CASE REPORT

T-stenting and small protrusion technique for left main coronary injury post Bentall procedure

Bentall ameliyatı sonrası ortaya çıkan sol ana koroner yaralanmalarda T-stentleme ve minimal protrüzyon tekniği

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Summary– Coronary injury is a rare, but possible, complication of aortic root surgery. Conventional management may include modifying the coronary button or coronary artery bypass graft for the affected vessel. Described is a case of left main coronary artery injury occurring following a Bentall procedure successfully managed percutaneously with stenting.

Özet– Koroner yaralanmalar aort kökü ameliyatlarında nadir de olsa, olası bir komplikasyondur. Bunun tedavisine yönelik geleneksel yöntem, yaralanan damardaki koroner butonun veya koroner arter baypas greftinin değiştirilmesi şeklindedir. Bu olguda, Bentall ameliyatı sonrası meydana gelen sol ana koroner arter yaralanmasında başarılı şekilde uygulanan perkütan stent işlemi ele alınmaktadır.

Perioperative myocardial ischemia is associated with increased mortality in patients who undergo a Bentall procedure.[1] It may manifest with acute coronary syndromes, ventricular arrhythmias, or hemodynamic compromise.

CASE REPORT

A 32-year-old woman with mucopolysaccharidosis, sickle cell anemia, and rheumatic heart disease presented with severe aortic stenosis, severe mitral stenosis, moderate tricuspid regurgitation, and a small left ventricular outflow tract (LVOT). Preoperative echocardiography (Fig. 1a-f) revealed thickened aortic valve (AV) cusps with a restricted opening (gradients across the AV: 44/26 mmHg, AV stroke volume: 29.2 mL, AV area: 0.4 cm^2), a thickened mitral valve (MV) severely restricted in movement with involvement of the subvalvular apparatus (gradients across the MV: 23/16 mmHg, MV area: 0.85 cm^2), and thickened tricuspid valve (TV) leaflets with moderate regurgitation (TV annulus diameter: 3.8 cm). The left ventricle (LV) was normal in size with normal function (ejection fraction [EF]: 55%). The right ventricle (RV) was severely dilated (RV dimension at end-diastole: 3.7 cm, RV dimension at end-systole: 2.8 cm, RV/LV ratio: 1.1) with moderately reduced function, and the systolic pulmonary artery pressure was severely elevated (>60 mmHg). The aortic root diameter was normal (1.9 cm), while the LVOT diameter was small (1.5 cm). Computed tomography angiography showed normal coronary arteries. A Bentall procedure was performed using a Dacron (E. I. du Pont de Nemours and Company, Wilmington, DE, USA) graft with a mechanical AV (size 21; St. Jude Medical Inc., St. Paul, MN, USA), mechanical MV replacement (Optiform size 27; Carbomedics Inc., Austin, TX, USA), and TV repair. The indication for aortic root replacement (Bentall procedure) was the small LVOT and to avoid the risk of patient-prosthesis mismatch with a small mechanical AV (size 19). Postoperatively, the hemodynamic parameters indicated systemic hypotension and oxygen desaturation. Urgent transesophageal echocardiogra-

Abbreviations:

AV	*Aortic valve*
CABG	*Coronary artery bypass graft*
EF	*Ejection fraction*
LAD	*Left anterior descending*
LCx	*Left circumflex*
LM	*Left main*
LV	*Left ventricle*
LVOT	*Left ventricular outflow tract*
MV	*Mitral valve*
PCI	*Percutaneous coronary intervention*
RV	*Right ventricle*
TAP	*T-stenting and small protrusion*
TV	*Tricuspid valve*

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phy showed good mechanical AV and MV function with severe hypokinesia in the anterior and lateral territories, and a reduced EF of 35%. Central extracorporeal membrane oxygenation was employed. A coronary angiogram showed severe left main (LM) coronary stenosis, primarily at the distal segment involving the left anterior descending (LAD) and left circumflex (LCx) ostia (Fig. 2a, b, Video 1, 2*). LM coronary spasm was ruled out with an intra-coronary nitrate injection. An ascending aorta angiogram confirmed the diagnosis of coronary compression throughout the length of the Bentall graft, most severely at the proximal and distal edges, including the LAD and LCx ostia (Fig. 2c, Video 3*). After a comprehensive discussion between the cardiac surgeon and the interventional cardiologist, percutaneous coronary intervention (PCI) was selected as the treatment of choice, given the patient's critical condition. PCI

