ORIGINAL ARTICLE

Radial approach reduces mortality in patients with ST-segment elevation myocardial infarction and cardiogenic shock

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KEY WORDS

cardiogenic shock, femoral approach, mortality, radial approach, registry

EDITORIAL

by Jolly and Akl, see p. 409

ABSTRACT

INTRODUCTION The beneficial outcome of the radial approach (RA) over the femoral approach (FA) in ST-segment elevation myocardial infarction (STEMI) has been widely demonstrated. However, most of the studies excluded patients with STEMI and cardiogenic shock (CS).

OBJECTIVES We sought to evaluate periprocedural outcomes of percutaneous coronary intervention (PCI) with the RA and FA in patients with STEMI complicated by CS using data from the Polish National PCI Registry (ORPKI).

PATIENTS AND METHODS A total of 3565 consecutive patients with STEMI and CS treated with emergent PCI and stent implantation were included. Data were collected prospectively from 151 tertiary invasive cardiology centers performing primary PCI in Poland between 2014 and 2018. To avoid possible selection bias, propensity score matching was used to create 945 matched pairs treated via the RA or FA.

RESULTS No differences were reported in baseline characteristics, clinical presentation, and delays in treatment between the RA and FA after propensity score matching. Similar radiation doses and total amount of contrast were used in both groups. A similar rate of periprocedural complications was observed in both RA and FA. However, the RA was associated with reduced periprocedural mortality (89 [9.4%] vs 176 [18.6%]; $P = 0.001$) and lower incidence of cardiac arrest (92 [9.7%] vs 152 [16.1%]; $P = 0.001$). The FA was the strongest independent predictor of increased periprocedural mortality in the multivariable analysis (odds ratio, 2.087; 95% CI, 1.629–2.674; $P = 0.001$).

CONCLUSIONS The RA was associated with lower periprocedural mortality compared with the FA in patients with STEMI complicated by CS. The RA seems to be a valuable option in technically feasible situations.

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Received: December 28, 2020.
Revision accepted: March 19, 2021.
Published online: March 19, 2021.
Pol Arch Intern Med. 2021; 131 (5): 421-428
doi:10.20452/pamw.15886

INTRODUCTION The radial approach (RA) has been widely adopted in percutaneous coronary intervention (PCI).[1-6] A growing body of evidence demonstrating the advantage of the RA over the femoral approach (FA) in PCI for ST-segment elevation myocardial infarction (STEMI).[1-8] Importantly, adjunctive antithrombotic and high-potency antiplatelet drugs used in STEMI might increase risk of bleeding complications and detrimental long-term outcomes. Thus, the RA should be the most beneficial in patients with STEMI.[1-3] However, most of the studies comparing the RA with the FA exclude patients with STEMI complicated by cardiogenic shock (CS).[1,9] Treatment of patients with CS is considered the most complex and technically challenging due to arterial vasoconstriction and poor general condition in that population. Absence of the radial pulse is the most common reason for choosing the FA in patients with CS. Thus, the RA in STEMI complicated by

WHAT'S NEW?

Treatment of patients with ST-segment elevation myocardial infarction (STEMI) and cardiogenic shock (CS) is considered the most complex and technically challenging. Thus, the use of the radial approach (RA) was scarcely evaluated in this clinical setting. This study suggests that the RA might be associated with reduced periprocedural mortality and rate of cardiac arrest as compared with the femoral approach in patients with STEMI complicated by CS. The femoral approach for percutaneous coronary intervention (PCI) was the strongest independent predictor for increased periprocedural mortality. Conversely, more PCI experience was associated with a lower risk of death, regardless of the access site. Vascular access might be an important modifiable risk factor in patients with STEMI complicated by CS. Thus, RA seems to be a valuable option in technically feasible situations. The presented study for the first time provided a clinical view from a national perspective on the impact of vascular access site on the clinical outcomes in patients with STEMI and CS.

