2,11} until reassessment of LVEF after a period of 40 to 90 days (depending on the presence of coronary revascularization) after an acute MI. The rationale for this waiting period is two-fold: (i) the lack of all-cause mortality benefit in the ICD recipients during the first 40 days after MI observed in DINAMIT¹² and IRIS,¹³ and (ii) the fact that partial or complete recovery of LVEF is observed^{14–16} in approximately 50% of patients 3 months after an acute MI under optimal medical treatment (or revascularization).

Patients with reduced LVEF after MI have access to wearable cardioverter–defibrillators (WCDs), which are effective in detecting and treating VT/VF.^{17,18} Nevertheless, because the VEST trial¹⁹ did not demonstrate a reduction in arrhythmic mortality in the early post-infarction phase, the latest published European Society of Cardiology (ESC) guidelines² do not recommend routine use of WCD in this setting, although its use may be considered (recommendation class IIb) in selected patients.

The negative results of DINAMIT,¹² IRIS¹³, and VEST¹⁹ in relation to their respective primary endpoints may legitimately call into question the hypothesis on which these studies were based, namely, the assumption that patients equipped during the early post-infarction phase with either ICD or WCD have better survival than those not treated with either system.

The aim of the present study was to verify whether this hypothesis remains valid in the current therapeutic era in a cohort of consecutive patients. We therefore evaluated the outcome of patients who received an ICD after the prescription of a WCD in the early post-infarction phase. We hypothesized that patients who survived VT/VF events under WCD protection in the early post-infarction phase (and therefore received an ICD for secondary prevention) have a worse outcome in terms of VT/VF recurrence and all-cause death compared with those who had no VT/VF during the early post-infarction phase (and therefore received a prophylactic ICD).

Methods

Study population

The study population consisted of a cohort of consecutive patients recruited from 41 French centers between June 2015 and December 2020 and meeting the following nine chronologically successive inclusion criteria: 1) age > 18 years; 2) hospital admission with a diagnosis of acute MI (ST-elevation MI or non-ST-elevation MI); 3) LVEF $\leq 35\%$ measured by echocardiography during hospitalization, but at least 48 h after admission [or after acute revascularization by percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG)]; 4) WCD prescribed at discharge pending LVEF reassessment at the end of the early post-infarction phase; 5) no discontinuation of WCD before the end of the WCD use period except in cases of documented sustained VT/VF leading to ICD implantation; 6) reassessment of LVEF by echocardiography at the end of the WCD use period; 7) implantation of an ICD at the end of the WCD use period either because of the occurrence of documented sustained VT/VF or because LVEF remained $\leq 35\%$ at reassessment; 8) follow-up period > 12 months after ICD implantation (the date on which follow-up ended is 31

December 2021); and 9) non-opposition to participate in the WICD-MI study (according to French law, patients must be informed of retrospective analysis in which they may be included and can notify their opposition to participation).

The study approved by our institutional review board (University Hospital Nancy) was registered in the ClinicalTrials.gov database (NCT05123885) and complied with the Declaration of Helsinki.

The different phases of myocardial infarction

For the sake of clarity regarding the terms used and to avoid any potential misunderstanding upon reading the manuscript, we propose, for our study population, to arbitrarily use the term 'early post-infarction phase' to define the 3-month period following acute MI and starting at hospital discharge.

According to this temporal-pivot definition, the period preceding this 'early post-infarction phase' corresponds to the acute phase of the infarction, and the period which follows it corresponds to the chronic phase of the infarction.

WCD indication, models, programming, and follow-up

All WCDs prescribed in this study complied with French healthcare system regulations, which state that prescribing a WCD is warranted in the early post-infarction phase after MI in patients with an LVEF $\leq 30\%$ (if discharged before July 2019) or an LVEF $\leq 35\%$ (if discharged after July 2019).

The WCD model used in all patients was manufactured by ZOLL (LifeVest® 4000, ZOLL, Pittsburgh, PA, USA). The precise description of this WCD model was published in the VEST trial.¹⁹

Default VT and VF thresholds (150 and 200 bpm, respectively) and default shock output (150 J) from WCDs were used in all patients.

Before receiving their WCDs, all patients underwent an educational program²⁰ designed to explain the expected benefits and the operation of the WCD (in particular regarding alarms management, battery charging and remote transmission) and to raise awareness of the need for maximum wear time. In addition, all patients were enrolled in ZOLL's online patient data management system (LifeVest® Network), which stores data, including cardiac electrograms, from the WCDs.

All event data submitted to the central monitoring service were analysed by an independent panel of cardiologists for classification into one of four categories: 1) sustained VT, 2) VF, 3) asystole, or 4) no VT/VF and no asystole. Shocks were defined as appropriate when administered for episodes of sustained VT or VF and inappropriate otherwise. Asystole was defined as a heart rate ≤ 10 bpm and duration ≥ 16 s.

ICD indication, models, programming, and follow-up

At the end of the WCD period, an ICD was implanted either because of the occurrence of documented sustained VT/VF (secondary prevention ICD) under WCD or because LVEF remained $\leq 35\%$ at reevaluation (primary prevention ICD according to current guidelines).

The type of ICD device implanted (i.e. transvenous ICD or subcutaneous ICD) as well as the model (single-chamber, dual-chamber, cardiac resynchronization therapy) and choice of manufacturer were left to the discretion of the implanting physician.

ICD programming was the responsibility of each investigator, with consensus among participating centers [Primary Prevention ICD French

Registry (DAI-PP)21] when implanting a transvenous ICD to program 1) lower detection rate limits > 170 bpm for VT and >220 bpm for VF in case of primary prevention and 2) prolonged detection duration to minimize the risk of unnecessary ICD therapy (i.e. self-terminating episodes).

Patients were followed by remote ICD monitoring when they agreed to this follow-up modality and, in all cases, during semiannual visits to the implantation center. Clinical assessment and ICD interrogation and testing were performed at each follow-up visit. Each event leading to ICD therapy (anti-tachycardia pacing and/or shock) was reviewed and classified by a local committee (composed solely of ICD physicians) as appropriate or inappropriate after analysis of electrogram (EGM) recordings. There was no dedicated adjudication committee for this study. Appropriate ICD therapy was defined as therapy given for VT or VF and inappropriate otherwise.

VT/VF storm (also known as 'electrical storm') was defined as three separate VT/VF episodes causing ICD therapy within 24 h.²

Study outcomes

The primary outcome was the occurrence of VT or VF at 1-year follow-up. This primary endpoint was met either when appropriate ICD therapy was administered or when sustained VT (with a rate below the ICD-programmed detection rate) was documented by a 12-lead electrocardiogram (ECG).

Secondary outcomes were 1) occurrence of VT or VF (same definition as for the primary outcome) at any time during follow-up, 2) all-cause death, 3) VT/VF storm, 4) hospitalization for heart failure, and 5) heart transplant or left ventricular assist device (LVAD) implantation.

