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Brief Communication

Simultaneous rota-stenting and transcatheter aortic valve implantation for patients with heavily calcified coronary stenosis and aortic stenosis

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Abstract

Given that coronary artery disease (CAD) in octogenarians undergoing transcatheter aortic valve implantation (TAVI) often presents with more complex lesions and extensive calcification, rotational atherectomy (RA) may be needed in some cases before stenting. However, data regarding the feasibility and safety of simultaneous RA during TAVI using the Medtronic CoreValve (MCV; Medtronic, Minneapolis, MN, USA) system are lacking. Three out of 107 (2.8%) patients (2 females, average age 85.6 years, mean aortic valve area 0.5 cm^2, mean left ventricular ejection fraction 39%, mean Logistic EuroScore 70%), with complex, heavily calcified coronary stenosis, and severe valvular aortic stenosis (AS) were treated with TAVI and RA due to high surgical risk. After balloon valvuloplasty, all coronary lesions were successfully treated with RA and stenting, immediately followed by transfemoral TAVI with a self-expandable MCV. Our data suggested that in the very elderly patients with severe and heavily calcified CAD and AS who were turned down for cardiac surgery, RA and stenting followed by TAVI may be performed successfully in a combined, single-stage procedure.

Keywords: coronary artery disease; percutaneous coronary intervention; rotational atherectomy; transcatheter aortic valve implantation; valvular aortic stenosis

1. Introduction

Coronary artery diseases (CAD) in octogenarians undergoing transcatheter aortic valve implantation (TAVI) often present with more complex lesions and extensive calcification, therefore, rotational atherectomy (RA) may be needed in some cases prior to stenting.[1,2] Until recently, only rare cases of RA during TAVI have been performed and reported in this very complex setting.[1,2] Although percutaneous coronary intervention (PCI) can be performed successfully after the implantation of a self-expandable Medtronic CoreValve (MCV; Medtronic, Minneapolis, MN, USA),[2,3] we consider it more technically challenging than that performed in the presence of a shorter TAVI prosthesis.

We herein illustrate our thoughts and experiences with the outcomes from three octogenarians who suffer from severe and heavily calcified CAD and aortic stenosis (AS). They were rejected as candidates for cardiac surgery, and Rota-stenting and TAVI were then performed successfully in a combined, single-stage procedure. To the best of our knowledge, there has been no specific prior report addressing this issue.

2. Methods

In all of our cases, RA and stenting were performed after balloon aortic valvuloplasty (BAV). RA was then performed through a 12Fr arterial sheath contralateral to the valve implanting side. The intention was to use only one burr with the strategy "to be simple and to go fast" in these critical

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patients, whose frailty must be taken into account. After rotablation, the lesions were treated with ballooning and stenting. Subsequent to PCI, transfemoral TAVI was performed according to the standard procedures previously described.[4]

In the present study, all relevant baseline, procedural, echocardiographic, and follow-up data were retrospectively collected by a well-trained research assistant, and taken from our computerized database for analysis. This retrospective study was approved by the Ethics Committee of Cheng Hsin General Hospital. All patients were critically reviewed by a dedicated heart team, and each signed an informed consent for RA and TAVI before the procedure.

3. Results

Among our consecutive series of 107 transfemoral TAVI procedures, 68 (63.5%) had significant CAD. Of that number, 31 (29%) were indicated for myocardial revascularization. In three cases (2.8%) with severe calcified lesions, RA was needed to improve acute procedural success. The clinical characteristics of the three patients who underwent concomitant RA and TAVI are detailed in Table 1.

Angiographic and procedural characteristics are detailed in Table 2. The target vessels for rota-stenting in the three patients were all long lesions from the left main to the left anterior descending artery. Among these three cases, RA was necessary due to a failure to cross a lesion with an intravascular ultrasound catheter, balloons, or a coronary stent (Figs. 1 and 2). Thereafter, angiographic and procedural success occurred in all three patients.

Additionally, TAVI after PCI resulted in significant hemodynamic improvement in all three patients. No complications occurred during or after the procedures, and only mild or moderate aortic regurgitation was demonstrated after TAVI. The patients also showed a remarkable recovery in their clinical status and a much improved quality of life, their angina disappearing and heart failure symptoms resolving from New York Heart Association (NYHA) Class IV to Class II, for up to 1-month following the procedures (Table 3).

Table 1
Clinical characteristics of the three patients who underwent concomitant rotational atherectomy and transcatheter aortic valve implantation.

