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Rotational Atherectomy: Improved Procedural Outcome With Evolution of Technique and Equipment. Single-Center Results of First 1,000 Patients

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We present our single-center experience of rotational atherectomy (RA) in the first 1,000 consecutive patients divided arbitrarily into three different time periods corresponding to significant changes in technique or equipment for RA. Period I (August 1994 to April 1995; 172 cases) is characterized by early experience, longer ablation, and frequent use of intra-aortic balloon pump; period II (May 1995 to January 1996; 254 cases) is characterized by short ablation runs (20–30 sec) and use of rotaflush; period III (February 1996 to February 1997; 574 cases) is characterized by ReoPro use, neosynephrine boluses to avoid hypotension, and rota floppy wire and flexible shaft burrs. The procedural success rate has improved and complication rates have progressively declined over these three time periods. The incidence of lesion complexity (long and type C lesions) and patients with unstable rest angina have increased over these time periods of RA. Therefore, modification in procedural techniques and equipment over time have made RA a safe technique despite its use in very complex lesion subsets. *Cathet. Cardiovasc. Intervent. 46:305–311, 1999.* © 1999 Wiley-Liss, Inc.

Key words: slow flow; intervention; micro-circulation

INTRODUCTION

Rotational atherectomy (RA) utilizes an over-the-wire, coaxially driven, diamond-tipped, high-speed rotating elliptical burr to pulverize the atherosclerotic plaque and may be preferred in the treatment of diffuse, calcified, and ostial lesions (type B_2 and C lesions of American College of Cardiology/American Heart Association (ACC/AHA) classification). The RA technique developed by David Auth in the early 1980s is designed to work on the principle of differential cutting whereby inelastic material such as plaque is preferentially ablated [1]. The mechanism of pulverizing plaque or ‘‘sanding’’ the fibrocalcific atheroma can conceivably translate into less arterial damage (barotrauma and stretch) than has been noted with balloon angioplasty and may reduce the incidence of ischemic complications. The atheromatous debris produced by RA are usually 5–10 µm in size and are easily cleared via the distal microcirculation in most cases. Nevertheless, abundant particulate debris caused by RA may clog the distal microcirculation and might result in the most feared complication of slow flow/no reflow, potentially causing catastrophic ischemic complications (myocardial infarction, arrhythmia, or death) [2,3]. Despite many years of widespread application of this device, technique of rotational atherectomy is very subjective and its results are very variable [4–6]. In an attempt to improve efficacy and safety, RA technique and equipment have also changed over time. To determine whether these changes have affected procedural outcome, we evaluated our single-center experience of RA in the first 1,000 consecutive cases.

MATERIALS AND METHODS

We evaluated our single-center results of rotational atherectomy at Mount Sinai Hospital, New York, since its start in August 1994 and continued to February 1997. The first 1,000 consecutive patients undergoing RA during this time period were included. Arbitrarily, this interval

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was divided into three different time periods corresponding to the significant changes in the technique or equipment of rotational atherectomy: period I, from August 1994 to April 1995 (n = 172 patients; 198 lesions), is characterized by early experience, longer ablations (as tolerated up to 1–2 min), and frequent intra-aortic balloon pump (IABP) use; period II, from May 1995 to January 1996 (n = 254 patients; 302 lesions), is characterized by short ablation time (20–30 sec) and rotaflush (containing verapamil, nitroglycerine, heparin); and period III, from February 1996 to February 1997 (n = 574 patients; 712 lesions), is characterized by ReoPro use (29%), IV neosynephrine boluses (0.1 mg) to keep systolic BP >100 mm Hg, and rota floppy wire and flexible drive shaft rota burrs.

All baseline clinical, angiographic, and procedural variables were prospectively recorded and analyzed for procedural outcome and in-hospital complications.