Follow-up began at ICD implantation. According to one of the abovementioned inclusion criteria, all patients were followed for at least 12 months.

Causes of deaths

Every effort has been made to try to identify the precise cause of death by examining death reports, hospital medical records, post-mortem ICD interrogation, as well as by interviewing relatives or witnesses of the deceased.

Death was defined as being of arrhythmic cause either because intractable ventricular arrhythmia had been duly documented at the time of death or because it met the definition of SCD. SCD was defined as death occurring within 1 h after first cardiac symptoms without evidence of non-arrhythmic causes or within 24 h in cases of unwitnessed unexpected death in a previously stable patient. Death preceded by sudden or progressive or repetitive cardiac decompensation was categorized as heart failure death. Death was categorized as noncardiac vascular when a clear vascular cause was identifiable (such as cerebrovascular stroke) and as non-cardiac nonvascular when a clear non-cardiovascular cause led to death (such as cancer).

When all efforts to identify the cause of death remained unsuccessful, the cause of death was classified as 'unknown'.

Data collection and management

After inclusion, data were collected by the principal investigator at each center and recorded on an electronic case report form (e-CRF). A dedicated web platform was developed to allow data entry and collection through the e-CRFs. Finally, a senior data manager ensured data completeness and accuracy prior to database lock.

Statistical analysis

Preparation of this report was in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology statement for the reporting of observational studies.²²

Categorical variables are presented as numbers and percentages. Continuous variables are described as means and standard deviations (SD) or as medians and interquartile ranges (IQR) for data with a skewed distribution.

Univariate differences were tested using Fisher's exact test for categorical variables and the *t*-test or Wilcoxon test for continuous variables, as appropriate.

The association between the occurrence of VT/VF during WCD and each of the study outcomes was assessed using univariable and multivariable Cox models adjusted for SCD risk score following acute MI calculated from 11 routinely collected clinical parameters²³ and modelled using restricted cubic splines with three knots placed at the 10th, 50th, and 90th percentiles, as recommended by Harrell,²⁴ and corresponding to SCD scores values of 1, 4, and 7 respectively. For 10 of the 11 parameters of this SCD risk score, data were collected in the e-CRFs (i.e. age > 70 years; mean heart rate on WCD \geq 70 bpm; active smoking status; LVEF \leq 30%; diabetes; history of atrial fibrillation; history of prior MI; history of heart failure; estimated glomerular filtration rate (eGFR) < 60 mL/min/1.73 m²; and absence of coronary reperfusion by PCI within 24 h after onset of symptoms for the index MI). For the remaining parameter (Killip class III/IV) of the SCD risk score, which was not systematically assessed in routine care and consequently not part of the e-CRF items, the New York Heart Association (NYHA) Class III/IV was used as proxy.

To preserve completeness of the data in the adjusted analyses, multiple imputation with chained equations (MICE) was used to impute the missing values needed to calculate the SCD risk score. Multiple imputation was therefore performed with the R package MICE25 resulting in 100 imputed datasets. All variables described in *Table 1* were used as predictors for imputation. After imputation, the SCD risk score was calculated in each imputed dataset. The Cox model adjusted for SCD risk score was then applied in each imputed dataset, and the results were finally pooled using Rubin's rules.

Hazard ratios (HRs) are expressed with their 95% confidence intervals (CIs). Survival curves were generated using Kaplan–Meier analyses, with differences between curves tested using the log-rank test.

Statistical analysis was performed using R software (R Foundation for Statistical Computing) version 4.2.1. The two-tailed significance level was set at $P < .05$.

Results

Clinical characteristics of patients

Our study population was derived from a cohort of 2639 consecutive patients recruited from 41 French centers with a diagnosis of acute MI who were prescribed a WCD at hospital discharge because of $LVEF \leq 35\%$ (*Figure 1*). These 2639 patients are part of a larger group of all patients (6099 in total) who were prescribed a WCD for various reasons between June 2015 and December 2020. Supplementary data online, *Table S1* shows the causes of deaths in the 56 patients who died during the WCD period and, therefore, were not enrolled in this study.

Our study population consisted of 1032 consecutive patients with acute MI and $LVEF \leq 35\%$ who were prescribed a WCD at discharge because of their low LVEF and subsequently implanted with an ICD either because of the occurrence of sustained VT/VF while on WCD therapy (VA+/WCD patients) or because their LVEF remained $\leq 35\%$ on reassessment after 6 to 12 weeks, but without VT/VF on WCD (VA-/WCD patients).

Table 1 shows the differences in clinical characteristics between VA+/WCD and VA-/WCD patients at the time of ICD implantation. VA+/WCD patients had poorer NYHA functional status (NYHA class III/IV = 39.6% vs. 19.1%, $P = .001$), higher body mass index (28.1 ± 5.7 vs. 26.5 ± 4.9 kg/m², $P = .012$), and higher average heart rate while on WCD (73.2 ± 12.5 vs. 68.3 ± 9.6 bpm, $P < .0001$) and were prescribed more amiodarone (41.7% vs. 12.2%, $P < .0001$). There was, however, no difference in the NYHA functional status between these two groups of patients at hospital discharge after the index MI (NYHA class III/IV = 44.2% vs. 42.8%, $P = .89$) in patients who subsequently will and will not have a VT/VF event during the WCD period.

Table 1 Comparison of patient characteristics at the time of ICD implantation between those who experienced VT/VF while on WCD (VA+/WCD) and those who did not (VA-/WCD)

