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ORIGINAL RESEARCH

Clinical investigation of transradial access for emergent percutaneous coronary intervention in patients with acute myocardial infarction

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Background: Use of intensive anticoagulation and antiplatelet therapy in acute myocardial infarction (AMI) potentially increases the risk of bleeding complications during percutaneous coronary intervention via the transfemoral route. Recently, the transradial access has been intensively employed as an alternative means for diagnostic and interventional procedures. A low incidence of vascular access site bleeding complications suggests that the transradial access is a safe alternative to the transfemoral technique in patients with AMI. The safety and efficacy of transradial access for emergent percutaneous coronary intervention in patients with AMI has not been investigated in the People's Republic of China.

Methods: We analyzed data from our single-center registry on 596 consecutive patients between October 2003 and October 2010. The patients were retrospectively divided into a transradial group (n = 296) and a transfemoral group (n = 300). A dedicated doctor was appointed to collect the following data: puncture time, coronary angiography time, percutaneous coronary intervention time, X-ray exposure time, duration of hospitalization, and complication rates associated with puncture, such as puncture site bleeding, hematoma, pseudoaneurysm, and major adverse cardiac events.

Results: There were no significant differences in baseline characteristics and angiographic findings between the two groups. There were also no significant differences in coronary angiography time (8.2 ± 2.4 versus 7.6 ± 2.0 minutes), percutaneous coronary intervention time (30 ± 6.8 versus 29.6 ± 8.1 minutes), or X-ray exposure time (4.6 ± 1.4 versus 4.4 ± 1.3 minutes) between the groups. There were significant differences in puncture time (4.4 ± 1.6 versus 2.4 ± 0.8 minutes) and duration of hospitalization (3.2 ± 1.6 versus 5.4 ± 1.8 days) between the groups ($P < 0.001$). The complication rate using transradial access was 2.03% (6/296) versus 6.0% (18/300) using transfemoral access ($P < 0.0001$).

Conclusion: Transradial access for emergent percutaneous coronary intervention is safe and effective in patients with AMI, and it is suggested that this route could be used more widely in these patients.

Keywords: percutaneous coronary intervention, vascular access, radial artery, stent deployment

Introduction

Percutaneous coronary revascularization with stent implantation is the preferred strategy for treatment of acute myocardial infarction (AMI) and is mainly performed using the transfemoral approach.[1–4] In recent decades, the transradial access has been increasingly used as an alternative means for diagnostic and interventional procedures. A low incidence of bleeding complications at the vascular access site suggests that transradial access is a safe alternative to the transfemoral route in AMI. Recently, some investigators[3–5] have reported using this approach to perform emergent percutaneous

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coronary intervention (PCI) in patients with AMI. The safety and efficacy of transradial access for emergent PCI has not been investigated in the People's Republic of China. This retrospective study investigated the safety and efficacy of transradial access for emergent PCI in patients with AMI.

Materials and methods

Patient selection

We analyzed data from our single-center registry on 596 consecutive patients treated between October 2003 and October 2010. All patients who presented with AMI without cardiogenic shock underwent catheter-based revascularization within 12 hours of initial evaluation. They were divided into a transradial group (n = 296) and a transfemoral group (n = 300).

Procedural methods

PCI was performed in a standard fashion via the transradial route. During PCI, all patients received an adjunctive intravenous bolus infusion of heparin 40–60 U/kg followed by a continuous intravenous infusion at 15 U/kg/hour until the end of the procedure. Activated clotting time was monitored (therapeutic range 250–350 seconds). All patients received aspirin 300 mg orally and clopidogrel 300 mg orally immediately before the procedure if not previously administered. Nitroglycerin 200 μg and verapamil 1 mg were administered intravenously immediately after insertion of the sheath in order to prevent radial artery spasm.