	Patient #1	Patient #2	Patient #3
Age (y)	83	81	93
Gender	Female	Female	Male
Body mass index (kg/m^2)	17.9	16.9	24.6
Smoking	No	No	No
Hypertension	No	No	No
Diabetes	Yes	No	No
Hyperlipidemia	Yes	Yes	No
Previous cerebral vascular accident	No	No	Yes
Chronic kidney disease (Stages 4 & 5)	No	No	No
Previous myocardial infarction	No	No	No
Logistic EuroScore (%)	59	71	80
Left ventricular ejection fraction (%)	40	22	55

Table 2
Angiographic and procedural characteristics of the PCI procedures in the three patients.

	Patient #1	Patient #2	Patient #3
Vascular access	Transfemoral	Transfemoral	Transfemoral
No. of diseased vessels	LM + 3VD	LM + 3VD	LM + 3VD
SYNTAX score	28	35	32
Guiding catheter diameter (Fr)	7	6	6
Target vessel (Rotablation)	LM & LAD	LM & LAD	LM & LAD
Target vessel (PCI only)	Nil	RCA	Nil
Baseline QCA (Rotablation)			
Reference vessel diameter (mm)	3.44	2.52	2.72
Lesion length (mm)	28	89	98
Minimal luminal diameter (mm)	0.4	0.3	0.2
Diameter stenosis (%)	88	88	93
Post-procedural QCA			
Reference vessel diameter (mm)	3.62	2.80	2.82
Lesion length (mm)	30	92	102
Minimal luminal diameter (mm)	3.24	2.61	2.58
Diameter stenosis (%)	10.4	6.7	8.5
No. of burr used	1	1	1
Largest burr size used (mm)	1.5	1.25	1.25
Type of stent implanted	Bare-metal stent	Drug-eluting stent	Drug-eluting stent
No. of stent implanted	2	4	3
Procedural success	Yes	Yes	Yes
Procedural complications	None	None	None

LAD = left anterior descending artery; LM = left main disease; PCI = percutaneous coronary intervention; QCA = quantitative coronary analysis; RCA = right coronary artery; 3VD = three-vessel disease.

4. Discussion

The optimal timing of PCI for patients undergoing TAVI remains an issue of ongoing controversy,[5–13] which varies among different institutions. A staged approach, with PCI and TAVI performed in two separate sessions, has the advantages of reducing the duration of the TAVI procedure, the volume of contrast media used, and the risk of hemodynamic instability due to PCI-related complications during the TAVI.[5,6,9,10] Performing PCI and TAVI during a single stage may be a more practical strategy however, and avoids the risks associated with an additional invasive procedure.[11–13] The onset of our institution's TAVI program was March 2013. Thereafter, our heart team adopted the strategy of staged PCI during the 1st year of our TAVI experience, treating concomitant CAD electively 2–4 weeks before TAVI. However, given the growing experience of our heart team, and the more mature skills of the operators, all PCI were performed during the same TAVI procedure since January, 2014.

From previously reported series, we found three patients underwent successful RA immediately after TAVI using a balloon-expandable valve.[1] It was assumed that any eventual ischemic complication related to the PCI procedure (slow flow or vessel occlusion) would have been better tolerated after the complete release of the left ventricular (LV) pressure overload.[1] In another case report, one patient was treated by complex PCI with RA 15 months after implantation of a MCV prosthesis.[2] However, we consider that some issues need to be addressed concerning PCI with RA in TAVI with MCV.