	VA+/WCD (n = 72)	VA-/WCD (n = 960)	P-value
Demographics			
Age (years)	61.5 ± 9.0	60.7 ± 10.5	.52
Male	64 (88.9)	796 (82.9)	.25
Clinical characteristics			
LVEF (%)	29.1 ± 6.6	29.3 ± 6.2 [n = 925]	.78
NYHA functional class III/IV	21/53 (39.6)	147/770 (19.1)	.001
Body mass index (kg/m ²)	28.1 ± 5.7 [n = 69]	26.5 ± 4.9 [n = 934]	.012
eGFR <60 mL/min/1.73 m ²	29/64 (45.3)	365/809 (45.1)	1.00
Average heart rate while on WCD (bpm)	73.2 ± 12.5 [n = 69]	68.3 ± 9.6 [n = 865]	<.0001
Medication			
Beta-blocker	71/72 (98.6)	901/949 (94.9)	.25
ACE inhibitors or ARBs	51/71 (71.8)	594/948 (62.7)	.13
Sacubitril/Valsartan	14/71 (19.7)	280/949 (29.5)	.10
MRAs	50/72 (69.4)	689/949 (72.6)	.59
Loop diuretics	49/72 (68.1)	578/948 (61.0)	.26
Amiodarone	30/72 (41.7)	116/947 (12.2)	<.0001
Medical history before index MI			
Hypertension	34/71 (47.9)	400/959 (41.7)	.32
Diabetes	22/72 (30.6)	223/960 (23.2)	.20
Active smoking status	17/71 (23.9)	227/947 (24.0)	.99
History of atrial fibrillation	6/72 (8.3)	46/960 (4.8)	.17
Peripheral artery disease	8/71 (11.3)	60/960 (6.2)	.13
Chronic obstructive pulmonary disease	5/72 (6.9)	55/960 (5.7)	.60
History of heart failure	3/72 (4.2)	64/960 (6.7)	.62
History of prior MI	12/72 (16.7)	180/958 (18.8)	.75
History of prior PCI	13/72 (18.1)	152/959 (15.8)	.62
History of prior CABG	5/72 (6.9)	26/960 (2.7)	.059
Index myocardial infarction			
ST-segment elevation MI	50/71 (70.4)	701/933 (75.1)	.40
Anterior LV wall MI	47/72 (65.3)	669/960 (69.7)	.43
Time from onset of symptoms to hospital <24 h	34/70 (48.6)	566/947 (59.8)	.08
PCI <24 h after hospital admission	35/72 (48.6)	612/958 (63.9)	.011
Congestive heart failure	35/72 (48.6)	412/957 (43.1)	.39
Cardiogenic shock ^a	16/72 (22.2)	241/956 (25.2)	.67
Pre-hospital sustained VT or VF	10/72 (13.9)	77/957 (8.0)	.12
Early (<48 h) in-hospital sustained VT or VF	17/72 (23.6)	123/957 (12.9)	.019
Events and compliance during the WCD period			
Duration of the WCD period (days)	22 (9–52)	89 (56–122) [n = 958]	.0001

Table 1 Continued

	VA+/WCD (n = 72)	VA-/WCD (n = 960)	P-value
Daily WCD wear time (hours)	23.7 (23.2–23.9) [n = 69]	23.6 (22.9–23.8) [n = 910]	.004
Daily WCD wear time >23 h	54/69 (78.3)	665/910 (73.1)	.40
Time interval to first VT/VF event (days)	10 (4–42)	-	-
At least one sustained VT episode	54/72 (75.0)	-	-
At least one sustained VF episode	20/72 (27.8)	-	-
≥Two episodes of sustained VT and/or VF	19/70 (27.1)	-	-
VT/VF storm	16/70 (22.9)	-	-
At least one appropriate shock delivered by the WCD	47/72 (65.3)	-	-
At least one sustained VT episode with aborted shock	30/72 (41.7)	-	-
Inappropriate shocks	1/72 (1.4)	2/958 (0.2)	.20
Asystole	0/72 (0.0)	11/955 (1.2)	1.00
Catheter ablation for VT or VF	2/70 (2.9)	4/958 (0.4)	.057

Continuous variables are expressed as mean ± standard deviation or median (IQR) and categorical variables as frequency (%). In case of missing data, the total number of patients with available data was mentioned.

Abbreviations: ACE, angiotensin-converting enzyme; ARBs, angiotensin II receptor blockers; CABG, coronary artery bypass grafting; eGFR, estimated glomerular filtration rate; IQR, interquartile range; LV, left ventricle; LVEF, left ventricular ejection fraction (assessed by echocardiography); MI, myocardial infarction; MRAs, mineralocorticoid receptor antagonists; n, number of patients; NYHA, New York Heart Association; PCI, percutaneous coronary intervention; SD, standard deviation; VA, ventricular arrhythmia; VT, ventricular tachycardia; VF, ventricular fibrillation; WCD, wearable cardioverter defibrillator. aRequiring inotropes, vasopressors, and/or mechanical circulatory support.

Differences were also observed between VA+/WCD and VA-/WCD patients with respect to index MI, with a lower percentage of VA+/WCD patients treated with primary PCI < 24 h after hospital admission (48.6% vs. 63.9%, $P = .011$) and a higher percentage of VA+/WCD patients with early (<48 h) in-hospital sustained VT or VF (23.6% vs. 12.9%, $P = .019$). There was, however, no association between coronary angiography characteristics or reperfusion therapy and the occurrence of VT/VF or death while on ICD (see Supplementary data online, *Tables S2* and *S3*).

At the time WCD was prescribed, the vast majority of patients (77.3%) had an LVEF ≤ 30%. The remaining patients (22.7%) therefore had an LVEF ≤ 35%, but >30%. Categorizing our population based on whether the qualifying LVEF for WCD prescription was below 30% or not, we observed a lower proportion of patients with LVEF ≤ 30% in the VA+/WCD group compared to the VA-/WCD group (65.3% vs. 78.2%, $P = .019$).

Most patients wore their WCD for more than 23 h per day on average (78.3% of VA+/WCD patients vs. 73.1% of VA-/WCD patients, $P = .40$). There was however a higher compliance in VA+/WCD patients when approaching almost uninterrupted wear of the WCD with a median daily wear time of 23.7 vs. 23.6 h ($P = .004$).

In VA+/WCD patients, the distribution of VT/VF of the median time from hospital to the first VT/VF was 10 days (IQR 4–42 days). The first VT/VF event occurred during the first, second, and third months in 41 (56.9%), 19 (26.4%), and 12 (16.7%) patients, respectively.

Catheter ablation of clinical monomorphic sustained VT was performed in two VA+/WCD patients prior to ICD implantation. Importantly, catheter ablation of inducible sustained monomorphic VT was performed prophylactically in four VA–/WCD patients.