Device

The high-speed rotational atherectomy device utilizes an over-the-wire, coaxially driven, diamond-studded burr to pulverize the atherosclerotic plaque. During period I and II rota C wire (Heart Technology, Redmond, WA) with 0.009'' diameter shaft and a 3.7-cm platinum soft tip was used. In period III, rota floppy wire (Scimed, Maple Grove, MN) was used, which tapers in its diameter from 0.009'' to 0.005'' and has a 2.2-cm distal soft tip. This rota floppy wire was more trackable and pushable than the earlier rota C wire. In this time period, the newer rota burrs with more flexible drive shaft, which made negotiation in tortuous arteries and bends easier, were also introduced.

Patient Selection

During the initial period, patients with stable or crescendo angina and/or inducible myocardial ischemia underwent RA. Patients with acute coronary syndrome (unstable rest angina, myocardial infarction, or postinfarct angina) who may have thrombus containing lesions were not considered the optimal candidates for RA and were avoided during the initial periods. In these cases RA was done only after initial stabilization on medical therapy for few days. In period III with ReoPro use and changed techniques, patients with acute coronary syndrome underwent RA if angiographic lesions warranted rotablation (such as heavy calcification, diffuse disease, or total occlusion).

Procedure

Premedications included aspirin (ticlopidine if allergic to aspirin), sedative, and calcium channel blockers. β-blockers were routinely held in elective cases in the early period. Intravenous (IV) heparin was administered to keep activated clotting time >300 sec and IV and intracoronary (IC) nitroglycerine were liberally used. Rotational atherectomy procedure was performed using 7–10 Fr guide catheters based on the maximum burr size. A 5 Fr venous sheath was routinely placed and a 4 Fr temporary pacemaker was inserted routinely throughout the study period for RA of right coronary artery (RCA), protected left main, left circumflex (LCX), or ostial left anterior descending (LAD) lesions. FCL (Scimed) guide catheters for LAD, Voda (Scimed) curves for LCX, and hockey stick guide for RCA were preferred. Lesions were routinely crossed with the rota wire except in some complex, tortuous, and totally occluded lesions where other guidewires like 0.014'' high-torque extra support or balance wire (Advanced Cardiovascular System, Temecula, CA), or choice plus or choice plus intermediate wires (Scimed) were used to cross the lesion and then exchanged with the rota wire over a small balloon or an exchange catheter. Rotablator burr was advanced to the treatment site and activated at 180,000 to 200,000 rpm and maintained between 175,000 to 190,000 rpm for burr size <2.0 mm and between 160,000 to 175,000 rpm for burr size >2.0 mm. In later time periods there was trend toward keeping low rpm (160,000 for >2.0 mm burr and 170,000 for <2.0 mm burr). In most tortuous, angulated, or total occlusion lesions, initial burr size of 1.25 mm was selected. Step burr approach was used in the majority of cases with an increment in burr size of <0.5 mm. Maximal burr-to-artery (BA) ratio was kept between 0.7–0.8, with lower ratio in tortuous, calcified, and angulated lesions.

After a stable platform speed, the burr was gradually advanced across the lesion using a slow pecking motion technique and special emphasis was placed to avoid drop of >5,000 rpm. Manual saline flush mixed with nonionic dye was performed during backward motion of the rota burr to interrogate the lesion improvement and to augment distal flow to promote clearance of the distal debris. Postdilatation with an slightly oversize balloon (1.1–1.2:1 BA ratio) of appropriate length was performed at 1–2 atm for 100–300 sec usually utilizing long compliant balloons. If the lesion did not crack at 1–2 atm and optimal rotablation has been done, then higher pressure, up to 4–6 atm, were used to dilate the lesion.

During the entire study period, if slow flow occurred, IC nitroglycerine and verapamil were liberally used and manual flush using patients' own blood was performed by slowly withdrawing the blood through the guide catheter and then forcefully reinjecting the blood into coronary vessel through the guiding catheter. Postprocedure IV heparin was continued only in cases of suboptimal results or staged procedure, otherwise sheaths were removed 3–4 hr postprocedure. If chest pain with slow flow or EKG changes persisted postprocedure, despite good angiographic results, an IABP was placed to improve chest pain and EKG changes and then removed 4–24 hr postprocedure.

