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# Temporary transvenous cardiac pacing in cathlab — myocardial infarction versus other causes — differences, complications, and prognosis. Data from a single-center retrospective analysis

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## Abstract

**Background:** *Transvenous temporary cardiac pacing (TTCP) is a lifesaving procedure, but the incidence of complications and prognosis depends on the underlying cause. The aim of this study was to compare the characteristics, complications, and prognosis in patients with myocardial infarction (MI) requiring TTCP vs. patients with TTCP due to other causes.*

**Methods:** *The present analysis involved 244 cases in whom TTCP was performed between 2017 and 2021 in a high-volume cathlab. All the procedures were performed by an interventional cardiologist. MI constituted 46.3% of the patients (n = 113), including 63 (55.75%) ST-segment elevation MI patients. Non-MI patients (control group) consisted of patients with any cause of bradycardia requiring TTCP.*

**Results:** *Myocardial infarction patients requiring TTCP are younger and have a higher prevalence of hypertension and heart failure. The pacing lead is more frequently inserted during asystole/resuscitation, and pacing was needed for a longer time. MI patients required cardiac implantable electronic device implantation less frequently than in other causes (22% vs. 82%, p < 0.01). The incidence of TTCP complications did not differ. The incidence of in-hospital death was 6.5-fold higher in TTCP patients with MI. Logistic regression showed MI to be a strong predictor of in-hospital death (odds ratio: 8.1; 95% confidence interval: 1.3–57.9).*

**Conclusions:** *In-hospital mortality in MI patients requiring TTCP is 6.5-fold higher than in other patients with bradycardia. The complication rate of TTCP is similar in MI and non-MI patients. It is not TTCP but the severity of MI itself and the fact that a pacing lead is frequently implanted in asystole or during resuscitation that is responsible for the higher mortality rate.* (Cardiol J 2024; 31, 5: 716–721)

**Keywords: transvenous temporary cardiac pacing, temporary pacemaker, cath lab, critical care, myocardial infarction**

## Introduction

Transvenous temporary cardiac pacing (TTCP) is a potentially life-saving procedure in life-threatening bradycardia refractory to pharmacological treatment, but the incidence of complications and patients' prognosis reported in the literature is highly variable and depends on several factors. In the European Society of Cardiology 2021 Guidelines on Cardiac Pacing and Cardiac Resynchroniza-

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tion Therapy, TTCP is a class I recommendation in hemodynamic-compromising bradyarrhythmia refractory to chronotropic drugs, as a bridge to recovery (where indications for pacing are reversible, such as in myocardial infarction [MI], myocarditis, hyperkalemia, or intoxication), or a bridge to permanent pacing [1]. However, due to common complications of temporary pacing, recently, emphasis is being put on avoiding unnecessary TTCP utilization and on shortening the period of temporary pacing [1].

The implantation of temporary pacing lead is typically performed by intensive care specialists and cardiologists. Depending on local policy and availability, the procedure is performed under electrocardiogram/intracardiac electrogram guidance, ultrasound/echo guidance, or fluoroscopy [2–4]. In cath-lab-equipped hospitals, the procedures are commonly performed under fluoroscopy and, most often, by interventional cardiologists.

The vascular access used also varies between centers and specialists, with jugular and subclavian access predominating among intensivists, and femoral vein access among interventional cardiologists, particularly when the procedure is performed simultaneously with other procedures.

Complications of transvenous pacing are well recognized and include lead dislocation (resulting in failure to sense failure to capture and requiring lead reposition), local or systemic infections, pneumothorax, immobilization, thrombotic events, right ventricle perforation, tamponade, and death [5–8]. The complication rates reported in the literature are highly variable depending on the criteria, population analyzed, vascular access, and other factors. The risk of in-hospital death in the most recent populations studies is above 10% [6, 9] but may vary among populations receiving TTCP.

The purpose of the study was to compare the clinical characteristics, complications, and prognosis in patients with MI requiring TTCP vs. patients with temporary pacing due to other emergent causes of bradyarrhythmia.

## Methods

The study was approved by the ethics committee and conformed to the Declaration of Helsinki. Informed written consent was obtained from every patient enrolled in the study.

Two hundred forty four consecutive emergency cases were analyzed in whom TTCP therapy was performed between 2017 and 2021 in a single high-volume tertiary cardiology center, providing a full range of cardiac care, including an intensive care unit, 24/7 treatment of acute coronary syndromes, and providing implantation of cardiac implantable electronic devices (CIEDs). All the procedures were performed in a cath lab by an interventional cardiologist. Patients with elective TTCP (i.e., prophylactic pacing before/during the surgery) were excluded. In this analysis, emergent temporary lead implantation performed by intensive care specialists at the bedside in an intensive care unit were also excluded.