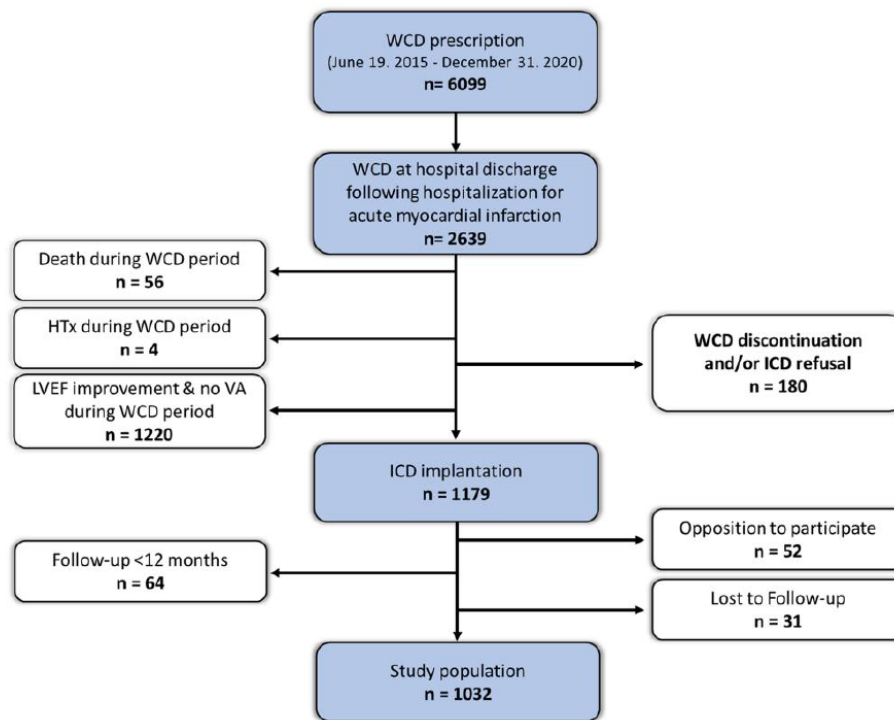


Figure 1 Flow chart showing the source of the study population, which was derived from a cohort of consecutive patients who were prescribed a WCD at hospital discharge after an acute myocardial infarction. Abbreviations: HTx, heart transplantation; ICD, implantable cardioverter–defibrillator; LVEF, left ventricular ejection fraction (assessed by echocardiography); VA, ventricular arrhythmias, i.e. sustained ventricular tachycardia or ventricular fibrillation; WCD, wearable cardioverter–defibrillator

Patient outcomes after ICD implantation

Table 2(univariate analysis) shows the differences in clinical outcomes between VA+/WCD and VA–/WCD patients during follow-up.

The 1032 patients were followed for a median of 30.9 months (IQR 18.0–47.1) after ICD implantation. The median follow-up was 29.2 months (IQR 17.6–48.4) in VA+/WCD patients and 31.0 months (IQR 18.0–46.9) in VA–/WCD patients ($P = .95$). There were no significant differences in ICD characteristics between VA+/WCD and VA–/ WCD patients.

A total of 105 patients died during follow-up. Table 3shows the causes of death in relation to the occurrence of VA while on WCD and/or on ICD. Information on the circumstances of death could be obtained in 82/105 patients (78.1%). In these patients, heart failure ($n = 39$) was the main cause of death, followed by non-cardiac cause ($n = 25$) and arrhythmic death ($n = 13$).

An arrhythmic cause of death was, however, more frequently found in patients who had presented VT/VF under WCD or ICD (8/26 vs. 5/79, $P = .003$).

Association between VT/VF on WCD and long-term outcome

The primary outcome of the study was achieved in 50 of 1032 patients (4.8%): 16 of 72 VA+/WCD patients (22.2%) and 34 of 959 VA-/WCD patients (3.5%) ($P < .0001$).

When considering secondary outcomes, there was a significant difference between VA+/WCD and VA-/WCD patients for all outcomes related to the occurrence of arrhythmic events with a higher incidence of VT/VF, electrical storm, and appropriate ICD shocks in VA+/WCD patients compared with VA-/WCD patients both at 1 year and at the end of follow-up. VA+/WCD patients had a higher mortality rate both at 1 year (11.1% vs. 3.4%, $P = .006$) and at the end of follow-up (18.1% vs. 9.6%, $P = .039$). In contrast, there was no significant difference during follow-up between VA+/WCD and VA-/WCD patients regarding heart failure-related criteria (hospitalization for heart failure, LVAD, or heart transplantation).

Figures 2 and 3 illustrate the Kaplan–Meier curves plotting VT/ VF-free survival and all-cause mortality-free survival during follow-up, respectively, according to whether VT/VF occurred or not on WCD.

Univariable and multivariable Cox models (*Table 4*) showed that the occurrence of VT/VF while on WCD (VA+/WCD patients) independently predicted primary and secondary outcomes related to the occurrence of arrhythmic events (occurrence of VT/VF and electrical storm), even after adjustment for SCD score after acute MI. The adjusted hazard ratio (HR) for VT/VF at 1-year follow-up was 6.91 (95% CI 3.73–12.81, $P < .0001$) and 3.86 (95% CI 2.37–6.30, $P < .0001$) at late follow-up. The adjusted HR for electrical storm at 1-year follow-up was 11.79 (95% CI 2.42–57.55, $P = .009$) and 7.14 (95% CI 2.19– 23.28, $P = .004$) at late follow-up. The adjusted Cox model also showed that VT/VF while on WCD (VA+/WCD patients) was predictive of all- cause death at 1-year follow-up [HR 2.86 (95% CI 1.28–6.39), $P = .012$] but not at the end of follow-up [HR 1.47 (95% CI 0.81–2.67, $P = .20$)].

No interaction was found between pre-hospital or early (<48 h) in- hospital VT/VF and VT/VF during the WCD period regarding major clinical outcomes (see Supplementary data online, *Table S6*). Thus, although an association was identified between early VT/VF and VT/VF on WCD (*Table 1*), the prognostic value of VT/VF while on WCD is independent of the occurrence of pre-hospital or early in-hospital VT/VF.

Excluding or censoring patients who underwent VT/VF ablation from the outcomes analysis did not result in significant changes regarding the predictive value of the occurrence of VT/VF while on WCD (see Supplementary data online, *Table S7*).

Association between VT/VF while on ICD and mortality

In the overall study population, the occurrence of VT/VF in patients with ICDs (considered as a time-dependent variable for statistical analysis) was independently associated with higher incidence of all-cause death both at 1-year follow-up [8/50 (16.0%) vs. 33/979 (3.4%), $P < .0001$] and at end of follow-up up [21/101 (20.8%) vs. 84/928 (9.1%), $P < .0001$]. The adjusted HR for all-cause death related to VT/VF in patients with ICDs was 6.52 (95% CI 2.88–14.77, $P < .0001$) at 1-year follow-up and 3.80 (95% CI 2.31–6.25, $P < .0001$) at late follow-up, respectively (*Table 5*).

Table 2 Comparison of ICD characteristics and major cardiac events during follow-up between patients who experienced VT/VF while on WCD (VA+/WCD) and those who did not (VA-/WCD)

