Can nominal burst pressure guarantee against dissection during percutaneous transluminal coronary angioplasty?

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Can nominal burst pressure guarantee against dissection in PTCA?

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Abstract
A 68 year-old male with hypertension, dyslipidemia, and current smoking as coronary risk factors was referred for coronary angiography (CAG) in lieu of chronic stable angina. He was Canadian Cardiovascular Society class III despite guideline-directed medical treatment. The CAG revealed a critical stenotic lesion (90%) in the proximal left circumflex (LCx) coronary artery with mild calcification. A 3.5 × 23 mm Xience prime drug-eluting stent (Abbott Vascular, USA) was deployed at 8 atm. During the procedure, he developed chest pain. Angiogram revealed a long spiral dissection starting from the distal edge of the stent. To bail out, another overlapping 3 × 38 mm Xience prime stent was deployed at 10 atm pressure, showing proper stent expansion and no residual dissection flap with TIMI-3 coronary flow. This case highlights that dissection can occur in a calcified vessel even below the nominal pressure which could be successfully bailed out by implantation with another coronary stent with complete cover of the coronary dissection.

Key words: calcium; chronic stable angina; nominal pressure; spiral dissection; stent
Introduction

Plaque fracture, plaque redistribution, and dissection of the arterial wall are key mechanisms of lumen enlargement after balloon angioplasty [1]. During stent implantation, unplanned vessel tearing may occur at the transition between the rigid stent struts and the adjacent arterial wall. This has been associated with increased risks of thrombosis and major adverse cardiac events (MACE) [2]. Vessel overstretching and the presence of large, calcified or attenuated plaques at stent edges are some of the predictors for stent edge dissection which can originate from either the proximal or distal edge of the stent. This can be the outcome of stent deployment at rated burst pressure (RBP), over-expansion by a non-compliant balloon, or deployment over a diseased region rather than over a normal vessel [3, 4].

Case report

A 68 year-old male with hypertension, dyslipidemia, and current smoking as coronary risk factors was referred for coronary angiography (CAG) in lieu of chronic stable angina. He was Canadian Cardiovascular Society (CCS) class III despite guideline-directed medical treatment. Electrocardiogram was normal and echocardiogram revealed mild concentric left ventricular hypertrophy with normal ejection fraction. The coronary angiography showed a critical stenotic lesion (90%) in the proximal segment of the left circumflex (LCx) coronary artery with mild calcification (Figure 1A). Percutaneous transluminal coronary angioplasty (PTCA) of the culprit artery was planned after proper consent. Left main artery was hooked with a 6F Extra Backup (EBU 3.5) guiding catheter (Medtronic, USA) and a 0.014” runthrough wire was parked in the second obtuse marginal branch (OM) of LCx. Lesion was sequentially predilated with a 1.5 × 10 and a 2 × 10 mm Maverick semicompliant balloon (Boston Scientific, USA) at 10 atm pressure (Figure 1B). 3.5 × 21 mm Xience prime stent (everolimus-eluting stent - Abbott Vascular, USA) was tracked across the lesion (Figure 2A) and inflated at 8 atm pressure (Figure 2B). After 15 seconds of inflation, the patient developed sudden chest pain with ST-T changes in inferior leads. Scout revealed contrast extravasations beyond the stent (Figure 3A). Balloon was deflated and angiogram revealed spiral dissection starting from the distal edge of stent down to second OM (Figure 3B). Apart from the pain and the ST-T changes, the haemodynamics were stable. The same stent balloon was intermittently inflated and deflated at low pressure to seal the dissection. Dissection flap was still visible after five minutes of intermittent inflation and also distal LCx was barely
visible (Figure 4A). In lieu of ongoing angina and ST-T changes, LCx was further stented with another 3 × 38 mm Xience prime stent which was deployed at 8 atm pressure (Figure 4B). Stent balloon was slightly pulled up and overlapping part was dilated at 16 atm pressure. Immediately after the procedure, chest pain and ST-T changes subsided. The final angiogram revealed a good result with TIMI-3 coronary flow with complete sealing of dissection flap (Figure 5A, B). His hospital stay remained uneventful and he was discharged with aspirin 150 mg, prasugrel 10 mg, rosuvastatin 20 mg, metoprolol 100 mg, and ramipril 10 mg.

**Discussion**

Mechanical factors such as vessel overstretching by an oversized stent relative to the reference vascular dimensions have been suggested as an important cause of dissection at stent edges, an event which is more pronounced in the distal compared to the proximal dissected edges. Other factors can be plaque type, fibrous cap thickness, and circumferential and focal calcification [2]. Gonzalo et al. assessed 24 stent edge dissections with optical coherence tomography and found fibrocalcific plaques (43.8%) to be more frequent at distal dissected edges than were fibrotic plaques (10%, p = 0.009) [5]. Calcification leads to loss of circumferential vessel compliance, which makes the vessel prone to dissection irrespective of its depth. Intravascular ultrasound (IVUS) data has demonstrated that plaque burden at the stent reference segments was significantly greater in lesions with dissections than in those without. [6] Liu et al. reported that the presence of a calcified plaque at the edge of a stent was an important predictor for dissection regardless of the angle of the calcified plaque, and they suggest that landing zones be selected to avoid calcified and attenuated plaques [7]. In our case, the stent was deployed below the nominal pressure, which ruled out any overstretching. There was mild plaque at the distal edge of the stent, but as it was not significant we planned for only focal stenting. During the deployment, the distal edge of the stent landing in softer plaque along with calcium precipitated the dissection.

Nominal pressure refers to the pressure at which when a balloon is inflated, it achieves the listed balloon diameter. This varies for different stents but usually ranges from 6–8 atm, while the rated burst pressure (RBP) refers to the pressure below which 99.9% of the balloons will not burst upon a single inflation. Therefore, during high pressure inflation by a non-compliant balloon, we should not go beyond RBP. Our case is unusual in the sense that dissection occurred below the nominal pressure.
Dissections are detected by angiography in about 30% of lesions after angioplasty, with a smaller fraction of 4-8% being major dissections, which bear a high risk for subsequent vessel closure leading to adverse ischaemic events [8]. In cases of dissections, the entry point should be sealed as it further stops its distal progression, as in our case. Not all dissections need stenting as antegrade flow may seal the smaller ones. In our case, as the patient was symptomatic with dynamic electrocardiographic changes, stenting was mandatory to prevent its progression.

References


**Figure 1.** Antero-posterior caudal view showing a critical stenotic lesion (90%) in the proximal segment of the left circumflex (LCx) coronary artery with mild calcification (A — white arrow); lesion being predilated with semicompliant balloon (B)

**Figure 2A, B.** 3.5 × 21 mm Xience prime stent being deployed at 8 atm pressure

**Figure 3.** Contrast extravasations beyond the stent while balloon is still inflated (A — white arrows); spiral dissection starting from the distal edge of stent down to second OM (B)

**Figure 4.** Dissection flap was still visible after five minutes of intermittent inflation (A); LCx was further stented with another overlapping 3 × 38 mm Xience prime stent at 8 atm pressure (B)

**Figure 5A, B.** Final angiogram revealed a good result with TIMI-3 coronary flow with complete sealing of dissection flap