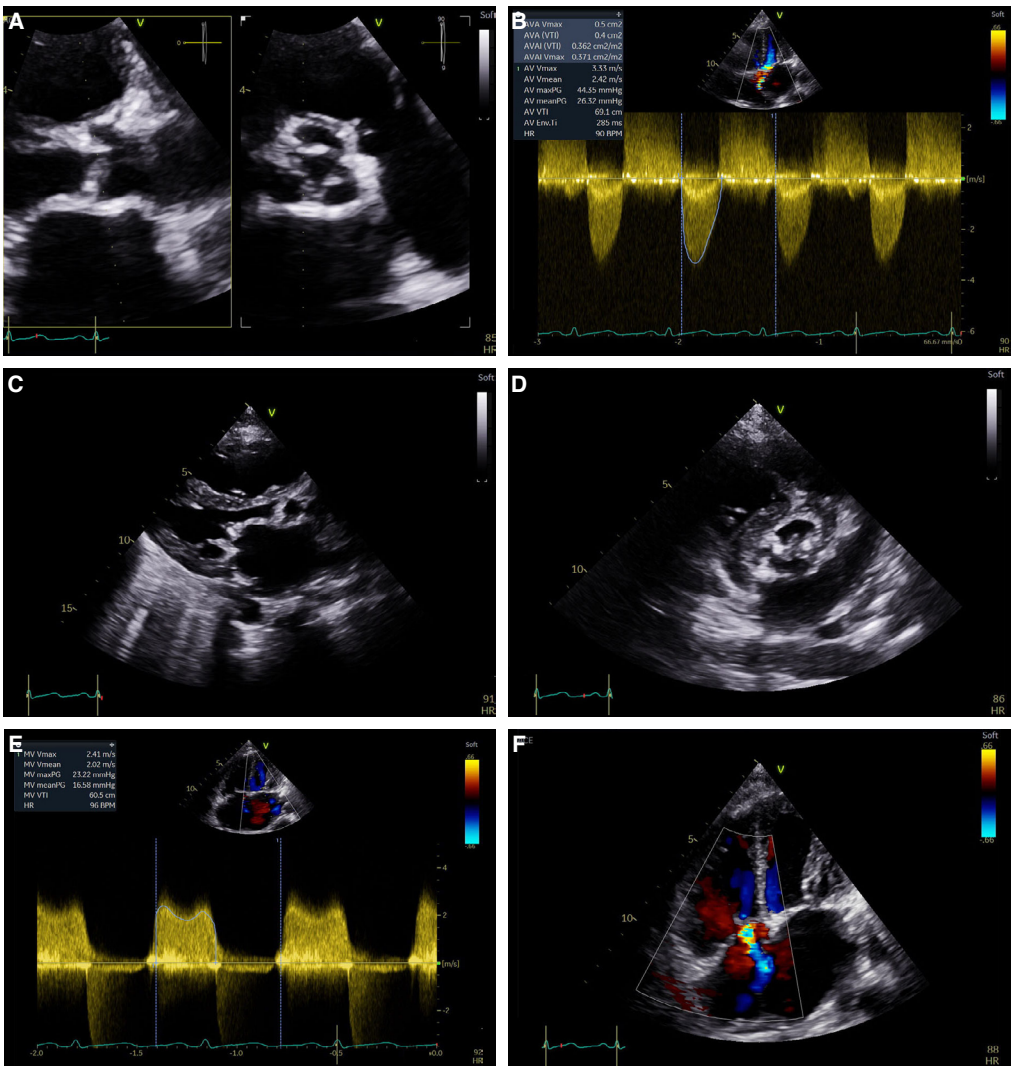

Figure 1. Preoperative echocardiography. **(A)** Parasternal long-axis and short-axis views showing thickened aortic valve (AV) cusps with restricted opening; **(B)** Continuous Doppler image across the AV illustrating gradients (44/26 mmHg), and confirming the diagnosis of severe aortic stenosis. The mismatch of aortic gradients and aortic valve area (0.4 cm^2) is explained by the low stroke volume (29.2 mL) in the setting of severe mitral stenosis (MS) and moderate tricuspid regurgitation (TR); **(C, D)** Parasternal long-axis and short-axis views demonstrating thickened mitral valve (MV) severely restricted in movement with involvement of the subvalvular apparatus; **(E)** Continuous Doppler image across the MV showing gradients (23/16 mmHg) and confirming the diagnosis of severe MS; **(F)** Color Doppler image of the tricuspid valve regurgitation and the dilated right ventricle.