	VA+/WCD (n = 72)	VA-/WCD (n = 960)	P-value
ICD characteristics			
Type of ICD			.12
Transvenous ICD	58/70 (82.9)	709/957 (74.1)	
Single-chamber ICD	32/70 (45.7)	473/957 (49.4)	
Dual-chamber ICD	17/70 (24.3)	144/957 (15.0)	
CRT-D	9/70 (12.9)	92/957 (9.6)	
Subcutaneous ICD	12/70 (17.1)	248/957 (25.9)	
Follow-up after ICD implantation			
Time to follow-up (months)	29.2 (17.6–48.4)	31.0 (18.0–46.9) [n = 959]	.95
Hospitalization for heart failure at 1-year follow-up	7/71 (9.9)	89/954 (9.3)	.83
Hospitalization for heart failure during the follow-up	13/71 (18.3)	144/954 (15.1)	.49
LVAD or heart transplantation at 1-year follow-up	2/71 (2.8)	26/956 (2.7)	1.00
LVAD or heart transplantation during the follow-up	4/71 (5.6)	42/956 (4.4)	.55
VT/VF (with ICD therapy) at 1-year follow-up	16/72 (22.2)	34/959 (3.5)	<.0001
VT/VF (with ICD therapy) during the follow-up	22/72 (30.6)	79/959 (8.2)	<.0001
Electrical storm at 1-year follow-up	5/72 (6.9)	5/959 (0.5)	.0003
Electrical storm during the follow-up	6/72 (8.3)	9/959 (0.9)	.0003
Catheter ablation for VT or VF (within 6 months post-ICD)	13/70 (18.6)	7/958 (0.7)	<.0001
Appropriate ICD shock during the follow-up	15/72 (20.8)	47/959 (4.9)	<.0001
Inappropriate ICD shock during the follow-up	1/72 (1.4)	16/959 (1.7)	1.00
Death at 1-year follow-up	8/72 (11.1)	33/957 (3.4)	.006
Death during the follow-up	13/72 (18.1)	92/957 (9.6)	.039
Death with history of VT/VF during the follow-up	8/72 (11.1)	13/957 (1.4)	<.0001
Death with history of appropriate ICD shock	5/72 (6.9)	7/957 (0.7)	.0008

Continuous variables are expressed as mean \pm standard deviation or median (IQR) and categorical variables as frequency (%). In case of missing data, the total number of patients with available data was mentioned.

Abbreviations: CRT-D, cardiac resynchronization therapy defibrillator; ICD, implantable cardioverter defibrillator; IQR, interquartile range; LVAD, left ventricular assist device; n, number of patients; VA, ventricular arrhythmia; VT, ventricular tachycardia; VF, ventricular fibrillation; WCD, wearable cardioverter defibrillator.

Discussion

Our study suggests that, in patients who received an ICD after a WCD-use period during the early post-infarction phase, the occurrence of VT/VF on WCD is an independent predictor of

the occurrence of arrhythmic events (VT/VF and electrical storm) during long-term follow-up, as well as an independent predictor of 1-year all-cause death.

In contrast, the occurrence of VT/VF on ICD was an independent predictor of all-cause mortality both at 1-year and long-term follow-up (*Structured Graphical Abstract*).

Novelty of the study

Several studies have shown VT/VF and SCD incidence peaks in the first month after myocardial infarction,^{1,17,26,27} which we also observed in the form of a leftward asymmetric temporal distribution with regard to the occurrence of the first VT/VF episode while on WCD in our population.

However, to our knowledge, our study is the first, in the PCI/ICD era, to evaluate the impact of VT/VF occurrence in the early post-infarction phase on subsequent major clinical events.

The prognostic role of early VT/VF within 48 h of STEMI is still controversial since several studies have suggested that such patients have increased 30-day mortality, but no increase in long-term arrhythmic risk.²⁸ Interestingly, in patients with STEMI, in-hospital VT/VF during ongoing ischemia or late (>48 h) after catheter revascularization is linked to significantly higher long-term mortality.²⁹

Our study did not aim to identify the highest-risk population for WCD use or to debate guidelines for WCD use. However, the reimbursement in France of WCDs for patients with impaired LVEF after MI offers the potential to create a comprehensive nationwide cohort of patients in the early post-infarction phase while allowing accurate identification of those with subsequent VT/VF based on analysis of WCD and ICD recordings.

Since WCDs have a therapeutic function, it is not a purely observational tool as, for example, Holter-ECG monitoring. However, on the basis of our results, post-MI risk stratification could henceforth fall within the remit of WCDs. We believe that there is a role for WCDs in the early post-infarction phase, and, from this perspective, we are in agreement with the latest ESC guidelines.²

We are aware, however, that economic considerations can be put forward regarding the use of WCD as a general device in the population we evaluated. Indeed, by compiling our data, we estimate that the number of patients saved by the WCD was 1.8% of all patients to whom this device was prescribed.

Table 3 Clinical characteristics and causes of death of the 105 patients who died during the follow-up while implanted with an ICD

List of parameters	Patients who died during follow-up (n = 105)
Demographics	
Age (years)	65.1 ± 8.5
Male	85/105 (81.0)
Data from the WCD period	
Time under WCD protection (days)	72 (40–113)
Sustained VA detected and treated by the WCD	13/105 (12.4)
Asystole detected by the WCD	1/104 (1.0)
Data from the ICD period	
Time under ICD protection (days)	17.5 (8–36)
Sustained VA detected and treated by the ICD	21/105 (20.0)

Causes of death

Unknown	23/105 (21.9)
Cardiac cause = Arrhythmic death	13/105 (12.4)
Intractable sustained VA	7/105 (6.7)
Sudden cardiac death	6/105 (5.7)
Cardiac cause = Heart failure death	39/105 (37.1)
Cardiac cause = Others (miscellaneous)	5/105 (4.8)
Non-cardiac cause	25/105 (23.8)
Vascular cause	2/105 (1.9)
Non-vascular cause	23/105 (21.9)

Causes of death in the 13 patients with history of VA while on WCD

Unknown	2/13 (15.4)
Cardiac cause = Arrhythmic death	3/13 (23.1)
Cardiac cause = Heart failure death	5/13 (38.4)
Other cardiac cause or non-cardiac cause	3/13 (23.1)

**Causes of death in the 13 patients with
VA only while on ICD**

Unknown	2/13 (15.4)
Cardiac cause = Arrhythmic death	5/13 (38.4)
Cardiac cause = Heart failure death	3/13 (23.1)
Other cardiac cause or non-cardiac cause	3/13 (23.1)

**Causes of death in the eight patients with
episodes of VA both on WCD and on ICD**

Unknown	0/8 (0.0)
Cardiac cause = Arrhythmic death	3/8 (37.5)
Cardiac cause = Heart failure death	3/8 (37.5)
Other cardiac cause or non-cardiac cause	2/8 (25.0)

**Causes of death in the 26 patients with
episodes of VA either on WCD or on
ICD**

Unknown	4/26 (15.3)
Cardiac cause = Arrhythmic death	8/26 (30.8)
Cardiac cause = Heart failure death	8/26 (30.8)
Other cardiac cause or non-cardiac cause	6/26 (23.1)

Causes of death in the 79 patients without episodes of VA (either on WCD or on ICD)

Unknown	19/79 (24.1)
Cardiac cause = Arrhythmic death	5/79 (6.3)
Cardiac cause = Heart failure death	31/79 (39.2)
Other cardiac cause or non-cardiac cause	24/79 (30.4)

Continuous variables are expressed as mean \pm standard deviation or median (IQR) and categorical variables as frequency (%). In case of missing data, the total number of patients with available data was mentioned.

Abbreviations: ICD, implantable cardioverter defibrillator; IQR, interquartile range, n, number of patients; VA, ventricular arrhythmia; WCD, wearable cardioverter defibrillator.

