Longitudinal distortion of coronary stent in the Left Main Stem:
A cautionary tale

Authors:
1. Ahmad Syadi Mahmood Zuhdi\textsuperscript{a}
   Senior Lecturer in Cardiology
   syadizuhi@yahoo.co.uk

2. Muhammad Dzafir Ismail\textsuperscript{a}
   Senior Lecturer in Cardiology
   dzafirismail@yahoo.com.my

3. Abdul Wahab Undok\textsuperscript{a}
   Senior Lecturer in Cardiology
   abdulwahabundok@gmail.com

4. Timothy Watson\textsuperscript{a}
   Consultant Cardiologist
   Tjw123@me.com

5. Imran Zainal Abidin\textsuperscript{a}
   Consultant Cardiologist
   Imran@edu.my

6. Wan Azman Wan Ahmad\textsuperscript{a}
   Consultant Cardiologist
   wanazman@ummc.edu.my

\textsuperscript{a}Cardiology Unit, University Malaya Medical Centre, Kuala Lumpur, Malaysia

Institution:
\textsuperscript{a}Department of Cardiology
Universiti Malaya Medical Centre
59100 Lembah Pantai Kuala Lumpur
Malaysia

Corresponding author:
Dr Ahmad Syadi Mahmood Zuhdi
Email: syadizuhdi@yahoo.co.uk
Tel: +60 379492613
Fax: +60 379492611

Conflict of Interest Statement:
None declared

Abstract

We describe a patient with triple-vessel coronary aretry disease who underwent PCI to the LMS and LAD with 2-overlapping Xience stents. An attempt to do PCI to the calcified LCx ended up with a major complication due to the difficulty in delivering a Resolute Integrity stent to the target lesion (of the LCx). The Resolute Integrity stent became entrapped in the LMS due to the longitudinal distortion of the previously placed Xience stent. This is an interesting case – firstly as longitudinal distortion with Xience stents is seldom reported and secondly, this highlights the importance of fastidious attention to detail to ensure that if longitudinal distortion occurs, it is noted and dealt with by further stent post-dilatation before passage of additional equipment.
Keywords: Distortion; shortening; longitudinal; Xience; coronary stent
Case Report

Introduction

Longitudinal distortion of intracoronary stent is well known especially in lower profile stents with fewer interconnects. However attention to the angiographic detail is utmost important in identifying this as further manipulation within or across the distorted stent could potentially lead to serious complication. We describe a case of trapped un-deployed stent within a longitudinal distorted implanted stent.

Presentation of the case

A 59-year old Malay man was referred for further assessment of angina pectoris. He had a background history of cigarette smoking, hypertension, dyslipidaemia, type 2 diabetes mellitus and end stage renal failure on haemodialysis. Echocardiogram shows mild left-ventricular dysfunction of 45%. Coronary angiography documented severe 3 vessel disease involving the left main stem (figure 1) and therefore coronary artery bypass grafting (CABG) was recommended. However, our patient declined this and therefore underwent percutaneous coronary intervention (PCI) to the left main stem (LMS) and left anterior descending (LAD) coronary arteries using two overlapping Xience Xpedition (Abbott Vascular, California, USA) 2.5x23mm (distal) and 3.5x38mm (proximal) drug eluting stents extending back to the ostium of the LMS (figure 2). Proximal optimisation of the LMS was performed using a 4mm non-compliant (NC) Trek balloon (Abbott Vascular) inflated to 20Atm. Satisfactory stent apposition and deployment was confirmed using intravascular ultrasound. At this point it was intended not to intervene on the diffuse and severely diseased left circumflex (LCx) artery.