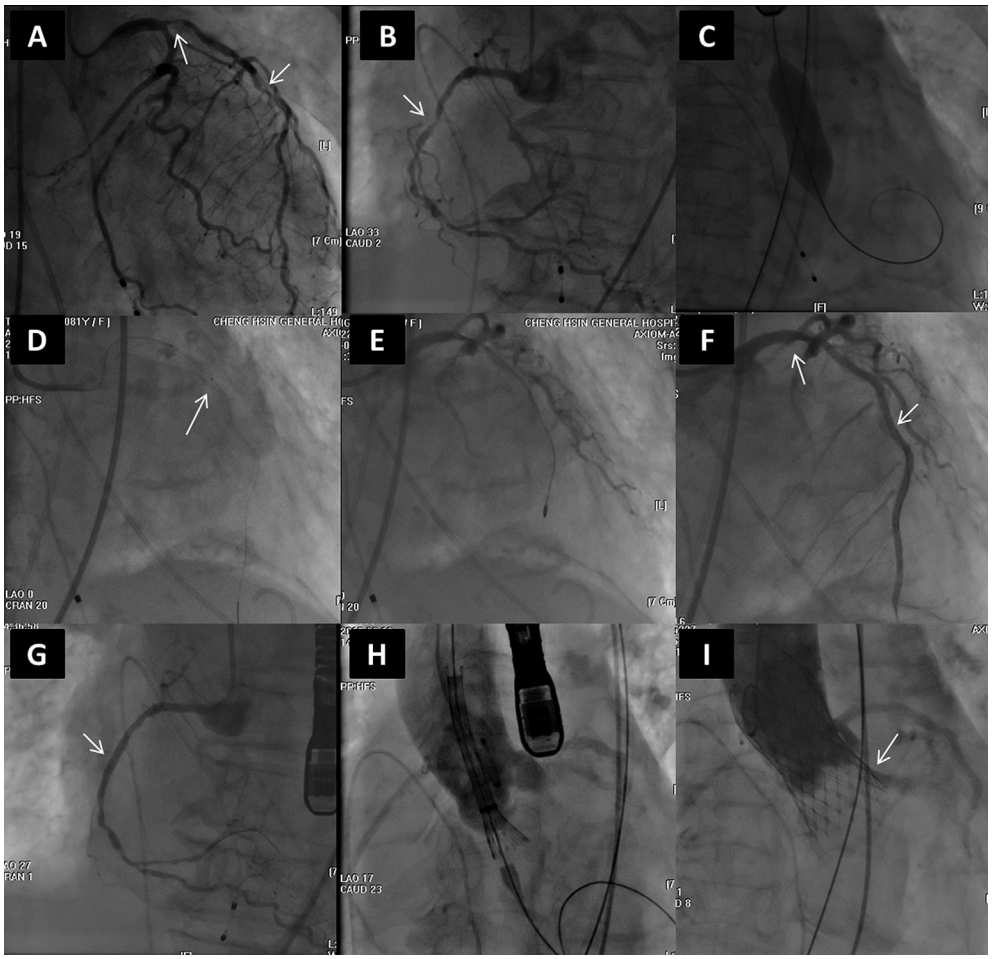

Fig. 1. Patient #2. (A) Coronary angiography showing left main disease and LAD artery stenosis before rotablation and stenting (arrows); (B) coronary angiography showing right coronary artery stenosis before stenting (arrow); (C) BAV before PCI; (D) failure to cross the lesion of the proximal LAD with an intravascular ultrasound catheter because of marked calcification (arrow); (E) rotablator burr crossing the left main and LAD lesions; (F) coronary angiography showing left main and LAD after rotablation and stenting; (G) coronary angiography showing RCA after stenting; (H) implantation of a 26 mm MCV prosthesis; (I) final angiography showing mild aortic regurgitation after MCV implantation (arrow). BAV = balloon aortic valvuloplasty; LAD = left anterior descending; MCV = Medtronic CoreValve; PCI = percutaneous coronary intervention; RCA = right coronary artery.

First, although PCI can be done successfully after the implantation of a MCV,[2,3] the procedure is more technically challenging than that performed in conjunction with a shorter TAVI prosthesis, such as the Edwards Sapien valve or the Boston Scientific Lotus valve. This is because the MCV is self-expandable with a longer stent frame. Although at the sinus of Valsalva level, the prosthesis takes the form of a calix so as not to compromise the flow of the coronary arteries, it is necessary to pass the tip of the guiding catheter through the rhomboid-shaped frames of the prosthesis in order to engage both coronary ostia. This may be problematic when coaxial and strong support is required, such as in the case of RA.

Secondly, the advantage of the MCV prosthesis is the gradual step-by-step deployment process, which permits fine adjustments to implantation depth and avoidance of interference with the surrounding structures. However, it takes longer to deploy the prosthesis compared to a balloon-expandable valve. The ischemia related to the rapid ventricular pacing during valve implantation is very short and unlikely to create irreversible hemodynamic impairment before PCI when a balloon-expandable valve is used; however, this may be a serious concern in the scenario of TAVI with MCV. Hence, we believe it would be safer to perform PCI before, instead of after, TAVI with MCV.