Risk stratification for VT/VF after acute MI

While LVEF remains pivotal for risk stratification of VT/VF and guiding prophylactic ICD implantation decisions after myocardial infarction, it is unsatisfactory as the sole tool for risk stratification of VT/VF.² Indeed, patients with LVEF $\leq 35\%$ have a higher risk of VT/VF, but those with preserved LVEF also face a significant risk. As patients with LVEF $> 35\%$ are far more numerous, many post-infarct patients who will experience VT/VF during follow-up actually have an LVEF $> 35\%$.³⁰

Programmed electrical stimulation (PES) is enjoying renewed interest for risk stratification, as reflected in recent ESC guidelines.² However, the utility of PES has not been confirmed so far in randomized studies. The ongoing PROTECT-ICD randomized trial³¹ (NCT03588286) is investigating whether PES has a role in guiding ICD implantation decision in early post-STEMI patients with reduced ejection fraction.

Cardiac magnetic resonance (CMR), particularly for assessing post-MI scar geometry, offers additional insight³² into SCD risk. The upcoming SMART-DEF trial (NCT06269692) will use CMR beyond LVEF for risk stratification for prophylactic ICD implantation in post-MI patients.

Clinical risk score models, though developed,^{23,33} have yet to be tested in randomized trials as alternatives to exams, such as PES or CMR.

Management and outcomes of post-MI patients considered at high risk of VT/VF in the early post-infarction phase

Managing patients with impaired LVEF after acute MI remains challenging, with many unanswered questions based on currently available literature data.

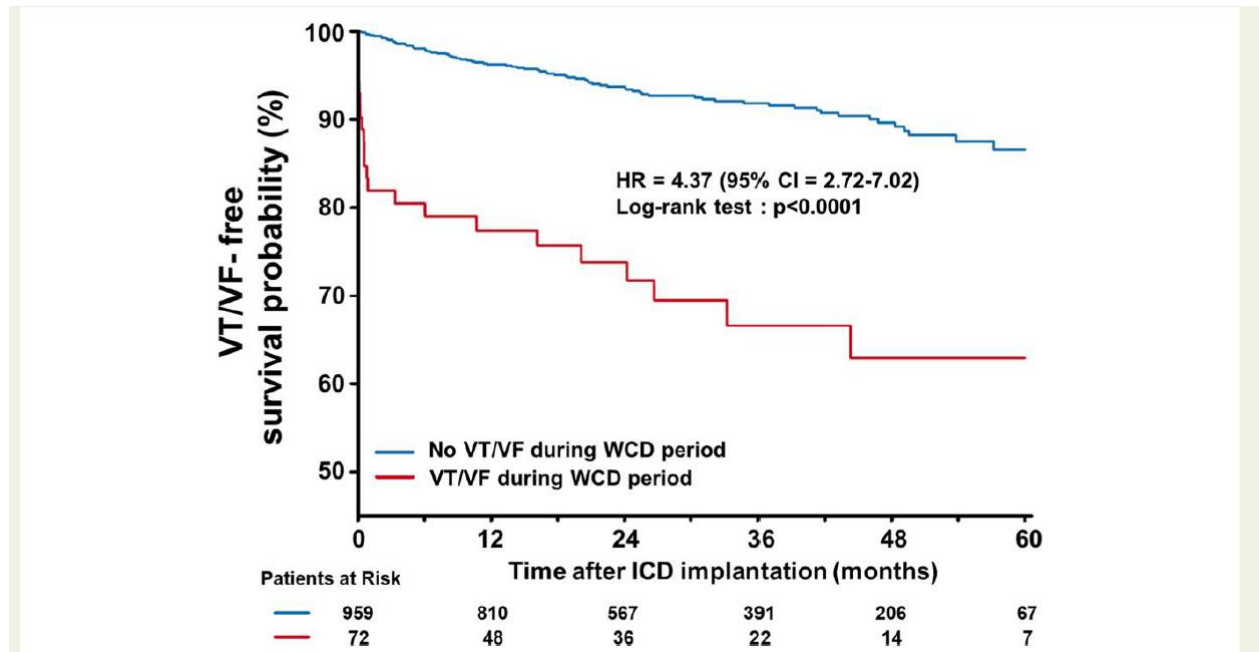


Figure 2 Kaplan–Meier curves showing VT/VF-free survival according to the occurrence or non-occurrence of VT/VF while on WCD

Large observational studies have shown that WCDs effectively interrupt VT/VF in post-MI patients, with >99% of episodes terminated by the first shock^{17,34,35} and a ≈90% survival rate after VT/VF episodes.^{17,34} However, as with ICDs,³⁶ electromechanical dissociation may occur after a WCD shock, possibly explaining the ≈10% death rate^{17,34} observed after an appropriate WCD shock.

Poor patient compliance may have negatively affected the VEST trial results,³⁷ while the significant decrease in SCD observed in the ICD groups both in DINAMIT¹² and IRIS¹³ was offset by an increase in non-SCD in the ICD groups. Based on the DINAMIT¹² and IRIS¹³ studies, there appears to be a subgroup of post-MI patients with LVEF ≤ 35% whose lethal outcome cannot be prevented despite ICD use and optimal medical treatment. In both studies,^{12,13} all-cause mortality was ≈11% at 1-year in both control and ICD groups.

Although there are significant methodological differences between DINAMIT¹² and IRIS¹³ on the one hand, and our study on the other, the populations studied are relatively similar. Our results are fairly comparable to those of DINAMIT,³⁸ in which the crude HR of

mortality was 2.9 for patients receiving appropriate ICD therapy and 2.7 for those patients in our study with appropriate WCD/ICD therapy.

As indicated by the DAPA trial³⁹ results, managing patients with low LVEF in the early post-infarction phase may involve slightly postponed ICD implantation (at least 30 days after MI). This approach addresses heart failure-related mortality in the early healing phase of MI while reserving ICDs for high-risk patients identified by certain clinical characteristics. In the prematurely terminated and thus underpowered DAPA trial,³⁹ early prophylactic ICD implantation significantly reduced all-cause mortality (5% vs. 13%, $P = .04$) at 3-year follow-up in STEMI patients treated with primary PCI and one of the following factors: LVEF < 30% within for 4 days after STEMI, primary VF, Killip class ≥ 2 , or TIMI flow < 3 after PCI.

Heart rate and NYHA class are both indicators of heart failure and poorer prognosis. The DINAMIT¹² and IRIS¹³ studies included a heart rate threshold to select higher-risk patients, hypothesizing it identifies those with a higher SCD risk. However, patients with more pronounced heart failure phenotype are also more likely to die of heart failure. This may explain why ICD benefits on SCD are offset by an increase in non-SCD events in both DINAMIT¹² and IRIS.¹³ Our study supports this, showing heart failure as the leading cause of death (47.6% of known causes of death), while arrhythmia-related deaths were 15.9% of known causes of death, similar to DINAMIT¹² and IRIS.¹³

Our findings on causes of death align with two studies on ICD patients.^{40,41} Duray et al.⁴⁰ found non-arrhythmic cardiac death to be the main cause of death (45.1%), with arrhythmia-related deaths accounting for 19% of known causes of death. Nägele et al.⁴¹ reported heart failure as the main cause of death (30.0%), while sudden death accounted for 20.2% of known causes of death.

