Comparison of Characteristics and Complications in Men Versus Women Undergoing Chronic Total Occlusion Percutaneous Intervention

Vinoda Sharma, MBBS[a], William Wilson, MBBS[b], William Smith, MD[c], Margaret McEntegart, MD, PhD[d], Keith Oldroyd, MD[d], Novalia Sidik, MD[d], Alan Bagnall, PhD[e], Mohaned Egred, MD[e], John Irving, MD[f], Julian Strange, MD[g], Thomas Johnson, MBBS, MD[g], Simon Walsh, MD[h], Colm Hanratty, MD[h], and James Spratt, MD[i,*]

Gender differences exist in clinical outcomes after routine percutaneous coronary intervention (PCI), but studies reporting such outcomes after chronic total occlusion (CTO) PCI are limited. We assessed the characteristics and outcomes of female patients undergoing CTO PCI. We retrospectively analyzed a dedicated national (United Kingdom) prospective CTO database from 2011 to 2015 for outcomes and characteristics of female patients undergoing CTO PCI (unmatched and propensity matched). Female patients constituted 20.5% (n = 260 of 1,271) of the unmatched cohort and 33.3% (n = 233 of 699) of the matched cohort and were more likely to be older (women aged >70 years, 48% in the unmatched and 45% in the matched cohort). An increased inhospital complication rate was observed in female patients (unmatched: 10% women vs 4.45% men, p = 0.0012, and matched 9.87% women vs 3.86% men, p = 0.0032). Coronary perforation, bleeding, and contrast-induced nephropathy were more frequently observed in female patients. Femoral access site with >6 French sheath was associated with an increased risk of bleeding. Presence of calcification in the CTO artery was associated with coronary perforation (grade III) in female patients in the matched cohort (p = 0.007). Female patients undergoing CTO PCI were older and experienced increased of inhospital complications. Increased awareness of these complications could influence the selection of access site and sheath size, the need for prehydration, judicious choice of balloon size, collateral selection, and wire placement in female patients undergoing CTO PCI. **(Am J Cardiol 2017;119:535−541)**

Chronic total occlusion (CTO) percutaneous coronary intervention (PCI) has generated increasing interest with the availability of new techniques and tools resulting in improved success rates, despite an increase in the complexity of arteries treated.[1] However, data regarding gender differences in CTO PCI are limited. Female patients are underrepresented in published CTO PCI literature with the proportion of female patients varying from 14% to 21%.[2−5] Although similar procedural success rates are seen in both men and women undergoing CTO PCI, a greater reduction in mortality has been reported in the male cohort,[3] potentially suggesting an unequal benefit of CTO PCI in male patients. It is well documented that gender differences exist in clinical outcomes after routine PCI,[6−8] but studies reporting such outcomes after CTO PCI are very limited. We aimed therefore to assess the characteristics and complications (inhospital and 30-day outcomes) of female patients, compared to their male counterparts undergoing CTO PCI.

Methods

Dedicated, expert CTO PCI operators (lifetime experience of >300 cases per operator) from the United Kingdom prospectively enter baseline, procedural, and outcome details into an anonymized online audit tool for consecutive CTO PCI cases. Participation is entirely voluntary and non/preproctored CTO operators do not contribute to this database. We retrospectively analyzed this database for outcomes and characteristics of patients undergoing CTO PCI from June 2011 to February 2015. Patients who had more than 1 CTO treated by PCI were entered as separate procedures. For patients who required more than 1 PCI attempt for the same CTO, only the final procedure was included. Demographics, procedural variables, procedural complications, and success rates (including success for the first CTO

[a]Department of Cardiology, Peter Munk Cardiac Centre, Toronto General Hospital, Toronto, Canada; [b]Department of Cardiology, Royal Melbourne Hospital, Melbourne, Australia; [c]Department of Cardiology, Trent Cardiac Centre, Nottingham City Hospital, Nottingham, United Kingdom; [d]Department of Cardiology, Golden Jubilee National Hospital, Glasgow, United Kingdom; [e]Department of Cardiology, Freeman Hospital, Newcastle-upon-Tyne, United Kingdom; [f]Department of Cardiology, Ninewells Hospital, Dundee, United Kingdom; [g]Department of Cardiology, University Hospitals Bristol, Bristol, United Kingdom; [h]Department of Cardiology, Belfast City Hospital, Belfast, United Kingdom; and [i]Department of Cardiology, Forth Valley Royal Hospital, Larbert, United Kingdom. Manuscript received September 9, 2016; revised manuscript received and accepted November 2, 2016.

See page 539 for disclosure information.

*Corresponding author: Tel/fax: (+44) 7816-615315.
E-mail address: James.spratt@nhs.net (J. Spratt).