CS was scarcely evaluated.[9-12] There is paucity of evidence since randomized comparison might not be feasible due to impaired consciousness and patient inability to consent in this clinical setting. Thus, studies in all-comer populations might elucidate this topic. More data from an unselected cohort of patients are essential in the era of widespread use of the RA by invasive cardiologists with various levels of radial dexterity and experience. This study aimed to compare periprocedural outcomes of PCI with the RA and FA in patients with STEMI complicated by CS using data from the Polish National PCI Registry (ORPKI).

PATIENTS AND METHODS A complete description and design of the ORPKI national registry were reported in previous studies.[3,5,13-15]

In brief, the ORPKI is an electronic database including information on all PCI procedures in interventional cardiology in Poland. This registry is administered by the Jagiellonian University Medical College in Kraków, Poland and was approved by the Polish Association of Cardiovascular Interventions of the Polish Cardiac Society.[16] Data were collected prospectively from January 2014 to December 2018 from a network of 151 tertiary invasive cardiology centers in Poland. A total of 3565 consecutive patients with STEMI complicated by CS and treated with emergent PCI with stent implantation were included in the analysis. The RA was used in 959 patients (26.9%) and the FA in 2606 patients (73.1%). The patient flow chart is presented in FIGURE 1.

The access site was chosen at the discretion of a local interventional cardiologist and depending on the use of circulation support with catecholamines or mechanical ventilation therapy. The vascular access site (either radial or femoral) was described as the site of a successful vascular entry. Procedures via the brachial artery or unknown access site (41 [1.1%]) were excluded from the analysis. Similarly, procedures with access-site crossover (82 [2.2%]) were also excluded. The selection of target lesions and treatment techniques was left at the discretion of the operator. Data on the type and complexity of lesions were not collected in the database. All PCIs were performed following local standards and current ESC guidelines wherever suitable.[1,17]

All procedures were performed by interventional cardiologists with various levels of dexterity and expertise in PCI via the RA. Total radial procedure volumes were defined with the use of individual physician identity numbers in the ORPKI database. They were calculated for a particular operator separately as the quotient of PCI performed with the RA and the overall number of procedures during enrollment.

Data on all adverse events reported during the procedure were collected prospectively. No follow-up was performed after hospital discharge. The diagnosis of periprocedural complications was left at the operator's discretion following definitions from the current ESC guidelines. Cardiogenic shock was defined as systolic blood pressure of less than 90 mm Hg for 30 minutes or longer or need for vasopressors / inotropes to preserve systolic blood pressure of 90 mm Hg or greater in combination with clinical evidence of hypoperfusion (coldness and / or pallor of the extremities, oliguria, decreased level of consciousness). Periprocedural mortality was defined as death from any cause during PCI till transport to either the cardiology department or the intensive care unit. Standardized bleeding definitions from the Bleeding Academic Research Consortium were used homogeneously in all centers as any glaring, actionable sign of hemorrhage (eg, more bleeding than would be expected, including bleeding found by imaging alone) that does not meet the criteria for type 3, 4, or 5 hemorrhage, but meets at least one of the following criteria: 1) requires nonsurgical, medical intervention by a healthcare professional, 2) leads to hospitalization or increased level of care, or 3) prompts evaluation.[18] Cerebrovascular events were diagnosed by local physicians based on clinical presentation. Neither data on the type of stroke nor further neurological outcomes were available.

The ORPKI is a national registry collecting data on current clinical practice, thus all patients provided only signed informed consent for the procedure. No personal data are gathered in the registry. There is no additional risk associated with participation in the registry and no impact on treatment, thus institutional ethics committee agreement was not required. The study complied with ethical principles for clinical research of the Declaration of Helsinki with later amendments. No funding was used to support this registry.

Statistical analysis A propensity score was calculated to mimic randomization and avoid the potential effect of bias on the preselection process. A multivariable logistic regression model was developed with the procedure access site approach (radial vs femoral) set as the dependent variable. All baseline characteristics (sex, age, weight,