was performed using the T-stenting and small protrusion (TAP) technique. A 3.5x22-mm Resolute Onyx drug eluting stent (Medtronic Inc., Minneapolis, MN, USA) was implanted in the LM toward the LAD (Fig. 2d). A 3.5x15-mm Resolute Onyx drug eluting stent was advanced through the implanted LM stent struts toward the LCx and kept undeployed, and a 3.0x20-mm Euphora semicompliant balloon (Medtronic Inc.,

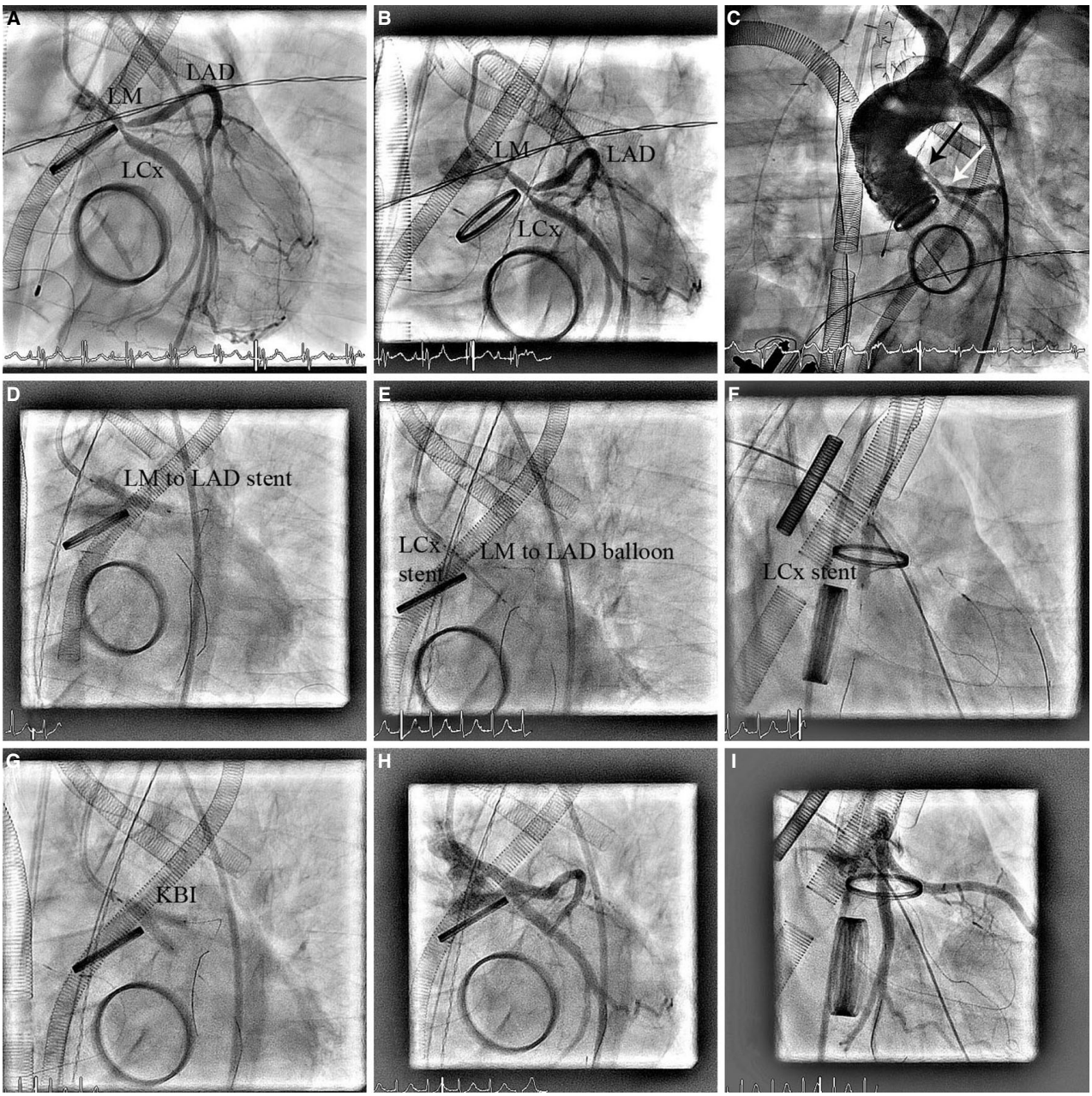

Figure 2. **(A, B)** (Video 1, 2) Left main (LM) coronary stenosis primarily at the distal segment involving the left anterior descending (LAD) and left circumflex (LCX) ostia; **(C)** (Video 3) Ascending aorta angiogram revealing coronary compression throughout the length of the Bentall graft, most severely at the proximal and distal edges (black and white arrows), including the LAD and LCx ostia; **(D)** 3.5x22-mm drug eluting stent (DES) positioned in the LM toward the LAD; **(E)** Undeployed 3.5x15-mm DES positioned toward the LCx through the implanted LM-LAD stent struts, and 3.0x20-mm semicompliant balloon parked in the LM-LAD stent with 2 markers completely within the newly deployed stent and covering the bifurcation with the LCx; **(F)** LCx stent implantation ensuring full coverage of the LCx ostium with minimal protrusion into the LM-LAD stent with an uninflated LM-LAD balloon; **(G)** Final kissing balloon inflation (KBI); **(H, I)** (Video 4, 5) Angiographic result through the LM bifurcation.

Minneapolis, MN, USA) was parked in the LM-LAD stent with 2 markers completely within the newly deployed stent and covering the bifurcation with the LCx (Fig. 2e). The LCx stent was positioned to ensure full coverage of the LCx ostium with minimal protrusion into the LM-LAD stent and implanted while the LM-LAD balloon was uninflated (Fig. 2f). The LCx stent balloon was deflated, partially pulled back toward the LM, and inflated simultaneously with the LM-LAD balloon, completing kissing balloon inflation (Fig. 2g) and achieving a good angiographic result through the LM bifurcation (Fig. 2h, i, Video 4, 5*). The hemodynamic parameters immediately improved, and the EF was 45% at discharge.

