Feasability, bleeding events and impact on door-to-balloon times

Switching from femoral to radial access for coronary angiography in ACS

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Summary

Background: Transradial access (TRA) for coronary angiography (CA) is thought to be superior to the transfemoral approach (TFA) in patients presenting with an acute coronary syndrome (ACS) regarding access site complications and bleeding events. As an institution that primarily uses TFA for CA, we switched to TRA during the year 2012. The aim of this study was to look for differences in bleeding events, procedure times, contrast use in ACS patients and door-to-balloon (dtb) times in STEMI patients comparing the TRA and TFA, respectively.

Methods/results: A total of 789 ACS patients underwent CA in 2012. Of these, 502 patients had the TFA and 287 patients the TRA for CA. The overall bleeding rate was 14.1% for TFA and 5.3% for TRA ($p < 0.01$) using the BARC (bleeding academic research consortium) criteria. Access site-related bleeding events were 10.5% in the TFA group and 3.9% in the TRA group ($p = 0.01$). There were no differences regarding procedure times or contrast use between the two groups. In a multivariate analysis, gender, age, Gp IIb/IIIa use and access site were independent predictors of bleeding events. Of the 789 patients, 428 were STEMI patients. Dtb time was 106 ± 100 minutes (including transfer patients). There was no difference regarding dtb time between the TRA and the TFA group.

Conclusion: For experienced "femoral operators", a switch to the radial access site is feasible and safe. There is no increase in dtb time, fluoroscopy time or contrast use, but a significant decrease in bleeding events with the radial approach in patients presenting with ACS.

Key words: radial access; acute coronary syndrome; access site bleeding; bleeding risk; door-to-balloon time

Introduction

The transradial approach (TRA) for coronary angiography (CA) was initially described by Campeau [1] in 1989 and for percutaneous coronary intervention (PCI) by Kiemeneij and Laarman [2] in the early 90s. Although the technique was rapidly adopted by a few groups in Europe, Canada, the United States and Asia, widespread use has not occurred. The obvious advantage of the radial artery compared with the femoral artery is the superficiality of the vessel with no adjacent structures susceptible to be damaged during percutaneous procedures. Hence, despite the use of aggressive antithrombotic regimens required for PCI, the artery is readily compressible, and introducer sheaths can be immediately removed upon completion of procedures. Haemostasis can be achieved safely and rapidly using simple compressive devices. Two meta-analyses reviewing randomised trials comparing TRA with the traditional transfemoral approach (TFA) for diagnostic coronary angiography or interventions estimated a 73% reduction in the risk of access site-related bleeding and an 80% risk reduction of major bleeding [3, 4]. These benefits are associated with earlier ambulation, increased patient comfort, and reduced duration of hospitalisation with substantial cost containment. However, the smaller calibre of the radial artery as well as the greater anatomical variability of its vascular course and distribution in the arm has been associated with a steep learning curve resulting in an increase in procedural failure and a higher rate of cross-over to femoral route [4] . Two recent large randomised trials comparing the two access sites in acute coronary syndrome (ACS) patients revealed less access site related bleeding in the subgroup with ST elevation myocardial infarction (STEMI) [5] with a reduction of cardiac mortality in one trial [6] . In the current ESC guidelines for STEMI treatment, TRA is the preferred access route in experienced centres [7] and there is a new consensus document on how to introduce TRA in a primarly femoral access center [8].

In 2012 we introduced TRA for coronary angiography and percutaneous coronary intervention (PCI) in ACS patients as the new standard approach at our centre, in accordance with the current guidelines. In this study we compared TFA to TRA in troponin-positive ACS patients regarding inhospital bleeding events,

door-to-balloon (dtb) times, contrast use and total fluoroscopy times.

Methods

This study was a single centre prospective registry study. All patients underwent diagnostic coronary angiography for a troponin-positive ACS. TRA was encouraged and operators switched to TRA according to a current consensus document [8] (first in elective patients, then stable ACS patients and finally in STEMI patients). All involved operators were using the TFA as a default approach for CA before this study. Five operators had >5 years' experience in interventional cardiology; one operator had 2 years of experience in interventional cardiology

All patients received an unfractionated heparin dose of at least 5000 IU i.v. preprocedure and a bolus of 500 mg aspirin i.v. if they were not already on aspirin treatment. Activated clotting time (ACT) was maintained >250 sec during the procedure, although ACT was not measured routinely. The use of a Gp IIb/IIIa was left to the operator. All patients received dual antiplatelet treatment with aspirin and clopidogrel, ticagrelor or prasugrel with a standard loading dose (600 mg for clopidogrel, 180 mg for ticagrelor and 60 mg for prasugrel). Clinical variables were collected from the individual patients' charts; coronary angiography and coronary intervention details were collected from the coronary intervention report and the procedure protocol.

In the STEMI subgroup, door-to-balloon time was defined as first medical contact to TIMI III flow in the culprit vessel. If there was spontaneous TIMI III flow, the time of (successful) arterieal puncture (radial or femoral) was used to calculate door to balloon time.