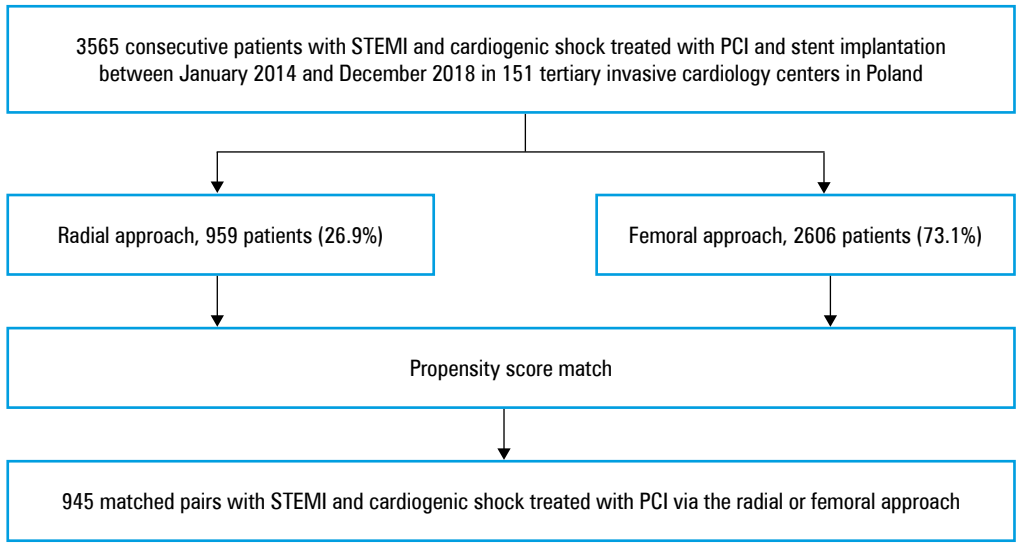

FIGURE 1 Flowchart of included patients
Abbreviations: PCI, percutaneous coronary intervention; STEMI, ST-segment elevation myocardial infarction

diabetes mellitus, previous stroke, previous myocardial infarction, previous PCI, previous coronary artery bypass grafting, smoking status, arterial hypertension, chronic kidney disease, psoriasis, cardiac arrest, and mild therapeutic hypothermia at baseline), data on periprocedural treatment (acetylsalicylic acid, P2Y12 inhibitors, unfractionated heparin, low-molecular-weight heparin), and baseline clinical data (Thrombolysis in Myocardial Infarction [TIMI] grade flow before PCI) were set as covariates. The cutoff for the caliper method was estimated at below 10% to obtain a satisfactory balance for standardized differences for all confounders. Patients were matched 1:1. Unpaired patients were not included in matched-pair analysis. Standard descriptive statistics were performed. Quantitative variables were presented as mean and SD or median and interquartile range (IQR). Categorical variables were delineated as counts and percentages. Before the matching, differences between groups were compared using the Student or the Welch *t* test depending on the equality of variances for normally distributed variables. The Mann–Whitney test was used for nonnormally distributed continuous variables. Nominal variables were compared by the χ^2 test or the Fisher exact test if 20% of cells had expected count of less than 5. Matched pairs of subjects were compared with the Wilcoxon signed-rank test (for nonnormally distributed data difference) or the paired *t* test (for normally distributed data difference) for continuous variables and the McNemar–Bowker test for categorical (nominal) variables. Equality of variances was assessed using the Levene test. The normality of the data was assessed with the Shapiro–Wilk test if the sample size was less than or equal to 2000, and the Kolmogorov–Smirnov test with Lillieforce correction was computed for samples that were greater than 2000. Furthermore, normal quantile plots were analyzed visually to evaluate normality of variables. A 2-sided *P* value of less than 0.05 was considered statistically significant. The analysis was conducted in the "as-treated" manner. In addition, multivariable logistic regression models were constructed to estimate predictors for mortality. Backward selection in logistic regression analysis with a probability value for covariates to enter the model was set at 0.05. The results were presented as odds ratios (OR) with 95% CIs. All statistical analyses were conducted with JMP, version 14.2.0 (SAS Institute Inc, Cary, North Carolina, United States).

