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Original Article

Usefulness of the wearable cardioverter defibrillator in patients in the early post-myocardial infarction phase with high risk of sudden cardiac death: A single-center European experience

Yusuke Kondo, M.D., Ph.D.*, Markus Linhart, M.D., René P. Andrié, M.D., Joerg O. Schwab, M.D., Ph.D.

Department of Medicine-Cardiology, University of Bonn, Sigmund-Freud Strasse 25, 53127 Bonn, Germany

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ABSTRACT

Background: The effectiveness of the wearable cardioverter defibrillator (WCD) therapy in early post-myocardial infarction (MI) patients remains uncertain.
Methods: We analyzed the characteristics and outcomes of patients who received a WCD in the early post-MI phase.
Results: Twenty-four patients were followed-up for 8 months (range, 4–16 months). Two patients (8.3%) received appropriate shocks. Left ventricular ejection fraction improved after the WCD therapy ($P < 0.01$). Fourteen patients (58%) received an implantable cardioverter defibrillator at the end of the follow-up period.
Conclusion: Early post-MI patients at high risk of sudden cardiac death may benefit from WCD therapy.

1. Introduction

The wearable cardioverter defibrillator (WCD; Life Vest 4000, Zoll, PA, USA) is an external defibrillator vest that automatically detects and treats ventricular tachyarrhythmias without bystander assistance [1–3]. Patients with early post-myocardial infarction (MI) are potentially at significant risk of sudden cardiac death (SCD). However, information for prescribing WCD to patients in the early post-MI phase is limited [4]. This study describes a single-center experience of the utility of WCD therapy in these patients in Germany.

2. Materials and methods

This study included WCD patients with high risk of SCD but did not meet the eligibility criteria for immediate implantation of an implantable cardioverter defibrillator (ICD). Current guidelines endorse indications for WCD therapy [5]. Patients with low left ventricular ejection fraction (LVEF; $\leq 35\%$) or therapy-refractory nonsustained ventricular tachycardias are at high risk of SCD. However, the guidelines recommend ICD implantation only after waiting at least 40 days or 3 months, depending on whether the patient had undergone revascularization or not. In patients who experience lethal ventricular arrhythmia after MI, ICD implantation is considered after assessment of the efficacies of revascularization, catheter ablation, and anti-arrhythmic therapy. If these therapies fail, ICD implantation is recommended.

We analyzed the characteristics and outcomes of patients with ventricular tachyarrhythmia in the early post-MI phase who received a WCD. All of the patients were followed up between August 2010 and November 2014 at the University Hospital of Bonn, Germany. Details of the WCD and the arrhythmia detection algorithm were described elsewhere [1,2]. Variables were reported as mean ± standard deviation, median (25–75 percentiles), or *n* (%). The patients' characteristics were compared by using the Fisher exact test for categorical variables and the *t* test for continuous variables. Statistical significance was established at $P < 0.05$.

3. Results

3.1. Characteristics and Outcomes of the WCD Patients

After obtaining written informed consent, 66 consecutive patients in our hospital received WCD therapy, of whom 24 (36%) were in the early post-MI phase and were followed up for 8 months (range, 4–16 months) (the period from the date of MI onset to the date of last

* Corresponding author. Tel.: +49 228 2871 6670; fax: +49 228 2871 4983.
E-mail addresses: yuusukondou-circ@umin.ac.jp, simokita9933@msn.com (Y. Kondo).

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Table 1
Characteristics and outcomes of the WCD patients.

	All patients ($n=24$)	Primary indication ($n=11$)	Secondary indication ($n=13$)	P value
Age (years)	69 ± 12	67 ± 11	76 ± 3	0.59
Male	22 (92)	9 (82)	13 (100)	0.20
ST-elevated MI	10 (42)	1 (9.1)	9 (69)	0.0045
Revascularized post-MI	19 (79)	9 (82)	10 (77)	1.0
Median time from MI to WCD prescription (days)	10 (5–31)	6 (4–20)	17 (7–38)	0.19
Median length of WCD use (days)	33 (20–67)	16 (29–56)	29 (15–67)	0.97
Median daily use of WCD (h/day)	23.1 (21.6–23.6)	22.8 (20.0–23.2)	23.3 (22.4–23.6)	0.23
LVEF before WCD therapy (%)	30 (20–36)	30 (18–34)	32 (20–38)	0.36
LVEF after WCD therapy (%)	35 (25–40)	33 (30–38)	43 (30–53)	0.26
WCD shock therapy	2 (8.3)	1 (9.1)	1 (7.7)	1.0
Defibrillator implantation	14 (58)	4 (36)	10 (77)	0.095

The data are presented as mean ± SD, number of patients (%), or median (25–75th percentile). WCD, wearable cardioverter defibrillator; MI, myocardial infarction; LVEF, left ventricular ejection fraction.