The counterintuitive, but long-recognized,⁴² occurrence of arrhythmic deaths despite ICDs is likely related to refractory VT/VF or electromechanical dissociation after successful appropriate ICD therapy,⁴² in particular following ICD shock.³⁶ Additionally, in the first month after MI, many sudden deaths are due to infarct recurrence or cardiac rupture,⁴³ explaining the lack of benefit from early ICD therapy.

Notwithstanding the above, a subgroup of high-risk patients (those with VT/VF during the early post-infarction phase) requires increased attention for better therapeutic management. Improving outcomes for these patients involves enhancing early acute MI management, especially with revascularization therapies, and exploring at least two therapeutic approaches: catheter ablation of ventricular arrhythmias and drugs that positively affect remodeling in infarcted areas.

Which strategies to improve the outcome of patients with VT/VF in the early post-infarction phase

Randomized studies of VT ablation in patients with ischemic heart disease *alone* have all,^{44–48} but one,⁴⁹ shown a beneficial effect of ablation on VT recurrence. However, none of these studies showed a benefit in terms of mortality. However, these findings should not be extrapolated to our study population. Indeed, in these studies, the average time between infarction and ablation was very long (8.4 to 15.7 years). Given that the process of ventricular

remodeling evolves over time, early ablation of an arrhythmogenic ventricular substrate may beneficially affect both VT/VF recurrence and mortality.

PARTITA is the first randomized trial to show that catheter ablation after an appropriate first ICD shock significantly reduces all-cause mortality and heart failure hospitalization.⁵⁰ PARTITA trial gives hope that catheter ablation can improve the prognosis of patients with ICD-shock treated VT/VF, whose prognosis is usually poor.¹⁰ However, there are differences between PARTITA patients and ours, such as the prevalence of ischemic heart disease (81% vs. 100%) and the timing of the qualifying VT/VF event for randomization, which happened more than 2.4 years after ICD implantation in at least 50% of the patients in PARTITA.⁵⁰ Only a randomized study with patients experiencing VT/VF during the early post-infarction phase will determine the true impact of catheter ablation on the prognosis of these patients.

Our study's finding of increased heart failure-related death after device termination of VT or VF aligns with observations from the MADIT II trial.⁹ Consequently, these patients should receive special attention to prevent and manage rapidly progressing heart failure, ideally within a multidisciplinary team.⁵¹ In addition to optimizing medical treatment and identifying the best short-term management, care should be taken to identify and avoid inappropriate prescriptions.⁵²

Numerous studies have highlighted the importance of early drug prescription (e.g. beta-blockers, ACE inhibitors, ARBs) to reduce adverse cardiac remodeling, chronic heart failure, and SCD in acute MI patients. These treatments are now standard for MI with impaired LVEF. New agents like sodium–glucose cotransporter-2 (SGLT2) inhibitors and angiotensin receptor–neprilysin inhibitor (ARNi) show promise, with ongoing trials assessing their impact on SCD in post-MI patients.⁵³

Association between VT/VF and subsequent aggravation of heart failure

Data indicate that VT/VF during the WCD period predicts 1-year mortality, while VT/VF during the ICD period predicts long-term mortality (*Table 5*).

Given that heart failure is the main cause of death in our population, as in Nägele's study,⁴¹ we hypothesize a pathophysiological link between VT/VF and heart failure deaths, whereby VT/VF may trigger, initiate, or catalyze a process which, in some patients, inexorably and insidiously evolves towards heart failure progression, leading to death. Potential mechanisms include neurohormonal pathways⁵⁴ and changes in cardiac energy metabolism.⁵⁵

The hypothesis of a link between VT/VF and heart failure is supported by: 1) the role of electromechanical dissociation in death following effective WCD or ICD shocks, 2) the ALTITUDE study,⁵⁶ which linked ventricular arrhythmias (whether VT or VF), but not their mode of interruption (in particular ICD shock), to subsequent worsening heart failure, and 3) the PARTITA trial,⁵⁰ which found that ablation after a first ICD shock reduced the combined end point of death or worsening heart failure hospitalization.

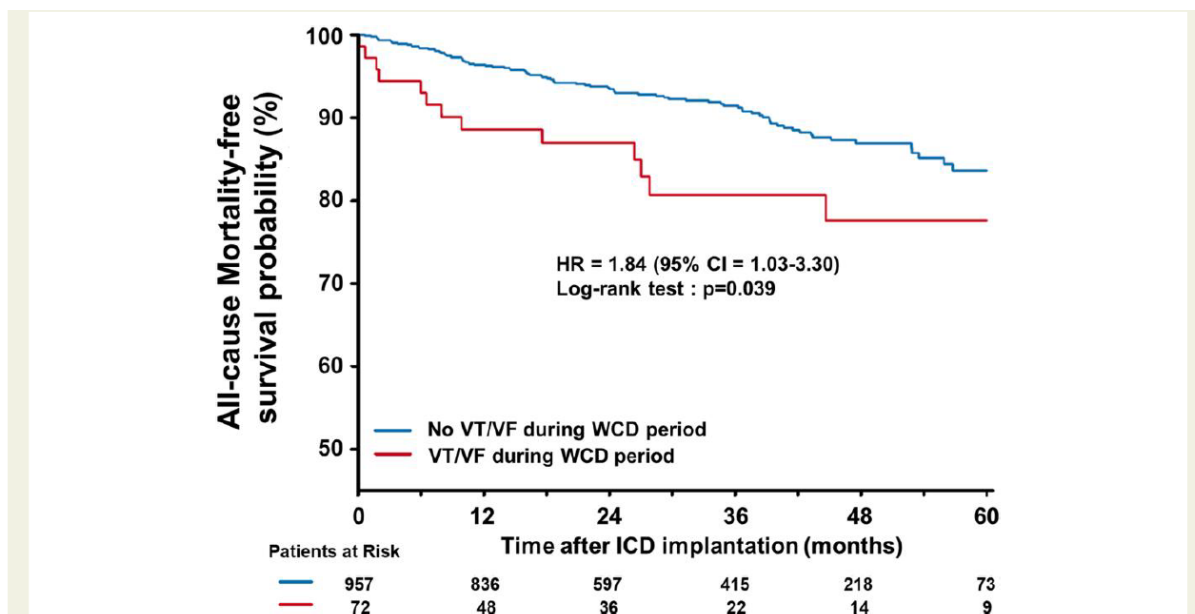


Figure 3 Kaplan–Meier curves showing all-cause mortality-free survival according to the occurrence or non-occurrence of VT/VF while on WCD

