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Clinical Research

Heart Block and Temporary Pacing During Rotational Atherectomy

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ABSTRACT

Background: Rotational atherectomy (RA) performed during percutaneous coronary intervention is commonly associated with distal embolization of calcific particles resulting in conduction abnormalities. As a result, temporary pacing is often used during these procedures. It is unknown whether temporary pacing should be routinely used.

Methods: We performed an analysis of 134 consecutive patients who underwent RA at our institution between January 2011 and September 2013 for the presence of intraprocedural heart block or pacemaker activation.

Results: A temporary pacemaker was inserted in 50% of cases. Forty-two (31%) patients experienced either heart block (n = 16) or pacemaker activation (n = 26). There was no difference in baseline characteristics between those who experienced heart block or required temporary pacing, and those who did not. Interventional characteristics including burr size, maximum rotations per minute used, and maximum run duration were also similar among the groups. Only target RA vessel was associated with the presence of heart block or temporary pacing in multivariate analysis ($P < 0.0001$). Heart block or temporary pacing occurred in 28 (53%) of RA to the right coronary artery, 2 (5%) of the left anterior descending artery, 8 (62%) of the left-dominant circumflex artery, and 2 (18%) with RA to the circumflex artery with right-dominant circulation. Asystole occurred only in patients who underwent RA to the right coronary artery.

Conclusions: Heart block or temporary pacing was more commonly associated with right coronary artery and left-dominant circumflex lesions. Prophylactic pacemaker insertion might be avoided with RA to other vessels.

RÉSUMÉ

Introduction : L'athérectomie rotationnelle (AR) réalisée pendant une intervention coronaire percutanée est souvent associée à l'embolisation distale de particules calcifiées entraînant des anomalies de la conduction. Par conséquent, la stimulation temporaire est souvent utilisée au cours de ces procédures. On ignore si la stimulation temporaire doit systématiquement être utilisée.

Méthodes : Nous avons effectué une analyse de 134 patients consécutifs qui ont subi une AR dans notre établissement entre janvier 2011 et septembre 2013 pour la présence de bloc atrioventriculaire (AV) intraprocedural ou pour l'activation d'un cardiostimulateur.

Résultats : Un cardiostimulateur temporaire a été installé dans 50 % des cas. Quarante-deux (31 %) patients ont expérimenté soit un bloc AV (n = 16) soit l'activation d'un cardiostimulateur (n = 26). Il n'y avait aucune différence dans les paramètres de base entre ceux qui ont vécu un bloc AV ou une cardiostimulation temporaire, et ceux qui n'en ont pas eu. Les caractéristiques d'intervention, notamment la taille de bavure, le maximum de rotations par minute utilisé, et la durée maximale d'intervention étaient également similaires entre les groupes. Seule la nature du vaisseau cible de l'AR a été associée à la présence d'un bloc AV ou d'une cardiostimulation temporaire en analyse multivariée ($P < 0{,}0001$). Le bloc AV ou la cardiostimulation temporaire s'est produit pendant 28 (53 %) des AR de l'artère coronaire droite, 2 (5 %) de l'artère interventriculaire antérieure gauche, 8 (62 %) de l'artère circonflexe gauche dominante, et deux (18 %) avec AR au niveau de l'artère circonflexe avec circulation droite dominante. L'asystolie s'est produite seulement chez les patients qui ont subi une AR de l'artère coronaire droite.

Conclusions : Le bloc AV ou la cardiostimulation temporaire ont été plus couramment associés aux lésions de l'artère coronaire droite et de l'artère circonflexe gauche dominante. L'installation prophylactique d'un cardiostimulateur pourrait être évitée pour l'AR des autres vaisseaux.

With the aging of the population, we witness an increase in the need to treat complex calcified coronary lesions.[1-3] Rotational atherectomy (RA) was invented in 1981 and first used in clinical practice in 1988. It remains to date a viable approach for percutaneous coronary intervention (PCI) of heavily calcified lesions.[4-6] This technology is based on debulking calcified coronary plaque with minor damage to the surrounding vasculature, a principle known as "differential cutting."[7,8] One of the limitations of this procedure is that it is technically challenging and associated with an increased risk of complications including slow/no coronary flow, bradycardia and atrioventricular (AV) block, myocardial infarction, stroke, and death.[9-11]

Many complications of RA have been hypothesized to arise from microembolization of small plaque and calcific particles

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to distal coronary sites. This results in the slow/no flow phenomenon, which is seen in approximately 8% of cases,[12] and might lead to bradycardia and conduction abnormalities. Initial studies have demonstrated high rates of AV block necessitating temporary transvenous pacing.[13-15] Consequently, the use of transient pacing has become a common practice, despite the lack of clearly defined recommendations guiding its use.[16-18]