Objectives

The primary objectives of the study were to compare puncture time, X-ray exposure time, coronary angiography time, PCI time, duration of hospitalization, and complications related to vessel puncture between the transradial and transfemoral access groups. Secondary objectives included an intergroup comparison of baseline and post-PCI TIMI (Thrombolysis in Myocardial Ischemia) III flow in the infarct-related vessel. Clinical outcomes, including sudden cardiac death and acute stent thrombosis, were recorded. Coronary angiography time was defined as the time from puncture of the access artery to completion of coronary angiography. PCI time was defined as the time from guiding catheter cannulation to the end of the PCI procedure.

Statistical analysis

All data are presented as the mean ± standard deviation or as percentages. Differences in proportions were analyzed using the Chi-square test, whereas differences in normal continuous variables were analyzed using the independent Student's *t*-test. All reported values were two-sided. Analyses were performed using Statistical Package for the Social Sciences version 10 software (SPSS Inc, Chicago, IL, USA). A two-tailed P-value < 0.05 was considered to be statistically significant.

Results

There were no significant differences in baseline patient characteristics, coronary angiography results, or lesion characteristics between the two groups (Table 1). PCI-related objectives were compared between the two groups (Table 2). A comparison of the infarct-related vessel, heart rate, blood pressure, and heart function between the two groups is shown in Table 3. The infarct-related culprit vessel was successfully opened in all patients, and no sudden cardiac death or acute stent thrombosis occurred during hospitalization in either group.

There was one case of unsuccessful radial artery puncture in the transradial group, giving a success rate of 99.6%,

Table 1 Patient characteristics, coronary angiography results, and lesion characteristics at baseline

Variable	Transradial group (n = 296)	Transfemoral group (n = 300)	Statistics Chi-square-test and *t*-test	*P*-value
Gender (male/female)	170/126	180/120	$\chi^2 = 0.3062$	0.58
Age, years	58.4 ± 10.6	58.8 ± 10.4	$t = 0.4649$	>0.05
Hypertension	86 (29.1%)	90 (30.0%)	$\chi^2 = 0.0267$	0.8703
Diabetes mellitus	60 (20.3%)	60 (20.0%)	$\chi^2 = \times 10^{-4}$	0.9841
Dyslipidemia	49 (16.6%)	50 (16.7%)	$\chi^2 = 0.0053$	0.9417
Current smoker	115 (38.9%)	120 (43.3%)	$\chi^2 = 0.0412$	0.839
CAG results				
LAD	158 (53.4%)	160 (53.3%)		
LCX	58 (19.6%)	60 (20.0%)	$\chi^2 = 0.0196$	0.9902
RCA	80 (27.0%)	80 (26.7%)		

Abbreviations: CAG, coronary angiography; LAD, left anterior descending coronary artery; LCX, left circumflex; RCA, right coronary artery.

Table 2 Objectives related to percutaneous coronary intervention

Objectives	Transradial group (n = 296)	Transfemoral group (n = 300)	Statistics t-test	*P*-value
Puncture time (minutes)	4.4 ± 1.6*	2.4 ± 0.8	19.26	<0.0001
CAG time (minutes)	8 ± 2.4	7.6 ± 2.0	1.64	>0.05
PCI time (minutes)	30 ± 6.8	29.6 ± 8.1	1.79	>0.05
X-ray exposure time (minutes)	4.6 ± 1.4	4.4 ± 1.3	1.81	>0.05
Duration of hospitalization (days)	3.2 ± 1.6*	5.4 ± 1.8	15.76	<0.0001

Note: *$P < 0.05$ statistically significant.
Abbreviations: CAG, coronary angiography; PCI, percutaneous coronary intervention.

and a case of unsuccessful femoral artery puncture in the transfemoral group, giving a success rate of 99.7%. The difference in puncture success rate was not statistically significant between the two groups. There were six cases of forearm hematoma in the transradial group (incidence 2.03%, 6/296) and 18 cases of femoral artery hematoma in the transfemoral group (incidence 6.0%, 18/300), of which two cases involved pseudoaneurysm formation. Comparing the two groups, there was a statistically significant difference in complication rates ($P < 0.0001$).