Three weeks later, our patient was readmitted to hospital with a non-ST-segment elevation myocardial infarction, associated with dynamic T-wave changes and peak troponin I 9.16ng/mL (normal value <0.06ng/mL). He underwent repeat coronary angiography via the right femoral arterial access route demonstrating patency of the LMS and LAD stents, but progression of disease in the LCx artery. The operator therefore opted to undertake further PCI to the LCx artery. After administration of 7000IU heparin, a 6Fr XB3.5 guide catheter (Cordis, Miami, USA) was carefully engaged. A 0.0014” Runthrough (Terumo, Tokyo, JP) wire was advanced on a loop through the LMS into the LAD and then withdrawn before advancing down the LCx into the second Obtuse Marginal (OM). Pre-dilatation of the proximal vessel was undertaken using a 1.5mm Trek (Abbott Vascular), followed by a 2.5mm Sapphire NC (Orbus Neich, Hong Kong, China) balloon. Although this improved flow considerably, neither balloon would pass more distally. Further pre-dilatation of the circumflex and obtuse marginal was therefore undertaken using a new 1.5mm Trek balloon.
which expanded fully. The calibre of the distal OM was considered too small to accommodate a stent. The operator attempted to pass a Sequent Please (B-Braun, Melsungen, Germany) 2.0x20mm paclitaxel drug eluting balloon with some difficulty, applying considerable force to advance through the ostium of the circumflex. However, once positioned, this was deployed at 10Atm for 60s as per standard practice. Withdrawal of this balloon proved challenging and again required considerable force. The operator opted to do T-stenting the proximal LCx and advanced a 2.75x30mm Resolute Integrity (Medtronic, USA) drug eluting stent. However this proved impossible to pass more than a few mm into the LMS. At this point, considerable brightening of the previously sited Xience stent in the LMS was evident (figure 3). Withdrawal of the Integrity stent was difficult and only possible using synchronized withdrawal of stent catheter, wire and guide. Unfortunately, the distal struts of the Integrity stent remained snared within the LMS and the force applied during withdrawal stripped the stent from the balloon catheter, which could now be seen hanging in the ascending aorta (figure 4). Although flow down both LAD and LCx remained brisk, given the multiple layers of malapposed and deformed stent within the LMS, he was considered high risk for stent thrombosis and therefore underwent urgent CABG surgery from which he has subsequently made a good recovery.

Discussion
This complex, high risk case was compounded by longitudinal stent compression of the Xience stent previously sited within the LMS. Longitudinal compression is a relatively new phenomenon and is thought to be primarily a consequence of contemporary stent design and consequently has attracted considerable interest amongst the scientific community [1]. Desirable stent characteristics include improved flexibility and deliverability, features which have largely been achieved by alteration in stent architecture, metal characteristics and progressive reduction in strut thickness [2]. However, this has resulted in a reduction in longitudinal strength [3]. Consequently when additional equipment (e.g. post dilatation balloon or intravascular ultrasound) or a guide catheter is drawn into a suboptimally deployed stent, longitudinal shortening can occur [1]. Although this phenomenon can occur with all stent designs, it seems to be more dramatic in lower profile stents with fewer interconnectors (e.g. Promus Element, Driver etc.) compared to others such as Biomatrix or Xience[3,4].

Throughout the procedure, the operator was mindful regarding the risk of disruption to the LMS stent and therefore selected an appropriately sized guide catheter and subsequently advanced the guidewire first into the LAD on a loop prior to entering the circumflex. This latter manoeuvre is
particularly important to minimize risk of weaving the wire under stent struts. However in spite of this and despite fastidious pre-dilatation, passing and withdrawal of the DEB was difficult. It is therefore likely that withdrawal of the DEB resulted in the guide catheter being sucked into the LMS stent resulting in longitudinal compression, which on retrospective review is evident through enhanced radiopacity (brightening) of the Xience stent. Had this been noted during the case, aggressive post dilatation of the LMS stent should have been undertaken and may have prevented the Integrity stent from becoming entrapped.
References


Figures

Figure 1. Baseline Coronary Angiography

(A) Right Anterior Oblique 15°, Cranial 40°; (B) Right Anterior Oblique 30°, Caudal 20°; (C) Left Anterior Oblique 40° projection. Note severe diffuse disease within left coronary system with poor run-off in distal left anterior descending artery. The right coronary artery has moderate diffuse disease.
Right Anterior Oblique 15°, Cranial 40° projection. Two overlapping Xience Xpedition stents deployed from mid left anterior descending artery to ostium of left main stem. The left main stem has been post dilated to 20Atm using a 4mm non-compliant balloon. Note that the circumflex is now subtotally occluded.
Figure 3. Attempt to deliver stent to circumflex

Right Anterior Oblique 10, caudal 30° projection. The Xience stent within the left main stem has brightened indicating longitudinal compression. The Integrity stent is now ensnared within the Xience stent.
Right Anterior Oblique 25°, caudal 15° projection. The Integrity stent is now visible extending from the left main stem into the ascending aorta (arrow). A coronary guidewire has been advanced back down the left anterior descending artery to secure guide catheter position as it proved impossible to fully engage the left main stem.