Several innovations to the procedure have been introduced to minimize these complications, including the intraprocedural coronary infusion of vasodilators, the use of glycoprotein IIa/IIIb receptor antagonists, maintenance of burr/artery ratios of < 0.7, short duration of burr rotation runs of ≤ 30 seconds, and strict avoidance of decelerations (< 5000) in burr rotations per minute.[18,19] Operator experience and comfort with the procedure have similarly contributed to reduced complication rates and improved procedural outcomes.[17,20]

Despite these advances, the literature is lacking in evidence regarding current rates of AV block and the need for pacing during RA procedures, which accounts for approximately 1% of all PCIs.[20] Moreover, current guidelines from the American Heart Association provide no standard of care with regard to the use of temporary pacing during these procedures.[5] As a result, prophylactic pacemaker insertion is used arbitrarily based on personal experience.

The purpose of this study was to examine the frequency of bradycardia and the need for prophylactic pacemaker insertion during rotational coronary atherectomy.

Methods

Patients

All consecutive patients who underwent RA at the London Health Sciences Centre in London, Ontario, Canada between January 2011 and September 2013 were included in our analysis. The Research Ethics Board of Western University approved the study. The decision to perform RA was based on the presence of severe calcification on coronary angiography and made at the discretion of the interventional cardiologist.

Data collection

Online and paper charts were retrospectively reviewed. Baseline characteristics such as cardiac risk factors, patient comorbidities, and procedural indication were documented. Procedural characteristics including RA time, burr size, atherectomy speed, and the number and duration of burr runs were recorded. Information on lesion characteristics was collected. Pacemaker activation and/or evidence of heart block were noted based on intraprocedural continuous electrocardiogram (ECG) monitoring, captured using the MacLab (Centricity, General Electric Company, Fairfield, CT) hemodynamic recording system. The system continuously records hemodynamic parameters including ECG and arterial blood pressure wave forms. The exact time of RA was also routinely recorded by the system. The ECG was analyzed from the time of RA activation to 10 seconds beyond the cessation of RA. Heart block and/or pacemaker activation were analyzed. Heart block was defined as any second degree AV block or greater, or absence of cardiac electrical activity for 2 seconds or greater. Periprocedural complications and in-hospital outcomes were recorded. All angiographic images were reviewed and vessel dominance (right vs left) was determined. Additionally, when RA was performed to a left circumflex (LCx) artery that provided collaterals to a completely occluded right coronary artery, the circumflex was considered dominant for the purposes of this study.

Procedure

All patients were treated with dual antiplatelet therapy and anticoagulation at the discretion of the interventional cardiologist. Intravenous nitroglycerin and verapamil were used routinely in all patients. RA was performed using the Boston Scientific Corporation Rotablator device. Arterial access was obtained using either a radial or femoral approach. Prophylactic insertion of a temporary pacing wire or a venous sheath facilitating rapid intraprocedural pacing wire insertion was made at the discretion of the interventional cardiologist.

Statistical analysis

Patients were divided into 2 groups—those who experienced heart block, asystole, or pacemaker activation (pacing/block), and those who did not (no block). Baseline variables are summarized using mean and standard deviation (continuous variables) and counts/percentages (categorical variables). Comparisons between continuous variables were performed using Student t test. Categorical variables were compared with the Pearson χ^2 test. Single-predictor and multivariable logistic regression models were used to calculate the effect of RA site on the incidence of conduction block or activation of pacing (primary outcome). Variables found to show marginal association with the primary outcome in the single-predictor analysis ($P < 0.20$) were used in the multivariable model.

P values are 2-tailed and statistical significance was defined as $P < 0.05$ for all statistical comparisons.

Results

During the study period, 138 patients underwent RA at our institution. This figure represents approximately 3% of our PCI volume. Four patients were excluded from analysis: 1 patient was paced throughout the procedure independent of RA, and 3 had missing hemodynamic tracings. Of the 134 patients who were included in the analysis, 67 (50%) underwent the procedure after insertion of a temporary pacemaker.

Baseline characteristics for the 2 groups are shown in Table 1. There were no significant differences between the groups.

Procedural profile

The procedural characteristics are outlined in Table 2. There were no differences between the groups in the indication for the procedure and most of the procedures were performed nonurgently for stable angina. Drug-eluting stents were used frequently, but relatively more in the no block group. A temporary pacemaker lead was inserted more frequently when RA was performed to the right coronary artery (RCA; Fig. 1).