In all patients, three sets of creatine kinase-MB isoenzyme (CK-MB) were measured routinely preprocedure, 6–8 hr and 16–24 hr postprocedure even if total CK was normal and patients with elevated CK-MB values were divided into three groups; 1–3 × normal (total CK-MB 17–48 U/L), 3–5 × normal (CK-MB 49–80 U/L), and >5 × normal (CK-MB >81 U/L). Three sets of CK-MB values were available in approximately 98% of patients in each period.

Modification in Technique

Rotaflush. A pressurized normal saline flush bag is connected to the rotablator advancer that flows through the teflon sheath to cool the system while burr is spinning and delivers normal saline at a rate of 7 cc/min when the system is not activated and about 13–17 cc/min when the system is activated. In period II, after the promising results of CARAFE Trial [7], heparin (5,000 units), verapamil (5 mg), and nitroglycerine (5 mg) were added into one litter of saline flush bag.

Short ablation time. In II and III periods, lesion engagement by the burr after a stable platform speed was reduced to 20–30 sec, and the burr was slowly and gradually advanced across the lesion using a ‘‘slow pecking’’ motion technique. Total burr time during each run did not exceed >30 sec and drop >5,000 rpm was strictly avoided.

ReoPro use. In the III period ReoPro became available and was used in long calcific, totally occluded, ostial, thrombotic, and bifurcation lesions or in cases with slow flow. It was also used routinely in patients with unstable rest angina and post–myocardial infarction setting. ReoPro was used in 29% of cases in period III mostly at the beginning of the procedure.

Avoidance of hypotension. The major determinant of the particulate clearance created during rotational atherectomy is coronary blood flow, therefore systemic hypotension during RA will decrease the pressure gradient for flow across the coronary vascular bed (Δ P = mean blood pressure minus left ventricular end-diastolic pressure). During the RA procedure, the hypotensive episode could occur due to dehydration, slow flow, vasospasm, heart block, or bradycardia. Patient volume status was assessed and adequately replenished prior to the procedure and IV atropine (0.6–1.0 mg) was frequently used to maintain the optimal heart rate and blood pressure during RA. Transient increase in blood pressure was achieved by giving IV neosynephrine bolus of 0.1 mg and on rare occasion by IV dopamine. Therefore, every effort was made to maintain adequate blood pressure (>100 mm Hg) and avoid further burring when the systolic blood pressure fell below 100 mm Hg during rotablation. If there was no response to above measures, an IABP was inserted.

Rota floppy wire and flexible shaft burrs. Rota floppy wire and flexible shaft burr were used in period III and made wire passage and burr advancement easier even in very tortuous calcified segments.

Quantitative Coronary Analysis (QCA)

Quantitative coronary angiography was performed with a previously validated edge detection/densitometric system (Cardiotrace; Cine Graphics, Grand Prairie, TX) [8] by a single operator using the contrast-filled catheter as the calibration standard. Only the single worst view without any overlap or foreshortening was used for analysis and measurements of reference vessel diameter (RVD), minimum luminal diameter (MLD), and % diameter stenosis (DS) pre- and postprocedure were obtained. The lesion length was measured with digital calipers using edge detection method. Slow flow was assessed visually and was considered to be present if distal vessel filled after >5 heart beats (dified ACC/AHA classification and dissections were graded according to National Heart Lung and Blood Institute (NHLBI) classification from A to F. All angiographic analysis were performed off-line postprocedure, independently by an operator (S.D.) not aware of the clinical scenario.