RESULTS Trends in the use of RA and FA for cardiogenic shock between 2014 and 2018 are presented in Supplementary material, *Figure S1*. Baseline clinical and demographic data are summarized in **TABLE 1**. A total of 945 matched pairs with STEMI and CS treated with PCI via the RA or FA were evaluated. No differences were reported in baseline characteristics and clinical presentations between the RA and FA after the propensity score matching. Furthermore, there were no differences in angiographic indications for PCI and both antiplatelet and antithrombotic therapy during the procedure (**TABLES 2** and **3**). However, the target lesion was more commonly located in the right coronary artery in patients with PCI via the FA as compared to the RA (377 [39.9%] vs 332 [35.1%]; *P* = 0.04) (**TABLE 3**). The delays from symptoms onset to the first medical contact as well as time from symptoms to coronary angiography did not differ between the groups (**TABLE 4**). Invasive cardiologists with the highest proficiency and experience in the RA more frequently chose the radial artery as the access site. Likewise, default femoral operators more often performed PCI with the FA (**TABLE 5**). Similar radiation doses (median [IQR], 927 [504.3–1659] mGy vs 938.5 [490.8–1575] mGy; *P* = 0.62) and the total contrast load (median [IQR], 180 [130–230] ml vs

TABLE 1 Baseline characteristics before propensity score matching

Variable	FA (n = 2606)	RA (n = 959)	*P* value
Male sex	1611 (61.9)	618 (64.5)	0.14
Weight, kg	78.56 (15.37)	80.39 (16.54)	0.004
Age, y	68.76 (12.38)	68.11 (11.45)	0.12
Diabetes mellitus	607 (23.3)	226 (23.6)	0.86
Previous stroke	164 (6.3)	52 (5.4)	0.33
Previous MI	529 (20.3)	159 (16.6)	0.01
Previous CABG	75 (2.9)	13 (1.4)	0.009
Previous PCI	427 (16.4)	115 (12)	0.001
Smoking	531 (20.4)	233 (24.3)	0.01
Arterial hypertension	1353 (51.9)	535 (55.8)	0.04
Chronic kidney disease	259 (9.9)	87 (9.1)	0.44
Chronic obstructive pulmonary disease	72 (3.7)	44 (5.7)	0.02
Psoriasis	9 (0.4)	6 (0.6)	0.26
Cardiac arrest at baseline	1222 (46.9)	291 (30.3)	<0.001
Hypothermia at baseline	37 (1.4)	16 (1.7)	0.56

Data are presented as number (percentage) or mean (SD).

Abbreviations: CABG, coronary artery bypass grafting; FA, femoral approach; MI, myocardial infarction; RA, radial approach; others, see FIGURE 1

TABLE 2 Percutaneous coronary intervention details after a propensity match

Variable		FA (n = 945)	RA (n = 945)	*P* value
Site volume ≥400 PCI in current year		905 (95.8)	914 (96.7)	0.31
Total amount of contrast, ml		180 (130–230)	170 (130–220)	0.19
Total radiation dose, mGy		927 (504.3–1659)	938.5 (490.8–1575)	0.62
Aspiration thrombectomy during PCI		160 (16.9)	206 (21.8)	0.007
Rotablation during PCI		1 (0.1)	0	>0.99
P2Y12 inhibitors before and during PCI	Clopidogrel	797 (84.3)	799 (84.6)	0.51
	Ticagrelor	139 (14.7)	139 (14.7)	
	Prasugrel	9 (1)	7 (0.7)	
GPI IIb/IIIa during PCI		405 (42.9)	416 (44)	0.6
Unfractionated heparin during PCI		802 (84.9)	811 (85.8)	0.61
Low-molecular-weight heparins during PCI		21 (2.2)	17 (1.8)	0.49
Bivalirudin during PCI		1 (0.1)	1 (0.1)	>0.99
Thrombolysis during PCI		3 (0.3)	3 (0.3)	>0.99
TIMI 0 or 1 flow before PCI		758 (80.2)	744 (78.7)	0.4
TIMI flow after PCI	3	684 (72.6)	759 (80.6)	0.002
	2	113 (12)	85 (9)	
	1	60 (6.3)	45 (4.8)	
	0	85 (9)	53 (5.6)	

Data are presented as number (percentage) or median (interquartile range).