The primary endpoint was (inhospital) access site-related bleeding. Secondary endpoints were total bleeding events (inhospital), total procedure/fluoroscopy times and dtb times (only STEMI patients), compared between the two different access sites. Bleeding events were defined according to the bleeding academic research consortium definition (BARC) [9]. All patients gave written informed consent for the study and the study was approved by the local ethics commitee.

Statistics

Baseline characteristics of the patients are summarised as mean ± standard deviation (SD) for continuous variables and number (percentage) for categorical variables. The Student t test was computed for bivariate analyses. To look for independent risk factors for bleeding events we computed a multivariate analysis using nominal logistic regression. Only variables with p-values <0.1 in the univariate analysis were included in the multivariate analysis. Risk factors for bleeding events analysed in the univariate analysis were: gender, age, access route for coronary angiography, diabetes, renal failure (defined as creatinine clearance <60 ml/min), body mass index and use of Gp IIb/IIIa antagonists. A two-tailed p-value <0.05 was established as the level of statistical significance for all tests. Statistical analyses were performed using Jmp 11.0 (SAS).

Table 1: Baseline characteristics.

	Radial (n = 285)	Femoral (n = 504)	p-value
Age	62.2 ± 13.5	64.9 ± 12.6	<0.01
Gender (male; %)	74.4	77.2	NS
STEMI (%)	44.6	59.7	<0.01
Diabetes mellitus (%)	16.5	14.9	NS
Hypertension (%)	51.6	52.6	NS
Smoking (%)	34.4	31.1	NS
Creatinine (µmol/l)	79.1 ± 23.5	86.4 ± 56.3	NS
Body Mass Index (kg/m^2)	27.2 ± 4.4	27.0 ± 9.3	NS
Previous stroke (%)	4.6	3.8	NS
Previous myocardial infarction (%)	15.4	19.0	NS
Previous CABG (%)	1.8	4.4	0.05
Previous PCI (%)	14.7	17.5	NS
PVD (%)	2.5	5.4	0.05
OAC (%)	2.8	3.2	NS

CABG = coronary artery bypass grafting; NS = not significant; OAC = oral anticoagulant treatment; PCI = percutaneous coronary intervention; PVD = peripheral vascular disease; STEMI = ST elevation myocardial infarction.

Results

In 2012, 789 patients underwent coronary angiography as a result of a troponin-positive ACS at our institution (mean age 63.9 ± 13.0 years; 24.6% women). TRA rate for ACS patients was around 10% in January 2012, increasing to over 60% in December 2012. A total of 502 patients had the TFA for coronary angiography compared with 287 patients with a TRA in 2012. Patients in the TFA group were older compared with the TRA group (64.9 ± 12.6 vs 62.2 ± 13.5; p <0.01) and there were more STEMI patients in the TFA group than in the TRA group (59.7% vs 44.6%; p <0.01) (table 1). The periprocedural characteristics were comparable between the two groups except for number of vessels diseased (average of 2.0 ± 1.0 vessel disease in the TFA group vs 1.8 ± 0.9 in the TRA group; p = 0.01) and periprocedural use of a Gp IIb/IIIa antag-

onist (33.9% vs 14.4%; p <0.01; table 2). Gp IIb/IIIa use was significantly less in the non-STEMI group (19.2% in TFA group vs 5.1% in TRA group; p <0.01) compared with the STEMI group (44.2% in TFA group vs 26.8% in TRA group; p <0.01). There were no differences regarding contrast use or fluoroscopy times between the TFA and the TRA group.

Crossover rate from the TRA to the TFA was 8.1%. All swaps from radial to femoral access were due to technical access problems (e.g., radial artery size, radial artery anatomy, short ascending aorta, etc). and not due to the complexity of the procedure.

The overall bleeding rate was 14.1% for the TFA and 5.3% for the TRA group (p <0.01) using the BARC bleeding criteria. Access site-related bleeding rates were 10.5% and 3.9%, respectively (p = 0.01). The strongest predictor of access site-related bleeding was the use of a Gp IIb/IIIa antagonist. Among patients without Gp IIb/IIIa use, there was still a trend towards a lower access site-related bleeding rate in the TRA group (table 3).

In a multivariate analysis including only variables with p values <0.1 in univariate analysis of bleeding events, gender (p = 0.02) , age (p = 0.03), Gp IIb/IIIa use (p <0.001) and access site (p = 0.03) were independent predictors of bleeding events (table 4). Inhospital mortality rate was 4.4% overall, 5.9% in the TFA group and 1.8% in the TRA group (p = 0.003)

A total of 428 of the 789 patients were STEMI patients. Average dtb time was 106 ± 100 minutes. About two-thirds of the STEMI patients had been transferred from non-PCI capable hospitals. There was no significant difference between the TFA compared to the TRA group regarding dtb times (table 2).

Table 2: Periprocedural characteristics.