DISCUSSION

Several mechanisms could explain a coronary injury during a Bentall procedure, including a vessel stretching or twisting during coronary reimplantation, or extrinsic compression caused by an intensive inflammatory and fibrous reaction induced by the surgical glue used on the coronary button to achieve homeostasis.[2–4] It can also be caused by direct trauma induced by the insertion of an antegrade cardioplegia catheter during AV replacement.[5] Conventional revascularization of a coronary injury with urgent coronary artery bypass graft (CABG) and the need to reopen the chest can include substantial risks and may be associated with a poor outcome.[6] If there is a suspicion of excess tension or external compression from the surgical glue as a potential underlying mechanism of coronary injury, refashioning the coronary button may correct a mechanical complication. External coronary compression from a Bentall graft is a rare entity that could also explain LM coronary stenosis. PCI may provide an alternative to cardiac surgery in these high-risk patients who have undergone aortic root replacement with coronary button re-implantation.[7–10]

In our case, PCI was preferred to CABG as a salvage option based on the critical clinical conditions for emergency myocardial revascularization. Clinical parameters improved rapidly with enhanced hemodynamic status.

The TAP technique is an elegant approach, relatively quick, and could serve as a bailout after provisional stent failure. It provides full coverage of the side branch ostium with no metal excess at the level of the neocarina.

PCI may facilitate emergency revascularization in patients with hemodynamic compromise due to coronary injury following a Bentall procedure. Heart team collaboration between cardiac surgeons and interventional cardiologists is a key factor in such high-risk situations in order to achieve the optimal patient outcome.

*Supplementary video file associated with this article can be found in the online version of the journal.

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