Abbreviations: GPI, glycoprotein, TIMI, Thrombolysis in Myocardial Infarction; others, see FIGURE 1 and TABLE 1

170 [130–220] ml; *P* = 0.19) were used in both the RA and FA (TABLE 2). Aspiration thrombectomy during PCI was performed more often during PCI with the RA (206 [21.8%] vs 160 [16.9%]; *P* = 0.007). Furthermore, complete restoration of blood flow after PCI (TIMI grade 3 flow) was more common in patients treated with PCI using the RA (TABLE 2). A similar rate of periprocedural complications was observed during PCI performed with both the RA and FA. However, the RA was associated with reduced periprocedural mortality (89 [9.4%] vs 176 [18.6%]; *P* = 0.001) and lower incidence of cardiac arrest (92 [9.7%] vs 152 [16.1%]; *P* = 0.001) (FIGURE 2). In multivariable analysis, the use of the femoral artery for PCI was the strongest independent predictor for increased risk of periprocedural mortality (OR, 2.087; 95% CI, 1.629–2.674; *P* = 0.001) (FIGURE 3). Conversely, more experience in PCI was associated with a lower risk of death, regardless of the preferred access

TABLE 3 Coronary angiography results and target lesion in particular vessels

Variable	FA (n = 945)	RA (n = 945)	*P* value
LMCA	131 (13.9)	110 (11.6)	0.21
LAD	458 (48.5)	462 (48.9)	0.92
Cx	194 (20.5)	216 (22.9)	0.19
RCA	377 (39.9)	332 (35.1)	0.04
LIMA/RIMA	0	1 (0.1)	>0.99
SVG	4 (0.4)	3 (0.3)	0.81
Single-vessel disease	263 (27.9)	288 (30.6)	0.64
LMCA only	14 (1.4)	12 (1.3)	0.62
Multivessel disease without LMCA	488 (51.7)	494 (52.4)	0.58
Multivessel disease with LMCA	178 (18.9)	148 (15.7)	0.62

Data are presented as number (percentage).

Abbreviations: Cx, circumflex artery; LAD, left anterior descending; LIMA, right internal mammary artery; LMCA, left main coronary artery; RCA, right coronary artery; RIMA, right internal mammary artery; SVG, saphenous vein graft; others, see TABLE 1

TABLE 4 Treatment delays after propensity score matching

Variable	FA (n = 945)	RA (n = 945)	*P* value
Time from first medical contact to angiography <120 min	568 (60)	594 (63)	0.11
Time from first medical contact to angiography, min	75 (50–108)	75 (54–104)	0.33
Time from pain to first medical contact, min	60 (30–91)	60 (30–117)	0.29

Data are presented as number (percentage) or median (interquartile range)
Abbreviations: see TABLE 1

TABLE 5 Operator radial and femoral experience after a propensity match

Variable	FA (n = 945)	RA (n = 945)	*P* value
PCI operator radial experience (2014–2018), n of procedures	1255 (794–1855)	1590 (1142–2293)	<0.001
Operators performing ≤25% procedures with RA (2014–2018)	302 (32)	158 (16.7)	<0.001
Operators performing >25% and ≤50% procedures with RA (2014–2018)	277 (29.3)	289 (30.6)	<0.001
Operators performing >50% and ≤75% procedures with RA (2014–2018)	233 (24.7)	268 (28.7)	<0.001
Operators performing >75% procedures with RA (2014–2018)	133 (14.1)	230 (24.3)	<0.001
PCI operator femoral experience (2014–2018), n of procedures	325 (174–563.5)	214 (130–350.5)	<0.001
Operators performing ≤25% procedures with FA (2014–2018)	181 (19.15)	310 (32.8)	<0.001
Operators performing >25% and ≤50% procedures with FA (2014–2018)	234 (24.8)	284 (30.1)	<0.001
Operators performing >50% and ≤75% procedures with FA (2014–2018)	285 (30.2)	243 (25.7)	<0.001
Operators performing >75% procedures with FA (2014–2018)	245 (25.9)	108 (11.4)	<0.001

Data are presented as number (percentage) or median and interquartile range.