Definitions

The terms are defined as follows: unstable angina denotes Canadian Cardiovascular Society (CCS) class III or IV angina symptoms; angiographic success, <50% diameter obstruction postprocedure (RA ± balloon); procedural success, angiographic success and the absence of major complications (Q-wave myocardial infarction, CK-MB >8x normal, emergent coronary artery bypass surgery, or death); acute closure, postprocedure out of the cath lab occlusion at the RA site; slow flow, <TIMI III flow (>5 heart beats needed to fill the distal vessel) in absence of proximal dissection or spasm; sidebranch occlusion, <TIMI III flow in a side branch with a normal flow pre procedure; perforation, dye extravasation; dissection, coronary dissection were graded from A to F, according to NHLBI classification and dissection grade A–C were considered minor; spasm, diffuse or focal narrowing of the vessel that usually responded to manual flush, intra coronary (IC) NTG or IC verapamil and rarely to low-pressure balloon inflation; calcification, fluoroscopic densities in the lesion or vessel; prophylactic IABP use, insertion of IABP for hemodynamic support prior to RA; IABP postprocedure, IABP inserted during or after the RA procedure for complications, slow flow, or persistent chest pain or EKG changes; vascular complications, large hematoma (>3 × 3’’ size), bleeding requiring transfusion, pseudoaneurysm, or need for vascular surgery.

TABLE I. Patient Clinical Characteristics[a]

Characteristics	Period I (n = 172)	Period II (n = 254)	Period III (n = 574)
Age (years)	63 ± 11	64 ± 10	65 ± 11
Male (%)	74	77	75
Diabetes mellitus (%)	24	27	27
Hypertension (%)	30	32	35
Hypercholesterolemia (%)	33	31	23[b]
Family history of CAD (%)	15	13	13
>2 CAD risk factors (%)	50	54	49
Unstable angina (%)	14	18	35[b]
Prior MI (%)	20	21	23
LVEF (%) mean	45 ± 16	48 ± 14	43 ± 15
LVEF <25% (%)	12	11	15
Multivessel disease (%)	34	35	37
Multivessel rotablator (%)	21	18	23
Prophylactic IABP (%)	11	7	3[b]

[a]CAD = coronary artery disease; prior MI = myocardial infarction <14 days; LVEF = left ventricular ejection fraction; IABP = intra-aortic balloon pump.
[b]$P < 0.05$ compared to period I or II.

TABLE II. Angiographic and Lesion Characteristics[a]

Characteristics	Period I (n = 198)	Period II (n = 302)	Period III (n = 712)
Vessel (%)			
LAD	44	46	41
RCA	30	33	34
LCX	24	19	22
LMCA	2	2	3
AHA/ACC lesion type (%)			
A	10	12	13
B_1	12	13	8
B_2	54	44	42
C	26	31	37[b]
Lesion length (mm)	12 ± 7	14 ± 6	17 ± 8
Restenotic (%)	15	17	16
Calcified (%)	42	50	58
Ostial (%)	9	8	10
Total occlusion (%)	7	8	8
Bifurcation (%)	5	7	7

[a]LAD = left anterior descending; RCA = right coronary artery; LCX = left circumflex; LMCA = left main coronary artery.
[b]$P < 0.05$ compared to period I or II.

Statistical Analysis

Continuos variables were expressed as mean with standard deviation and categorical variables were expressed as percentage. Group means were compared by unpaired student's *t*-test or ANOVA analysis and categorical variables were compared by chi-square analysis. Univariate analysis was performed on all variables. Fisher's exact test was used when the marginal frequencies were too low for chi-square testing. *P* value of <0.05 was considered significant.

RESULTS

Clinical Characteristic

Mean age of the entire group was 64 ± 11 years (Table I). Seventy-six percent were males and more than two risk factors were present in 50% of cases. The number of patients with unstable angina increased in later time periods. Multivessel disease was present in one-third and about 20% of patients had multivessel rotablation. Prophylactic IABP was commonly used in period I (11%), but its use gradually declined to 3% in period III. The mean left ventricular ejection fraction (LVEF) for the entire group was 45 ± 15% with 13% of the patients having LVEF <25%.

Angiographic Characteristics

The most common vessel underwent RA was LAD artery followed by RCA (Table II). Two patients with saphenous vein graft distal anastamotic lesion underwent RA in period III. In period III, AHA/ACC type C lesions (37%) and longer lesion lengths (17 ± 8 mm) were more frequent than the earlier time periods. Other lesion characteristics were not different in the three time periods.