Table 4 Association between VT/VF while on WCD therapy and clinical outcomes

	VA+/WCD (n = 72)	VA-/WCD (n = 960)	Crude Cox model		Adjusted Cox model ^a	
			HR (CI 95%)	P-value	HR (CI 95%)	P-value
Primary outcome						
VT/VF at 1-year follow-up	16/72 (22.2%)	34/959 (3.5%)	7.49 (4.14–13.58)	<.0001	6.91 (3.73–12.81)	<.0001
Secondary outcomes						
VT/VF at during the follow-up	22/72 (30.6%)	79/959 (8.2%)	4.37 (2.72–7.02)	<.0001	3.86 (2.37–6.30)	<.0001
Electrical storm at 1-year follow-up	5/72 (6.9%)	5/959 (0.5%)	14.34 (4.15–49.55)	<.0001	11.79 (2.42–57.55)	.009
Electrical storm during the follow-up	6/72 (8.3%)	9/959 (0.9%)	9.00 (3.19–25.35)	<.0001	7.14 (2.19–23.28)	.004
LVAD or heart transplantation at 1-year follow-up	2/71 (2.8%)	26/956 (2.7%)	1.06 (0.25–4.46)	.94	0.89 (0.19–4.09)	.88
LVAD or heart transplantation during the follow-up	4/71 (5.6%)	42/956 (4.4%)	1.26 (0.45–3.52)	.66	1.12 (0.39–3.22)	.84
Death at 1-year follow-up	8/72 (11.1%)	33/957 (3.4%)	3.39 (1.57–7.35)	.002	2.86 (1.28–6.39)	.012
Death during the follow-up	13/72 (18.1%)	92/957 (9.6%)	1.84 (1.03–3.30)	.039	1.47 (0.81–2.67)	.20
Hospitalization for heart failure at 1-year follow-up	7/71 (9.9%)	89/954 (9.3%)	1.07 (0.50–2.31)	.86	0.94 (0.43–2.06)	.88
Hospitalization for heart failure during follow-up	13/71 (18.3%)	144/954 (15.1%)	1.20 (0.68–2.11)	.54	1.01 (0.57–1.80)	.96

Abbreviations: CI, confidence interval; HF, heart failure; HR, hazard ratio; IQR, interquartile range; LVAD, left ventricular assist device; n, number of patients; VA, ventricular arrhythmia; VT, ventricular tachycardia; VF, ventricular fibrillation; WCD, wearable cardioverter defibrillator.

^aModels were adjusted for SCD risk score (see methods/statistical analysis, for details).

Limitations

Although this study provides important new information, with clinical implications and a strong basis for further research, certain limitations should be acknowledged.

Firstly, this study has the inherent limitations of observational studies, including selection biases. We have, however, implemented a patient identification procedure, as well as several measures (‘Methodology’ paragraph in the supplemental data document) to control the quality and accuracy of the data collected as effectively as possible. Nevertheless, in our study, there

is no control or treatment group to which our population can be compared, in particular post-infarct patients with a preserved LVEF.

Secondly, we have not studied all the risk factors and comorbidities that have been described in the literature as associated with or predictive of the risk of sudden death and/or ventricular arrhythmias after myocardial infarction. However, we have collected the various clinical variables that make up one recently described SCD risk score²³ and used it for Cox model adjustment.

Thirdly, we did not perform a centralized reading of echocardiographic LVEF measurements. Although these measurements were carried out by experienced cardiologists in each of the participating centers, we cannot rule out greater heterogeneity in the values measured than would have resulted from analysis by a Core-Lab.

Fourthly, a lower than anticipated proportion of patients received guideline-recommended heart failure therapy. Although this reflects the management of MI in ‘real life’, it is, of course, impossible to know if the outcomes would have been different for patients who did not receive the best recommended treatment. Nevertheless, we strongly support the current recommendations on the need to optimize medical treatment after MI.

Fifthly, total mortality was used as an outcome rather than SCD or non-SCD. This choice was made to avoid misclassification as discrepancies have been reported between adjudicated events and ‘true events’ identified by retrospective interrogation of ICDs at the time of death.⁵⁷ However, the causes of death have been investigated and are shown in *Table 3*.

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Finally, our study does not allow drawing any conclusions regarding a change in current guidelines for the management of patients with a low ejection fraction in the early post-infarction phase.

Table 5 Association between the occurrence of VT/VF while on WCD and/or on ICD and death

	Unadjusted		Adjusted ^a	
	HR (CI 95%)	P-value	HR (CI 95%)	P-value
Outcome = death at 1 year				
VT/VF while on WCD therapy	3.39 (1.57–7.35)	.002	2.86 (1.28–6.39)	.012
VT/VF while on ICD ^b	8.40 (3.85–18.36)	<.0001	6.52 (2.88–14.77)	<.0001
VT/VF while on WCD therapy and/or while on ICD ^b	4.52 (2.31–8.87)	<.0001	3.71 (1.84–7.50)	.0006
Outcome = death during follow-up				
VT/VF while on WCD therapy	1.84 (1.03–3.30)	.039	1.47 (0.81–2.67)	.20
VT/VF while on ICD ^b	4.61 (2.83–7.52)	<.0001	3.80 (2.31–6.25)	<.0001
VT/VF while on WCD therapy and/or while on ICD ^b	2.71 (1.74–4.24)	<.0001	2.15 (1.36–3.41)	.001

Abbreviations: CI, confidence interval; HR, hazard ratio; VF, ventricular fibrillation; VT, ventricular tachycardia; WCD, wearable cardioverter defibrillator.

^aAdjusted for SCD risk score (see methods/statistical analysis, for details).

^bConsidered as time-dependent variable.

Clinical perspectives

Based on our findings, patients who present with VT/VF in the early post-infarction phase (such as those who were on WCD support in our study) should be considered at increased risk of short-term death as well as short- and long-term arrhythmia recurrence. Therefore, the occurrence of VT/VF in the early post-infarction phase is a valuable tool for risk stratification, and WCD is an effective means (which also has a therapeutic function) for identifying these events.

This information, which is currently not considered in clinical reasoning, should now serve as significant input in developing strategies to improve patient care. Given the causes of death and the pathophysiological link between ventricular arrhythmias and heart failure, these patients should benefit from specific management with two therapeutic approaches that deserve to be explored in new studies: 1) controlling the arrhythmogenic substrate, particularly by evaluating early ablation of VT/VF occurring in the early post-infarction phase and 2) improving the management of heart failure.

Conclusions

Our study suggests that the occurrence of VT/VF during the early post-infarction phase is an independent predictor of sustained VAs recurrence and 1-year mortality in patients with LVEF \leq 35%. Further studies are needed to assess which therapeutic strategies may improve short-term prognosis in these patients.

Declarations

Disclosure of Interest

All authors declare no disclosure of interest for this contribution.

Data Availability

No data were generated or analysed for this manuscript.

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