**Table 1.** Baseline characteristics of the entire study group (n = 244)

| | N = 244 |
|---|---|
| Age [years] mean (SD) | 77 (11.8) |
| Sex (female/male) | 117/127 (48%/52%) |
| Indication for pacing: | |
| 2nd and 3rd degree AV block | 174 (71.3%) |
| SND/sinus bradycardia | 33 (13.5%) |
| Asystole/PEA/other | 37 (15.2%) |
| Brady symptoms: | |
| Loss of consciousness | 132 (54.1%) |
| Sudden cardiac death | 34 (13.9%) |
| Comorbidities: | |
| Myocardial infarction | 113 (46.3%) |
| Hypertension | 195 (13.9%) |
| Diabetes | 100 (41%) |
| History of PCI/CABG | 57/18 (23.4%/7.4%) |

AV — atrioventricular; CABG — coronary artery bypass grafting; PCI — percutaneous coronary angioplasty; PEA — pulseless electrical activity; SD — standard deviation; SND — sinus node disease

The most frequently used access site was the femoral vein (174/244 patients; 71.3%), followed by subclavian (48/244 patients; 19.7%) and internal jugular vein (22/244 patients; 9.02%). There were no differences in the procedure between study groups (MI vs. non-MI) nor in the type of bradycardia. The access site was not correlated with complications or death.

The standard guidance for emergency placement of TTCP was fluoroscopy, despite the etiology of bradycardia.

Baseline characteristics of the entire study population are presented in Table 1.

Out of 244 patients treated with TTCP, MI cases constituted 46.3% (n = 113), including 50 non-ST-segment elevation MI (NSTEMI) cases (44.25% of the MI group) and 63 ST-segment elevation MI (STEMI) patients (55.75%), out of which 50 cases had inferior wall STEMI (44.25%

of MI group), 12 patients — anterior MI (10.6%) and 1 — lateral MI (1%). Percutaneous coronary intervention was performed in 101 (89.4%) cases, with the right coronary artery being a target vessel in 62 (69.7%) patients.

Non-MI patients (n = 131; 53.7%) consisted of patients with any other cause of bradycardia requiring temporary pacing, including reversible causes (hyperkalemia, beta-blocker overdose) and irreversible sinus or atrioventricular (AV) node dysfunction eventually requiring permanent pacing.

## Statistical analysis

Statistical analysis was performed using SPSS v.25.0 software (IBM Corp, Armonk, NY) and MedCalc v.14.8.1 software (MedCalc Software, Ostend, Belgium). Continuous variables were expressed as mean, standard deviation (SD) or median (interquartile range [IQR]). Qualitative parameters were shown as crude numbers and percentages. The type of continuous variable distribution was acquired using the Shapiro-Wilk test. As all of the continuous variables shared a non-normal type of distribution, the two-tailed Mann–Whitney U or Kruskal-Wallis tests were utilized. The significance of proportions in contingency tables was calculated using the chi-square test. The variables with $p < 0.1$ in univariate analysis were incorporated into a logistic regression analysis to determine independent predictors of in-hospital death. The universal p-value level $< 0.05$ was regarded as statistically significant throughout the analyses.

# Results

Out of the entire studied cohort, 35.7% of bradyarrhythmia resolved without the need for permanent pacing, 54% eventually required CIED implantation (dual-chamber pacemaker: 82%, single chamber: 4%, implantable cardioverter defibrillator [ICD]: 3%, cardiac resynchronization therapy [CRT]: 11%), and 10% died while on TTCP. 55% of patients had TTCP for longer than 24 hours, with a median time to resolution of 40 hours.

The incidence of complications is shown in Table 2.

Fifty-three (21.7%) patients died during the index hospitalization (including those who died after TTCP discontinuation or CIED implantation).

## Patients on TTCP — MI vs. other causes of bradycardia

Patients requiring TTCP in the course of MI tend to be younger and have a higher prevalence of hypertension and heart failure with lower left ventricular ejection fraction. The studied subgroups did not differ regarding the incidence of diabetes, atrial fibrillation, bundle branch blocks, or AV block as an indication for pacing (a predominant mechanism of bradycardia in both groups).