TABLE III. Procedural Characteristics[a]

Characteristics	Period I (n = 198)	Period II (n = 302)	Period III (n = 712)
Burr-to-artery ratio	0.70 ± 0.2	0.72 ± 0.2	0.74 ± 0.2
Maximal mean burr size (mm)	1.80	1.85	1.92
Burr numbers	2.0 ± 0.04	1.9 ± 0.5	2.1 ± 0.4
Total ablation time (sec)	222 ± 111	221 ± 90	232 ± 96
Balloon size (mm)	3.0 ± 1.0	3.0 ± 1.1	3.1 ± 0.9
Average balloon length (mm)	30	30	30
Mean inflation pressure atm	2.5 ± 2.2	3.2 ± 2.3	3.3 ± 2.4
Stent use (%)	9	15	21[b]
Reference vessel diameter (mm)	2.54 ± 0.32	2.55 ± 0.31	2.57 ± 0.36
MLD pre (mm)	0.65 ± 0.21	0.60 ± 0.24	0.52 ± 0.31
% DS pre	75 ± 18	77 ± 11	80 ± 10
MLD post RA	1.60 ± 0.21	1.62 ± 0.22	1.73 ± 0.31
MLD post (mm)	1.94 ± 0.31	2.02 ± 0.26	2.20 ± 0.21
% DS post	24 ± 8	21 ± 7	14 ± 8

[a]MLD = minimum luminal diameter; DS = diameter stenosis.
[b]$P < 0.05$ compared to period I or II.

Procedural Characteristics

The step burr approach was used in 94% of cases with final burr-to-artery ratio of 0.73 (Table III). The BA ratio, burr number, and maximal burr size were similar during three time periods with slight trend toward higher maximal burr size and BA ratio in period III. Most of the lesions after RA were postdilated (96%) with a long compliant balloon at low inflation pressure (1–3 atm). Mean inflation pressure (excluding patients requiring stents) also remained similar throughout the study period.

TABLE IV. Procedural Results and Complications

Procedural results	Period I (n = 198)	Period II (n = 302)	Period III (n = 712)
Angiographic success (%)	96	97	99
Acute closure (%)	4.0	2.3	1.1[a]
Slow flow (%)	9	4	2[a]
Dissection A–C NHLBI type (%)	5	4	4
Side-branch closure (%)	4	5	5
Spasm (%)	7	5	5
Perforation (%)	0.6	0.7	1.0

[a]$P < 0.05$ compared to period I or II.

TABLE V. Clinical Results and Complications[a]

Clinical results	Period I (n = 172)	Period II (n = 254)	Period III (n = 574)
Procedural success (%)	94	95	98[b]
Major complications (%)	5.2	3.2	1.3[b]
Q-wave MI	2.3	1.2	0.7
CK-MB > 8× normal	1.7	1.2	0.4
Urgent CABG	1.7	0.8	0.2
In-hospital death	1.7	0.8	0.2
IABP postprocedure (%)	1	2	2

[a]MI = myocardial infarction; CABG = coronary artery bypass surgery; IABP = intra-aortic balloon pump.
[b]$P < 0.05$ compared to period I or II.

Also, stent use after RA increased over the three time periods. The reference vessel diameter, preprocedure and post-RA minimal luminal diameter (MLD), and % diameter stenosis (DS) were similar during the three periods but postprocedure MLD was higher and % DS was lower in the last period largely due to stent use.