Abbreviations: others, see FIGURE 1 and TABLE 1

site. However, higher proficiency with the FA (OR, 0.964; 95% CI, 0.941–0.986; *P* = 0.002) was linked with a slightly more favorable outcome as compared with a parallel increase in the RA expertise (OR, 0.985; 95% CI, 0.941–0.986; *P* = 0.005) (FIGURE 3).

DISCUSSION Our analysis suggests that the RA might be associated with lower mortality than the FA in patients with STEMI complicated by CS. The FA for PCI was the strongest independent predictor for increased periprocedural mortality. Thus, the RA seems to be a valuable option in technically feasible situations.

To our best knowledge, the present study is the first to provide a clinical view from a national perspective on the impact of vascular access site on clinical outcomes in STEMI with CS in a contemporary unselected cohort of patients. Our analysis is consistent with the results of former studies.[11,19-24] Favorable outcomes of the RA were confirmed in a large meta-analysis of 6 observational studies.[11] However, the meta-analysis included observational and retrospective studies. Thus, the results might not entail causation or a treatment effect.[11] Furthermore, enrollment of STEMI and non–ST-segment elevation myocardial infarction with blood pressure threshold of less than 100 mm Hg rather than most commonly used less than 90 mm Hg for CS definition might limit the generalizability of the results.[11,24] Only 2 small retrospective studies confirmed no difference in short-term outcomes between the RA and FA in patients with STEMI complicated by CS.[25,26] However, in both studies, the sample size was not sufficient to detect differences. The reduction of mortality in PCI with CS via the RA was frequently credited to a lower rate of major bleeding, which was not present in our study.[11,22,24] Similarly, a numerically lower incidence of bleeding complications in the RA as compared with the FA was observed in the post hoc analysis of the CULPRIT-SHOCK (Culprit Lesion Only PCI Versus Multivessel Percutaneous Coronary Intervention in Cardiogenic Shock) trial, albeit also not reaching statistical significance (6.9% vs 10.6%; *P* = 0.3).[21] The absence of difference in bleeding complications between the RA and FA might be partially explained by an impaired effect of oral antiplatelet agents related to diminished intestinal absorption in the setting of CS.[21,23,24] Furthermore, the RA might reduce bleeding risk by limiting the number of femoral punctures needed in CS treatment.[27-29] Previous retrospective analysis of 321 consecutive patients with intra-aortic balloon pump (IABP) support during PCI complicated by CS reported a decreased risk of bleeding events in patients with a single use of the radial artery and a single use of the femoral artery as compared with the bilateral FA group (36.6% vs 57.4%; *P* = 0.01).[29] This outcome remained significant after propensity score adjustment (OR, 0.57; 95% CI, 0.4–0.9; *P* = 0.007).[29]

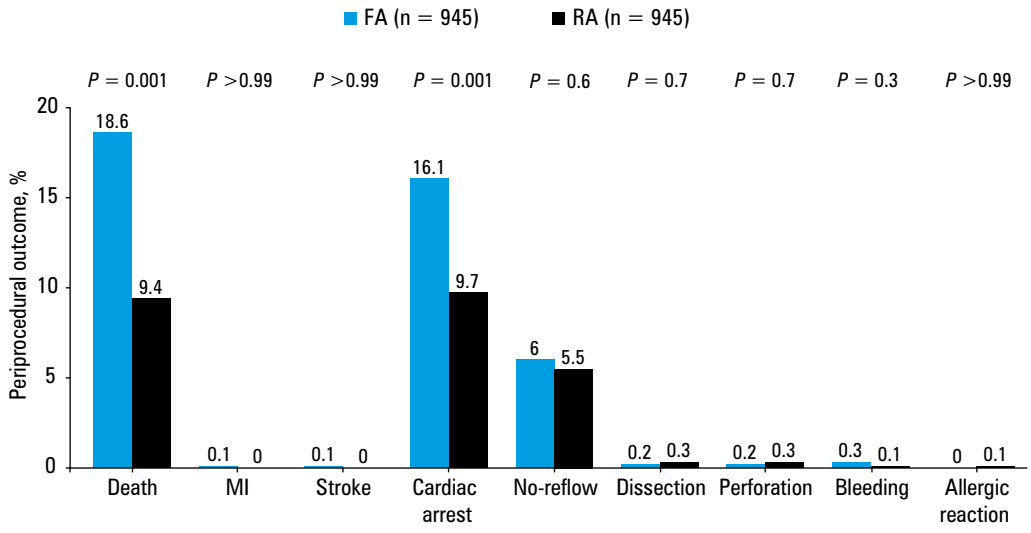

FIGURE 2
Periprocedural outcomes of percutaneous coronary interventions after propensity score matching
Abbreviations: MI, myocardial infarction; others, see TABLE 1