**Table 2.** Resolution of indications to temporary pacing and complications of transvenous temporary cardiac pacing in the entire study group

| | Incidence in group |
|---|---|
| **Resolution** | |
| Bradycardia resolved | 87 (35.7%) |
| CIED implantation | 132 (54.1%) |
| Death | 25 (10.2%) |
| Time to resolution [h] (median, IQR) | 40 (12–70) |
| **Complications** | |
| In-hospital death | 53 (21.7%) |
| Dislocation (req. reposition) | 26 (10.1%) |
| Perforation/tamponade | 8/4 (3.3%/1.6%) |
| Pneumothorax | 2 (0.8%) |
| Vein thrombosis | 2 (0.8%) |
| Inflammation (elevated CRP) | 66 (27.4%) |
| Combined endpoint (any of the above) | 120 (49.2%) |

CIED — cardiac implantable electronic device; IQR — interquartile range; CRP — C-reactive protein

In MI patients, temporary pacing lead is more commonly implanted in asystole and in patients who had sudden cardiac death prior to or during the procedure (Table 3).

The most common reason for TTCP in the non-MI group was the 2nd and 3rd AV block (74.81%), followed by sinus node disease (18.32%), and pulseless electrical activity [PEA]/asystole (6.87%). Only in 14.17% of patients the bradycardia resolved; the mean time to resolution was 38 (20–72) hours. The causes for reversible bradycardia in the non-MI group were: hyperkalemia (40%) and toxic etiology (beta-blocker and/or digoxin overdose) (60%).

The 2nd and 3rd AV block occurred in 67.26% of patients with MI, followed by PEA/asystole — 19.47%, sinus node disease/bradycardia — 13.27%. The bradycardia resolved in 53.64% of patients with MI; mean time to resolution was 54 (26–112) hours.

Only the rate of PEA/asystole was significantly different between study groups (MI vs. non-MI; 19.47% vs. 6.87%; $p = 0.003$).

**Table 3.** Transvenous temporary cardiac pacing patients — myocardial infarction (MI) vs. other causes

| | MI (n = 113) | Non-MI (n = 131) | P |
|---|---|---|---|
| **Baseline** | | | |
| Age [years] (mean, SD) | 74.8 (11.4) | 78,4 (11.8) | 0.012 |
| Sex, female | 38% | 56.5% | 0.004 |
| 2nd and 3rd AV block | 67.26% | 74.81% | 0.193 |
| SND/sinus bradycardia | 13.27% | 18.32% | 0.157 |
| PEA/asystole | 19.47% | 6.87% | 0.003 |
| Diabetes | 41.6% | 40.5% | 0.857 |
| GFR (median, IQR) | 60 (41-79) | 52 (32-69) | 0.031 |
| Hypertension | 25.7% | 14.6% | 0.003 |
| HFrEF | 39% | 25.4% | 0.024 |
| LVEF [%] (mean, SD) | 37.6 (11) | 49.5 (11) | 0.000 |
| SCD/resuscitation | 25.7% | 3.8% | 0.001 |
| **Resolution** | | | |
| Mean time to resolution [h] (median, IQR) | 54 (26–112) | 38 (20–72) | 0.005 |
| Outcome: bradycardia resolved | 53.64% | 14.17% | 0.000 |
| Outcome: CIED implantation | 21.82% | 82.68% | 0.000 |
| **Complications** | | | |
| In-hospital death | 40.18% | 6.11% | 0.000 |
| RV perforation | 2.68% | 3.88% | 0.605 |
| Dislocation/reposition | 9.82% | 10.77% | 0.545 |
| Pneumothorax | 0 | 1.54% | 0.187 |
| CRP > 3*ULN or baseline | 29 (26%) | 26 (20%) | NS |

AV — atrioventricular; CIED — cardiac implantable electronic device; CRP — C-reactive protein; GFR — glomerular filtration rate; HFrEF — heart failure with reduced ejection fraction; IQR — interquartile range; LVEF — left ventricular ejection fraction; NS — non-significant; PEA — pulseless electrical activity; RV — right ventricle; SD — standard deviation; SCD — sudden cardiac death; SND — sinus node disease; ULN — upper limit normal

Time to resolution and TTCP discontinuation is longer in the MI group, and CIED is implanted 4 times less frequently than in the non-MI group (22% vs. 83%). The most common complications of TTCP, including right ventricle perforation and tamponade, lead dislocation and the need for repositioning, embolic events, pneumothorax, and elevated inflammatory markers, are similar between groups. The statistical analysis showed no differences between STEMI and NSTEMI groups regarding bradycardia resolution, rate of CIED implantation, and in-hospital death. In-hospital mortality is, however, almost 7-fold higher in MI requiring TTCP than in non-MI cases (40% vs. 6%).

### CIED indications

Overall, 54% of patients required CIED implantation — 22% in the MI group and 83% from the non-MI group ($p < 0.005$). The selection of CIED was based on the European Society of Cardiology Cardiac Pacing and CRT Guidelines. Mostly pacemakers were implanted, but in patients with low ejection fraction, an ICD was implanted, and in the case of left bundle branch block, CRT was preferred.