Procedural and Clinical Results

Both angiographic and procedural success were high throughout the study period (>94%), with significant improvement in period III (Tables IV and V). The acute closure and incidence of major complications declined with time, being 1.3% in period III. The incidence of slow flow declined significantly over the study period, being only 2% in period III. The use of postprocedure IABP remained very low. Other procedural and clinical complications, as shown in Tables IV and V, were low and constant in three periods. There was a slight statistically nonsignificant increase in coronary artery perforation in period III. Overall incidence of CK-MB release was 15.4% (Fig. 1); CK-MB of 3–5 × and >5 × normal declined over the study period (1.5% and 1.2% in period III vs. 3.1% and 2.0% in period II vs. 6.0% and 3.8% in period I, respectively; $P < 0.02$). The incidence of CK-MB >8 × normal without Q-wave was rare in all three time periods (0.4% in period III, 1.2% in period II, and 1.7% in period I; P = not significant). The low-level CK-MB elevation (1–3 × normal) were higher in period III, despite a lower incidence of any CK-MB elevation, largely due to significant decrease in larger CK-MB elevations (>3 × normal), while some CK-MB release could not be prevented despite the improved techniques. In period III, the incidence of CK-MB elevation in patients with ReoPro use was similar to that without ReoPro (15.4% vs. 14.2%; P = not significant), despite its use in clinically high-risk patients and complex lesion subsets. The incidence of vascular complications remained approximately 2% throughout the study period, despite the use of ReoPro in the last period.

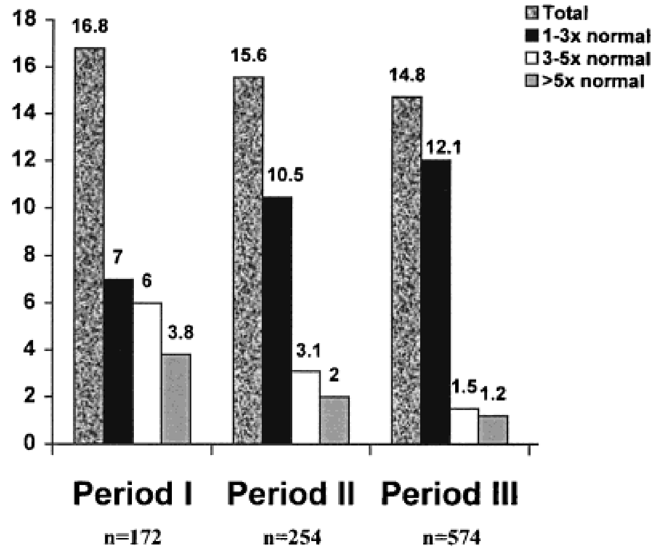

Fig. 1. CK-MB elevation after rotational atherectomy in three periods

DISCUSSION

Rotational atherectomy (RA) offers an advantage over other interventional devices (such as balloon angioplasty or excimer laser) in percutaneous treatment of complex, calcified, and type B_2 and C lesions of ACC/AHA classification by improving procedural success and lowering major ischemic complications [9]. The angiographic vessel lumen obtained after RA is usually smooth without coronary dissection. One unique complication of RA is occurrence of slow flow/no reflow and is associated with CK-MB release and other ischemic complications of RA. The mechanism of slow flow/no reflow occurrence is multifactorial like atheromatous debris, platelet aggregation, heat generation, cavitation, microcirculatory spasm, or neurohumoral reflex [2,3].

Prevention of hypotension has played a very important role in decreasing and avoiding the occurrence of slow flow during the procedure. With time our slow flow incidence has decreased from 9% (period I) to 2% (period III; $P < 0.02$). The treatment of choice for slow flow is to prevent it from occurring. This could be achieved by short ablation runs, step burr approach, use of rotaflush, avoidance of further burring until normal flow is restored, manual ''autoflush,'' and administration of vasodilators. Postprocedure IABP use, if slow flow remained for >30 min, perhaps also decreased the incidence of subsequent CK-MB release. Our single-center results revealed that with improved RA technique and equipment, the procedural success is >98% and incidence of major complications is about 1%, despite increasing use of RA in complex lesions (type C and long) and unstable angina patients.