Discussion

Campeau[1] published the first report of coronary angiography performed via the transradial route in 1989. Since then, many researchers[2–5] have shown that the transradial approach is safe and effective for stent implantation in patients with coronary artery disease. Compared with transfemoral access, the transradial route had several advantages, including a lower puncture-related complication rate, less invasiveness, ability to use heparin continuously to prevent thrombosis, no constriction of the patient's physical activity, and increased comfort.[6–9]

Table 3 Comparison of infarct-related vessel, heart rate, blood pressure, and heart function between the two groups

Objectives	Transradial group (n = 296)	Transfemoral group (n = 300)
Anterior myocardial infarction	154	154
Inferior myocardial infarction	126	128
NSTEMI	16	20
Heart rate (beats per minute)	86.4 ± 12.8	87.3 ± 13.2
SBP/DBP (mmHg)	110 ± 16.8/70 ± 9.8	108 ± 17.0/72 ± 10.0
Killip classification		
I	270	265
II	26	30
III	–	5

Abbreviations: DBP, diastolic blood pressure; SBP, systolic blood pressure; NSTEMI, non-ST elevation myocardial infarction.

This single-center, retrospective study demonstrated the safe and effective use of transradial access for stent implantation in the infarct-related artery in patients with AMI. Compared with transfemoral access, our results show that there were no significant differences in coronary angiography, PCI, and X-ray exposure times in the transradial group, but there were significant differences in puncture time and duration of hospitalization. This is consistent with the results reported by Kim et al.[8] Moreover, transradial access was associated with a lower incidence of complications related to puncture of blood vessels, including hematoma and pseudoaneurysm. All patients underwent successful stent implantation in the infarct-related artery, and there were no adverse events, such as sudden cardiac death or acute stent thrombosis.

Our analysis suggests that emergent PCI can be performed in patients with AMI safely and effectively via the transradial route. One reason for this is that, in most cases, the hand is supplied by both the radial and ulnar arteries, which have abundant connecting vascular networks. Even if the radial artery is occluded accidentally, it does not cause ischemia of the hand.[4,6,8] Another reason is that the radial artery is a superficial vessel, easy to puncture, not accompanied by an important nerve supply, and bleeding is easier to stop. Therefore, many investigators[9–11] have used transradial access for PCI in patients with coronary heart disease, and this route may decrease the puncture-related arterial complication rate, enable a shorter duration of hospitalization, and reduce the associated medical costs in patients with AMI.[12]

It is widely believed that the diameter of the radial artery is too small and prone to spasm, the operation is time-consuming, and the guiding catheter cannot provide backup support to accomplish PCI. In our experience, radial artery spasm can be prevented if patients are given intravenous nitroglycerin 200 μg and verapamil 1 mg immediately after the radial artery has been successfully punctured.[13] In addition, we chose an extra back-up guiding catheter, such as a 6 French XB: Vista britetip (Cordis Corporation, Hialeah, FL, USA)/EBU: Launcher (Medtronic

Corporation Minneapolis, MN, USA) for the left coronary system or an AL_1/AR_2 catheter for the right coronary artery to perform the procedure according to the angiographic findings. Compared with transfemoral access, transradial procedures are technically more challenging because of the greater difficulty in cannulating the relatively small radial artery, variations in radial anatomy, and occurrence of radial spasm. A fairly steep learning curve exists for the younger cardiologist switching to transradial access.[14] However, as time goes by, this route is being adopted by interventional cardiologists in clinical practice and is well accepted by patients with AMI.

With advances in science and technology, we anticipate that the transradial route will be adopted for emergent PCI in patients with AMI,[3–5] but much larger clinical studies would be needed to support its widespread use in clinical practice.

Conclusion

The study demonstrated that trans-radial access was safe and efficacious for emergent percutaneous coronary intervention in patients with acute myocardial infarction. This access may be an alternative for trans-femoral access in patients with acute myocardial infarction, and can be intensively used in the future.

Disclosure

The authors report no conflicts of interest in this work.

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