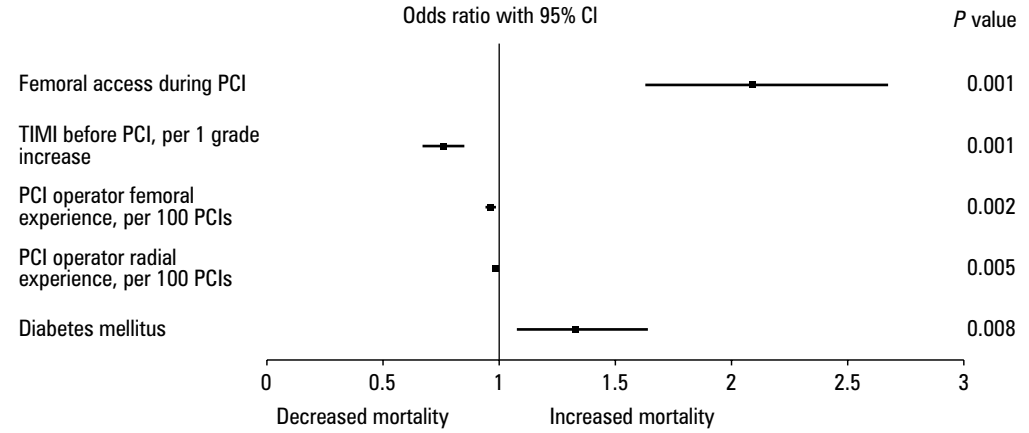

FIGURE 3 Independent predictors of periprocedural mortality in patients with ST-segment elevation myocardial infarction complicated by cardiogenic shock
Abbreviations: see FIGURE 1 and TABLE 2

In our "real-world" registry, reduced periprocedural risk of death was demonstrated despite similar baseline characteristics and anticoagulant and antithrombotic therapies in both groups. The beneficial outcome in periprocedural mortality in the RA group cannot be explained by a direct cause-effect association with any adverse event and should be considered an independent outcome. Furthermore, cardiac arrest was more frequently reported in the FA group, but it was not identified as a predictor for mortality in multivariable analysis (FIGURES 2 and 3). However, TIMI grade 3 flow after PCI was more frequently observed in the RA group and an increase in preprocedural TIMI grade flow was identified as an independent predictor of a decreased risk of death. Thus, it might be a possible mechanism partially responsible for reduced mortality in PCI via the RA.

Some studies suggested that clinical outcomes of PCI in STEMI depend on the time of hospital admission.[30-32] Off-hour presentation might be associated with longer transfer delay and an increased risk of death both in short and long-term observation.[30-32] In this study, there was no difference between both groups in delays between symptoms onset and the first medical contact or coronary angiography (TABLE 4). However, diurnal variability in myocardial perfusion and fatigue of medical staff might also be partially responsible for these outcomes.[30-32] Thus, day- and night-time admission might be also fractionally attributed to differences in mortality rate in the high-risk population. However, in this study, the time of intervention was not captured.

Furthermore, limitations related to available data might be another plausible explanation for these results. Propensity score matching might not sufficiently equalize unaccounted differences between groups.

Also, the experience of invasive cardiologists might be related to the mortality benefit in the RA group. Despite the wide range of proficiency of invasive cardiologists, both FA and RA used by trained and experienced cardiologists were linked to reduced mortality. This observation is consistent with previously reported data.[5,33] Procedures performed by operators with most experience in the RA might be associated with higher mortality in PCI with the use of FA. This observation seems to be related to a decreased level of dexterity in the FA in favor of RA adaptation in everyday clinical practice.[5,33] Thus, the impact of proficiency and experience might be another plausible explanation for a favorable outcome in the RA group.