This is an observational study and no attempt was made to standardize the RA technique among various operators (five interventionalist), although 80% of these cases were performed by a single operator (S.S.). The instruments used for RA have also changed with time. Rota floppy wire was designed to be more flexible and steerable than the earlier rota C wire and usually follows the contour of the tortuous vessels. This rota floppy wire with its increased flexibility reduces the side lead tension of the guidewire against the wall of the artery, thereby reducing guidewire bias [10]. Also, the use of flexible burrs have made the negotiation easier in tortuous and calcified vessels. The slight nonsignificant increase in maximum burr size and BA ratio in the later time periods reflected an aggressive debulking strategy.

Murchu et al. [11] reported the benefit of prophylactic IABP in high-risk RA patients. In their study, patients were divided into two groups: group I included 25 patients with ejection fraction <25% and had prophylactic IABP placed before the procedure; group II included patients in whom IABP was placed urgently due to the procedural complications such as hypotension and showed that prophylactic IABP prior to RA in selected high-risk patients promoted procedural hemodynamic stability with successful outcome and no CK-MB release despite the similar incidence of slow flow in both groups (18%). Prophylactic IABP use in our series has significantly declined despite more patients with complex lesions and low LVEF underwent RA in period III. This is largely attributable to liberal use of IV neosynephrine boluses during hypotension that commonly occurs during ablation, thereby preventing slow flow.

Our current procedural success rate of 98% and major complication rate of 1.3% compares favorably with other published reports [4,6,9,12,13]. A single-center report by Stertzer et al. [6] of RA in 710 lesions revealed success rate of 96% and complication rate of 3.5% and is comparable to our results in periods I. Gilmore et al. [12] in their single-site experience of RA revealed an angiographic success rate of 92% and acute closure rate of 6% despite normal LVEF and only 8% incidence of type C lesions. This probably represented very early experience of RA where technique was in evolution.

MacIsaac et al. [13] reported a significantly higher incidence of death after RA in calcified (1.2%) vs. noncalcified lesions (0.2%) because 57% of the calcified lesions had two or more adverse angiographic or clinical risk factors compared with 46% in the noncalcified lesions ($P < 0.001$). Reisman et al. [14] compared early vs. recent results of RA registry and observed an increased mortality in recent registry (3%) as compared to early registry (1%) ($P < 0.05$). This difference was most likely due to older patients, a greater proportion of unstable angina, and more type B_2 and C lesions in the recent registry. Although the mortality was increased in the recent registry, the overall rate of major complications was not significantly different between the two registry (4.7% vs. 6%, $P =$ not significant). Coronary perforation, although rare, is a serious complication of RA [15] and can be avoided by careful initial burr selection and paying attention to wire bias situations in tortuous and angulated lesions. In our series, a minimal increase in perforations in period III may just reflect a high complex lesion subset.

Recent reports have shown synergy of ReoPro with RA to decrease platelet aggregation [16] and CK-MB release [17]. In period III, ReoPro was used in 29% of cases with complex, calcific, and long lesions but incidence of slow flow and CK-MB release was not different compared to patients who did not receive ReoPro, underscoring the importance of improved RA technique. Nevertheless, it was our personal experience that RA cases done with ReoPro were less symptomatic and had less hemodynamic instability and procedure ran much smoother than patients without ReoPro. Higher incidence of stent use in later time periods was in accordance with prevailing practice of stenting after RA in large vessels to decrease long-term restenosis [18,19]. This increased stent use might have also contributed to the improved procedural results and better in-hospital outcome.

CONCLUSION

Rotational atherectomy is currently the preferred treatment for heavily calcified coronary lesions. Procedural results of RA have improved with time. A consecutive series of 1,000 patients in a single center has demonstrated a high success rate of RA predominantly in B_2 and C lesions with a complication rate not different from percutaneous transluminal coronary angioplasty. We believe that this is largely due to improved RA equipment (wire and burrs) eliminating the wire bias, infusion of rotaflush, decreasing the time of lesion engagement (20–30 sec), ReoPro use, and avoidance of hypotension during rotablation. The impact of current optimal RA technique on long-term restenosis needs to be evaluated.

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