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Table 1
Baseline characteristics of unmatched patients

Variable	Men n=1011	Women n=260	Significance p value
Age in years	64.2±10.3	68.5±9.8	p<0.0001
>70 years	289 (28.6%)	125 (48.1%)	p<0.0001
Hypertension	684 (67.7%)	190 (73.1%)	p=0.10
Hypercholesterolemia	690 (68.2%)	184 (70.8%)	p=0.45
Diabetes Mellitus	250 (24.7%)	62 (23.8%)	p=0.81
Smoker	696 (68.8%)	136 (52.3%)	p=<0.0001
Angina (CCS class >2)	476 (47.1%)	142 (54.6%)	p=0.03
Previous TIA/Stroke	50 (4.9%)	11 (4.2%)	p=0.75
Previous Myocardial Infarction	559 (55.3%)	134 (51.4%)	p=0.30
Previous coronary bypass	244 (24.1%)	36 (13.8%)	p<0.001
Chronic Kidney Disease	129 (12.8%)	38 (14.6%)	p=0.41
Family History of CAD	337 (33.3%)	90 (34.6%)	p=0.71
Previous PCI	566 (56.0%)	135 (51.9%)	p=0.26
Peripheral Vascular Disease	107 (10.6%)	28 (10.8%)	p=0.91

CAD = coronary artery disease; PCI = percutaneous coronary intervention; TIA = transient ischemic attack.

PCI attempt) were compared between male and female patients. CTOs were defined as lesions with angiographic evidence of a total occlusion with thrombolysis in myocardial infarction 0 grade flow and estimated occlusion duration of >3 months.[1] Procedural success was defined as restoration of antegrade thrombolysis in myocardial infarction 3 flow with <30% residual stenosis within the treated segment.[1] Definitions of other procedural characteristics are described in detail by Wilson et al.[1]

Inhospital complications evaluated included were a composite of coronary perforation (Ellis grade III), acute vessel closure, bleeding (according to site-local hematoma, retroperitoneal or gastrointestinal), periprocedural myocardial infarction (chest pain ± electrocardiographic changes with typical increase and decrease of cardiac biomarkers), transient ischemic attack/stroke, contrast-induced nephropathy (CIN: acute kidney injury leading to dialysis or leading to an increase in serum creatinine >25% from baseline), and death. Follow-up complications included composite of stent thrombosis, transient ischemic attack/stroke, myocardial infarction at 30 days, and death.

SPSS version 20 was used for statistical analysis (IBM Corporation, Armonk, New York). Missing variables were replaced by mean of nearest neighbor. Variables with >10% missing data were excluded. Categorical variables were presented as percentage and continuous variables as mean (±standard deviation). Differences in categorical variables were tested by the chi-square or the Fisher exact test and differences in continuous variables by the Student *t* test or Mann−Whitney *U* test. Variables were tested for normality, and non-normal continuous variables were log transformed for inclusion in the analysis. To overcome the limitations of the observational nature of our study, we performed a propensity score−matched analysis and compared variables between men and women in both the unmatched and matched patient cohort. The propensity score was derived by regression analysis with gender as the dependent variable and the following variables were included: age, chronic kidney disease, history of smoking, hypertension, diabetes mellitus, history of stroke, previous history of coronary artery bypass graft (CABG) surgery, history of previous PCI, hypercholesterolemia, peripheral vascular disease, and family history of coronary artery disease (CAD).

Propensity score matching was performed (2:1 nearest neighbor) without replacement and with calipers (set at 0.2 of the standard deviation of the logit of the propensity score).[9] We ensured balance in the propensity score of the matched samples by assessing the standardized difference in the mean propensity score (0.36), the ratio of the variance of the score (1.22) in the 2 groups,[10] and in addition, single-factor analysis of variance demonstrated a Levene statistic p >0.05 indicative of no difference in the 2 groups. Demographics, procedural variables, procedural complications, and success rates (including success for the first CTO PCI attempt) were compared again between male and female patients in this matched cohort.

Results

Female patients constituted 20.5% (n = 260) of the unmatched cohort of a total of 1,271 and were significantly older, with almost half of the female population aged >70 years (Table 1). Female patients were less likely to be smokers (current or ex) or have undergone CABG in the past (Table 1) in the unmatched cohort. Lesion complexity, as defined by the Japanese CTO (J-CTO) score, was similar between the 2 groups (Table 2). Final CTO PCI approach was similar between the groups, except for retrograde dissection reentry (RDR), which was more common in male patients (p = 0.04, Table 2). Fluoroscopy dose, procedural time, screening time, and contrast load were all significantly lower in female patients. Success rates were no different, even taking into consideration the first attempt at CTO PCI (Table 2).

Inhospital complications were more common in women (women 10.0% vs men 4.45%, p = 0.0012). Coronary perforation (Ellis III), bleeding complications, and CIN were more frequent in female patients (Table 3). Both male and female patients in the unmatched cohort with coronary perforation were more likely to have calcification and tortuosity of the CTO artery (p <0.01 for all).

Propensity score matching was performed (2:1 nearest neighbor) without replacement and with calipers and resulted in a cohort of 466 male patients matched to 233 female patients (2:1 matching) from the original database.[9] The matched group was assessed for differences in baseline, procedural characteristics and outcomes (Table 4).

The 233 propensity score−matched women demonstrated similar baseline characteristics as the unmatched female cohort (Table 4). Female patients were older and less likely to be smokers or undergone previous CABG (Table 4). Those aged >70 years constituted nearly half of the matched female population (45.1%, 105 of 233). Lesion complexity continued to be similar between female and male patients in the matched group (Table 5).

Final CTO PCI approach was less likely to be RDR in women compared to men undergoing CTO PCI. Fluoroscopy dose and total contrast use were again significantly less in female patients. Success rates were similar (men 82.6% vs women 85%, p = ns) and continued to be >80% as in the