	Radial (n = 285)	Femoral (n = 504)	p-value
Total fluoroscopy time (min)	11.2 ± 6.1	12.1 ± 8.8	NS
Total contrast used (ml)	238 ± 75	241 ± 84	NS
Door-to-balloon time (STEMI patients only)	111.5 ± 123.0	104.0 ± 90.4	NS
Number of guides used	1.1 ± 0.4	1.1 ± 0.4	NS
Total stent length (mm)	28 ± 17	31 ± 20	0.06
Access site crossover	8.1%	0%	<0.01
X-vessel disease	1.8 ± 0.9	2.0 ± 1.0	0.01
Gp IIb/IIIa use (%)	14.4	33.9	<0.01

NS = not significant; STEMI = ST segment elevation myocardial infarction

Table 3: Bleeding events.

	Radial (n = 285)	Femoral (n = 504)	p-value
Any bleeding (%)	5.3	14.1	<0.01
Access site bleeding (%)	3.9	10.5	0.01
Any bleeding without Gp IIb/IIIa use (%)	4.1	8.7	0.03
Access site bleeding without Gp IIb/IIIa use (%)	2.9	6.0	0.07
Bleeding according to BARC criteria (%)			
BARC 2	4.2	9.9	
BARC 3a	0	1.2	<0.01
BARC 3b	1.1	2.6	
BARC 5	0	0.4	

BARC = bleeding academic research consortium

Table 4: Multivariate analysis regarding risk factors for bleeding events.

	95% confidence interval*	p-value
Gender (male)	–0.58 to –0.05	0.02
(Lower) age	–0.04 to –0.005	0.02
Access route for coronary angiography (femoral)	0.04 to 0.66	0.03
Diabetes	–0.70 to 0.08	NS
Renal failure	–0.20 to 0.46	NS
Gp IIb/IIIa use	0.37 to 0.87	<0.001

NS = not significant
Only variables with p values <0.1 in the univariate analysis were included in the multivariate analysis. Risk factors for bleeding events analysed in the univariate analysis were: gender, age, access route for coronary angiography, diabetes, renal failure (defined as creatinine clearance <60 ml/min), Body Mass Index and use of Gp IIb/IIIa antagonists.
* Values <0 are indicate protection regarding bleeding events, values >0 indicate higher bleeding risk

Discussion

Our data demonstrate that it is safe to switch from the TFA to the TRA in ACS patients without increasing dtb times, fluoroscopy times or contrast use when the technique is introduced according to a current consensus document. Additionally, the risk of access site-related bleeding is smaller with the TRA, especially in patients recieving Gp IIb/IIIa antagonists.

Coronary angiography and finally PCI through the radial approach started in the late 80s and early 90s but only recently has the reduced access site-related bleeding events in ACS patients compared with the TFA has been documented in large studies [1–6] . One recent large randomised study showed a reduction in access site bleeding and a reduction in cardiovascular mortality with TRA in STEMI patients [6]. Another large randomised trial did not show any mortality benefit when comparing the two approaches in ACS patients but there was a reduction in access site-related bleeding (although only if the ACUITY [10] bleeding criteria were used), especially in TRA experienced centres [5]. We used the BARC [9] bleeding criteria in our study, which are more sensitive than the TIMI or ACUITY criteria. The rates of bleeding events were therefore slightly higher in our study than in these randomised trials. Nevertheless, access site-related bleeding events were lower in the TRA group in

our registry as well. Using multivariate analysis, conventional risk factors for bleeding events like Body Mass Index, renal function and diabetes mellitus were not associated with bleeding events. One possibility is that our sample size was too small to detect an effect of these weak risk factors for bleeding in ACS patients. On the other hand the strongest predictor for a bleeding event was the use of a Gp IIb/IIIa antagonist. Additional independent risk factors for bleeding events were gender, age and access site for coronary angiography.

Crossover rates from the TRA to the TFA were 8.1% in our study, altogether comparable to previous work (7.6%–9.6%; [5, 6]).

A current consensus document recommends the introduction of the TRA in a stepwise manner (diagnostic coronary angiography in elective patients first, then PCI in elective patients followed by PCI in non-STEMI patients and finally STEMI patients) [8]. In our study the switch from the TFA to the TRA in ACS patients was encouraged and the TRA rate has steadily increased in ACS patients from below 10% in January 2012 to over 60% in December 2012. Using this stepwise introduction, the fluoroscopy times and the contrast use did not differ between the TFA and TRA, and dtb times were similar in STEMI patients.

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Conclusion

Introduction of the TRA in ACS patients at a centre primarily using the TFA is feasible and safe. If the current consensus document is followed when introducing the new technique, there is no increase in procedure time, contrast use or dtb time in STEMI patients. Additionally, rates of access site bleeding are lower with the TRA especially in patients receiving Gp IIb/IIIa antagonists.

Limitations

This was a prospective registry study. The baseline characteristics, especially bleeding risk factors, were not balanced between the TFA and TRA groups. There is a clear selection bias with more complex cases in the TFA group. This is due to the introduction of TRA with elective/stable patients first, then non-STEMI patients and then STEMI patients. Not all operators switched to TRA in STEMI patients at the same time point. This is a known phenomenon when switching from TFA to TRA [11]

All events were inhospital. Nothing can be said about long-term outcome.

Disclosures
No financial support and no other potential conflict of interest relevant to this article was reported.

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A full list of references is available in the online version of this article.

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