Logistic regression showed MI to be a strong predictor of in-hospital death (odds ratio [OR]: 8.1; 95% confidence interval [CI]: 1.3–57.9) but was not related to any other complication of TTCP. Besides, sudden cardiac death before or during TTCP (OR: 69.8; 95% CI: 4.3–1130) and maximal high-sensitive troponin T level (OR: 1.68, 95% CI: 1.16–2.41 per unit) were associated with in-hospital death.

## Discussion

Although transvenous temporary pacing is recommended only in hemodynamic-compromising bradycardia [1] and its utilization has been decreasing in recent years [9], it remains a crucial therapy in drug-refractory bradycardia of any cause.

Transvenous temporary cardiac pacing is frequently performed as an emergency procedure — the vascular access site is often based on the operator's preference and experience. According to European Society of Cardiology Cardiac Pacing guidelines [1], there is not enough data to favor either jugular or subclavian access. Experts suggest that due to the instability of lead and patient immobilization, the duration of the femoral approach should be minimized. According to Marik et al. [10], the risk of infection while using femoral access is not higher than jugular or subclavian access.

Complications of TTCP have been reported by many authors since back in the 1970s [5, 8]. Although the incidence of complications tends to decrease in the more recent reports [7, 9], the data is still highly variable and reflects a high inhomogeneity in the approaches adopted by cardiologists for TTCP [11]. It also reflects differences in vascular access, utilization of ultrasound or fluoroscopy guidance, and — last but not least — the number and heterogeneity of the studied groups.

The present analysis focuses on TTCP utilization in a cardiology center, performed by an interventional cardiologist under fluoroscopy. Results and conclusions cannot be directly translated to the general population of TTCP recipients, particularly those implanted in emergency units, intensive care unit, at the bedside, and by other specialists. The current dataset, however, reflects a better, very common scenario in cardiology centers, where temporary pacing leads are commonly implanted under fluoroscopy by an interventional cardiologist and, in the majority of cases using femoral access [10].

Similar to Tjong's report (systematic review: 32 studies, 4546 patients), the AV block was the most common indication (60–70%) for pacing [7] and a permanent pacemaker was required in more than 50% of patients.

Ninety percent of procedures in the studied registry were performed via femoral access, which was also the preferred site of access in Tjong's review [7]. Although it eliminates the risk of pneumothorax and makes the procedure easier for interventional cardiologists, the femoral vein has many disadvantages. It was reported to be related to a very high (37%) reposition rate (due to a failure to sense/failure to capture), higher risk of deep vein thrombosis, and infection, including sepsis [8, 12]. Due to the small proportion of other than femoral access, the present study was not able to assess its effect on complications, but the dislocation rate was significantly lower (10%) than what was reported by Austin et al. [8].

The incidence of the most common complications in the current study was similar to that reported in the literature. The rates of pneumothorax (< 1%), tamponade (1.6%), and lead dislocation (10%) were similar to what was observed in the largest population analysis published to date [6].

The population was divided into MI and non-MI groups, as they differ significantly in terms of baseline characteristics and prognosis.

Differences in baseline characteristics (age, sex, incidence of hypertension, heart failure, ejection fraction) reflect the underlying disease. The incidence of the common TTCP complication (perforation, tamponade, inflammation, and lead reposition) was similar to the non-MI group, even though the median time of TTCP was longer among MI patients (54 vs. 38 h).

The most significant endpoint differentiating the groups was death during the index hospitalization.

In-hospital mortality rates in MI have been reported to be single-digit over the past decade, particularly in patients treated with angioplasty. In Poland, in 2018, 8.4% of MI patients died during MI hospitalization [13]. A 40% in-hospital mortality rate in MI patients requiring temporary pacing clearly points out that this is a subpopulation with a particularly high risk of death, and in many cases, the pacing lead is implanted during resuscitation or in asystole. Considering the incidence of other TTCP complications, which is similar in MI and non-MI groups, it was concluded that it is the severity of MI and sometimes compassionate use of TTCP that is responsible for the higher mortality rate. The complications of the procedure itself do not seem to add up to the risk.

## Limitations of the study

The limitations of this study are the relatively small number of events, which are likely to have confounded with our statistical analysis of vascular access and culprit vessel connection with TTCP.

## Conclusions

In-hospital mortality in MI patients requiring TTCP is high, 6.5-fold higher than in other patients with bradycardia requiring temporary pacing. However, the incidence of common complications of TCCP is similar in MI and non-MI patients. Thus, it is not TTCP but the severity of MI itself and the fact that the pacing lead is frequently implanted in asystole or during resuscitation that is responsible for the higher mortality rate.

**Conflict of interest:** None declared.

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