Thirdly, in order to avoid possible ischemic complication related to the RA, which is extremely risky and may jeopardize the patient,[14] we recommend relieving LV outflow tract obstruction. This would improve cardiac output and immediately reduce LV wall stress by balloon aortic valvuloplasty (BAV) before PCI with RA. Even though permanent elimination of the transaortic gradient is impossible, BAV may provide temporary relief of LV outflow tract obstruction or at least improve the patient's coronary blood flow.[15] Of course, during BAV, the duration of rapid ventricular pacing should be kept as short as possible to avoid myocardial ischemia and irreversible hemodynamic impairment before PCI with RA. Our data did demonstrate that the contrast media volume was relatively low, even though the fluoroscopy time and total procedure time was longer. Moreover, using a smaller size of burr would be more than adequate for partial debulking to

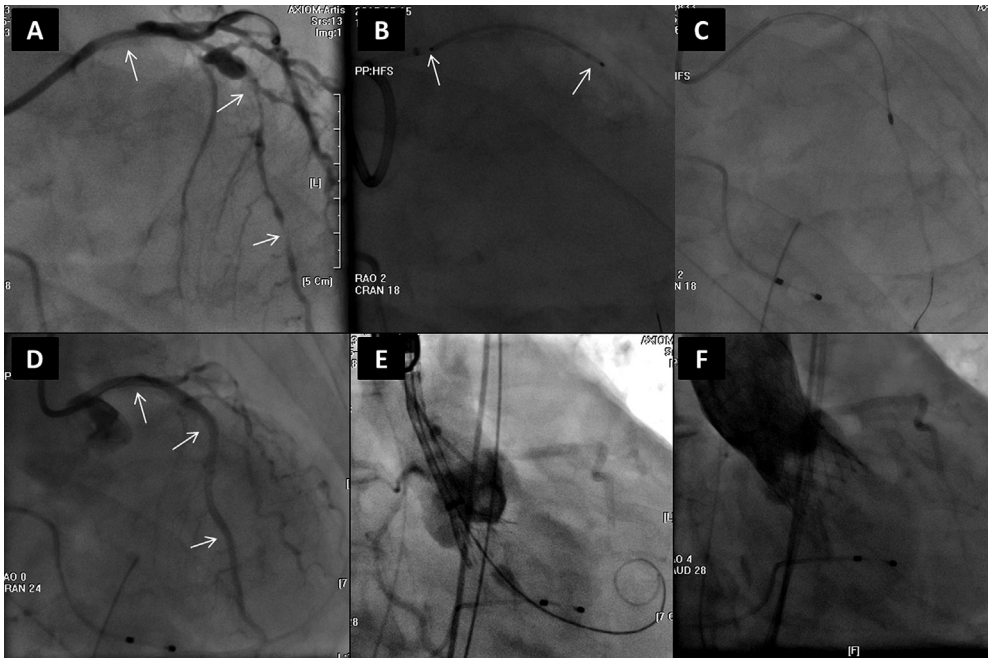

Fig. 2. Patient #3. (A) Coronary angiography showing left main disease and LAD artery stenosis before rotablation and stenting (arrows); (B) failure to cross the lesion of the proximal LAD with a 2.25 mm × 35 mm stent because of marked calcification (arrows); (C) rotablator burr crossing the left main and LAD lesions; (D) coronary angiography showing left main and LAD after rotablation and stenting; (E) implantation of a 29 mm MCV prosthesis; (F) final angiography showing mild aortic regurgitation after MCV implantation. LAD = left anterior descending; MCV = Medtronic CoreValve.

allow the alteration of plaque compliance and facilitate appropriate stent expansion.

In conclusion, RA and TAVI can be performed successfully in a combined, single-stage procedure without increasing the risks of renal failure in very high-risk octogenarians presenting with more complex coronary lesions and extensive calcification, who are primarily denied surgical revascularization. Prospective comparisons with a larger number of patients and long-term follow-up are required to confirm these potential advantages.

Table 3
Procedural characteristics and outcomes of the transcatheter aortic valve implantation procedures in the three patients.

	Patient #1	Patient #2	Patient #3
Vascular access	TF	TF	TF
Pre-procedural parameters			
NYHA functional class	IV	IV	IV
Aortic valve area (cm^2)	0.3	0.6	0.6
Mean pressure gradient (mmHg)	41	48	24
Aortic annulus diameter (mm)	22.3	23.6	25.2
Aortic regurgitation (grade)	Moderate	Mild	Mild
Medtronic CoreValve size (mm)	26	26	29
Post-procedural parameters			
NYHA functional class	II	II	II
Aortic valve area (cm^2)	1.4	1.7	1.8
Mean pressure gradient (mmHg)	8	7	6
Aortic regurgitation (grade)	Mild	Mild	Mild
Procedural success	Yes	Yes	Yes
Post-operative complication by VARC	None	None	None
Mortality at 1-month follow-up	No	No	No
NYHA functional class at 1-mo	II	II	II
Aortic regurgitation at 1-mo	Mild	Mild	Mild

NYHA = New York Heart Association; TF = transfemoral; VARC = Valve Academic Research Consortium.

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