Furthermore, the absence of a palpable pulse on the radial artery as a sign of vasoconstriction and a generally worse clinical condition might

be related to the default assignment to the FA group. Thus, selection bias might also be associated with increased mortality for PCI using the FA, although we have attempted to mimic the randomization process with the use of both multivariable analysis and propensity score matching to avoid such unmeasured confounders. Despite postulated superiority, the RA is frequently considered as more technically demanding. The radial artery is usually a small-caliber vessel prone to spasm, common anatomical variation or subclavian tortuosity. Procedures with the RA might be associated with longer fluoroscopy time or total contrast volume and increased radiation. Inconsistent data were reported in term of radiation doses and the total amount of contrast in patients undergoing PCI via the RA.[11,33,34] Several factors might impact radiation exposure, including operator dexterity and proficiency, angiographic indication for PCI, or lesion characteristics.[1,11,17] No difference in both radiation dose and administered contrast volume in this study might suggest a comparable dexterity level of invasive cardiologists in both RA and FA groups. This observation could be related to the diverse level of complexity of PCI in both groups. However, this registry does not provide these data. The choice of the vascular access site should be left at the discretion of the operator. However, the RA seems to be a valuable option for the vascular access site in a technically feasible situation of STEMI complicated by CS.

To summarize, this study provided data on beneficial outcomes of PCI via the RA in patients with STEMI complicated by CS. However, only a dedicated randomized clinical trial might provide sufficient data for a more robust analysis. Nevertheless, a randomized comparison might not be feasible due to impaired consciousness of the patients and inability to provide consent in this clinical setting. Thus, studies with a larger sample size are crucial to validate these findings and evaluate the suggested advantage of the RA in STEMI with CS.

Limitations Several limitations related to the nature of the study should be acknowledged. The most important is the nonrandomized design. Some unmeasured confounding variables might have persisted despite propensity score matching. Another major limitation is lack of long-term follow-up of patients. Data beyond hospital discharge were not collected. Data on the size of vascular sheaths as well as utilization of closure devices were not reported. Furthermore, some clinical data are lacking. Data on the impact of the duration and type of all mechanical ventilation or circulatory support were not available and could therefore not be included in the multivariable model. The choice of the access site was left at the operator discretion; thus, it was related to experience and personal skills. Furthermore, the absence of a palpable pulse on the radial artery might represent vasoconstriction related to worse general conditions; therefore, high-risk patients were routinely assigned to the FA group. This analysis did not consider access for IABP in which FA using one or both arteries is preferred; thus, the risk of bleeding from the access site might be increased. However, the use of mechanical circulatory support in CS remains unclear. Furthermore, the routine use of IABP is no longer recommended.[1,17,27,28] However, this study reflects a national experience from an unselected cohort including numerous high-risk patients who are often excluded from randomized clinical trials. Thus, we provided comprehensive insights into the real-world clinical practice in STEMI complicated by CS.

Conclusions The RA was associated with lower periprocedural mortality as compared with the FA in patients with STEMI complicated by CS. In high-risk patients, access site selection should be at the operator's discretion. However, the RA seems to be a valuable option in technically feasible situations. Greater experience in PCIs was linked with a reduction in the risk of periprocedural death.

SUPPLEMENTARY MATERIAL

Supplementary material is available at www.mp.pl/paim.

ARTICLE INFORMATION

CONTRIBUTION STATEMENT TT conceived the concept of the study and prepared the manuscript. TT, AD, and ZS coordinated the research at all steps of the study. All authors were involved in the concept and design of the study. KP conducted the statistical analysis. All authors participated in the analysis and interpretation of data. All authors revised the manuscript critically for important intellectual content. All authors edited and approved the final version of the manuscript.

CONFLICT OF INTEREST None declared.

HOW TO CITE Tokarek T, Dziewierz A, Plens K, et al. Radial approach reduces mortality in patients with ST-segment elevation myocardial infarction and cardiogenic shock. Pol Arch Intern Med. 2021; 131: 421-428. doi:10.20452/pamw.15886

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