follow-up). Table 1 shows the characteristics and outcomes of the patients. The mean age of the patients was 69 ± 12 years, and 22 (92%) of them were male. Of the 24 patients, 10 (42%) had ST elevation and 19 (79%) underwent acute revascularization. Eighteen patients received PCI, and only 1 patient (primary indication) underwent coronary artery bypass grafting surgery. Eleven patients (46%) used a WCD for primary SCD prevention. Meanwhile, 13 patients (54%) used a WCD for secondary SCD prevention after sustained ventricular tachycardia or cardiopulmonary resuscitation. Of these patients, 12 (92%) experienced lethal ventricular arrhythmia before or during revascularization. Only 1 patient (7.7%) had sustained ventricular tachycardia 7 days after MI. The median time from MI to the WCD prescription was 10 days (range, 5–31 days). The median length of use was 33 days (20–67 days), and the median daily WCD use was 23.1 h/day (range, 21.6–23.6 h/day). One patient (4.2%) was excluded because of irregularities in device use. LVEF improved after using a WCD (30% [range, 20–36%] vs. 35% [range, 25–40%], $P<0.01$). In 12 patients (50%), LVEF was $>35\%$. In 8 patients (33%), LVEF improved from $\leq 35\%$ to $>35\%$. None of the patients died during the WCD therapy. However, 2 patients (8.3%) had a fatal nonarrhythmic event within 3 months after MI.

3.2. WCD shock therapy

Two patients (8.3%) received shock therapy from the WCD. First-shock success for ventricular fibrillation (VF) was 100% (3/3). One of the patients, who used a WCD for primary SCD prevention, had 2 VF episodes within 6 days after MI onset. The second patient, who used a WCD because of VF during MI, had VF again 15 days after MI onset. The LVEF of these patients was $\leq 35\%$ before using a WCD (29% and 34%). None of the patients experienced inappropriate treatments.

3.3. ICD implantation after WCD therapy

An ICD was implanted in 14 patients (58%) at the end of the follow-up period. Table 2 shows the relationship between serial cardiac function and ICD implantation in all 13 patients indicated for primary SCD prevention. Eleven patients (46%) used a WCD for primary prevention, of whom 4 (36%) received an ICD because their LVEFs remained at $\leq 35\%$. However, 2 patients (numbers 5 and 9) refused to receive an ICD. Thirteen patients (54%) used a WCD for secondary prevention, of whom 10 (77%) received an ICD.

Table 2
Relationship between serial cardiac function and ICD implantation in patients indicated for primary prevention of SCD.

Patient no.	LVEF before WCD therapy	LVEF after WCD therapy	ICD implantation
1	30	40	No
2	10	40	No
3	37	30	Yes
4	55	68	No
5	15	30	No (refuse)
6	35	35	No
7	30	33	Yes
8	15	21	Yes
9	29	25	No (refuse)
10	20	38	No
11	32	32	Yes

ICD, implantable cardioverter defibrillator; LVEF, left ventricular ejection fraction; WCD, wearable cardioverter defibrillator; SCD, sudden cardiac death.

4. Discussion

Currently, ICD therapy represents a cornerstone of cardiology practice for reducing the incidence of SCD after MI [6–9]. However, previous randomized trials [10,11] could not show a mortality benefit of early ICD implantation in post-MI patients. Hence, in patients with LV dysfunction in acute MI, current guidelines in the United States and Europe [5] recommend ICD implantation only after waiting at least 40 days or 3 months, depending on whether the patient had undergone revascularization or not. In this study, the median time from MI to WCD prescription was 10 days (range, 5–31 days) and the median length of use was 33 days (range, 20–67 days). Compared with the current guidelines, actual practice uses the mean waiting period. A proportion of the post-MI population eventually recovered LV function without further risk of SCD (i.e., crossing the EF threshold of 35–40%). The present study reveals that the median LVEF improved with WCD therapy (30% [range, 20–36%] vs. 35% [range, 25–40%], $P<0.01$). Thus, ICD implantation was prevented in 10 patients (42%). The use of WCD contributed to the prevention of an unnecessary ICD implantation.

Inappropriate shock is rare, occurring in only 0–3% of WCD patients [12,13]. A WCD is a unique tool designed to avoid an unnecessary shock therapy. If persistent arrhythmia is detected, the WCD notifies the patient via a responsiveness test, allowing a conscious patient to prevent treatment by holding the Response buttons. Therefore, education and medical information have been provided to patients in order to optimize their understanding and acceptance of WCD therapy. Most of our patients agreed that the device was easy to handle after sufficient training before receiving the device.

5. Conclusion

Patients in the early post-MI phase who are at high risk of SCD may benefit from a time-limited WCD therapy.

Conflict of interest

None of the authors have any conflict of interest to declare.

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