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Middle Aortic Syndrome with Mesenteric artery stenosis- successful percutaneous endovascular reconstruction
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Abstract
Chronic mesenteric ischemia (CMI) is a challenging problem especially when both the superior mesenteric artery (SMA) and celiac artery (CA) are involved. We report a case 65-year-old female with hypertension, type II diabetes, and dyslipidemia who presented with exertional angina for 11-months duration and abdominal angina with weight loss for 5-months. Coronary computed tomographic (CT) angiogram revealed critical discrete lesion of mid right coronary artery (RCA). A contrast CT angiogram revealed a high grade, long segment stenosis of supra-renal abdominal aorta which was mildly calcified, mild ostial stenosis of celiac artery, and critical ostial stenosis of superior mesenteric artery (SMA) suggesting middle aortic syndrome with mesenteric artery stenosis. RCA was revascularised by deployment of 3.5 x 18 mm Xience prime Everolimus eluting stent (Abott Vascular; USA) at 13 atm pressure achieving TIMI III flow through left transbrachial approach. Aorta was stented transfemorally using two overlapping Epic self-expanding stents (Boston scientific, USA) — 12x60 mm proximally and 10 x 40 mm distally. SMA was stented with 6 x 18 mm stent (Herculink, Boston, USA) after predilatation achieving complete revascularization.

Key words: Atherosclerosis; Chronic mesenteric ischemia; Abdominal angina; Superior Mesenteric Artery angioplasty; Percutaneous Endovascular Treatment

Introduction
Atherosclerosis is a systemic disease that can involve many vascular territories, including the coronary, carotid and femoral arteries and the aorta. Chronic mesenteric ischemia (CMI), commonly referred to as "abdominal angina" is an uncommon vascular condition being caused by advanced atherosclerotic obstruction or occlusion with catastrophic outcome if left untreated [1]. Its clinical recognition is often challenging due to its vague symptoms and insidious clinical presentation. Therefore, it requires high index of suspicion, especially in patients with atherosclerotic co-morbidities. Once diagnosed, treatment options include percutaneous endovascular treatment (PEVT) or surgical repair [2]. Though surgical repair is
traditional treatment of choice in CMI, PEVT is becoming the preferred treatment in atherosclerotic CMI due to reduced peri-operative morbidity and mortality compared to surgery. In the era of rising atherosclerosis incidence and prevalence, greater knowledge of CMI and PEVT is necessary to advance minimally invasive therapies as alternatives to open surgery in selected group of patients [3].

Case report
A 65-year-old female with hypertension, type II diabetes, and dyslipidemia presented with exertional angina (Canadian Cardiovascular System class III) for 11-months duration despite guideline directed medical treatment and severe postprandial abdominal pain for 5-months duration during which she had experienced a 5-kg weight loss. On physical examination, the blood pressure in both arms and both legs were 192/96 mmHg and 92/60 mmHg respectively. There were feeble pulses on tibial and femoral arteries on both legs with appreciable radio-femoral delay. Other examination findings were not remarkable. Routine haemogram and urine examination were normal. Her whole abdomen sonogram, esophagogastrosopy, and colonoscopy were within normal limits. Electrocardiogram revealed left ventricular hypertrophy with mild ST-T changes. Transthoracic echocardiogram diagnosed a bicuspid aortic valve, left ventricular hypertrophy and normal ejection fraction. She was being treated with aspirin, atorvastatin, metoprolol, nitrates, and antihypertensive drugs including amlodipine, losartan, and chlorthalidone. Coronary computed tomographic (CT) angiogram revealed critical discrete lesion of mid right coronary artery (RCA). A contrast CT angiogram of aorta showed a high grade, long segment stenosis of mildly calcified abdominal aorta, mild ostial stenosis of celiac artery, and critical ostial stenosis of superior mesenteric artery (SMA) (Fig. 1 A, B, C). RCA was revascularised by deployment of 3.5 x 18 mm Xience prime Everolimus eluting stent (Abott Vascular; USA) at 13 atm pressure achieving TIMI III flow through left transbrachial approach. Catheter based angiogram confirmed the CT finding (Fig. 2 A, B). Endovascular approach was planned after informed consent. Access was gained by 6F sheath through the right femoral artery (retrograde approach). 6F Multipurpose (MP 1) catheter was advanced over 0.035-inch straight tip Terumo wire (Terumo Inc, Japan) and lesion was crossed. MP catheter was advanced beyond the lesion and wire was exchanged with 0.035” exchange length (260 cm) superstiff Amplatz guidewire (Meditech, USA). Predilatation was performed by 6 mm × 40 mm followed by 10 mm × 40 mm Mustang balloon (Boston Scientific, USA). Pressure gradient trans-aorta after the balloon dilatation was 60 mm Hg. Aorta was stented with two overlapping Epic self-expanding stents (Boston
scientific, USA) - 12 mm × 60 mm proximally and 10 mm x 40 mm distally (Fig. 3 A, B). It was further post dilated with 12 mm × 40 mm Mustang balloon at 10 atm pressure (Fig. 3 C, D). During catheter pull back, residual gradient was 3 mm Hg. His blood pressure was 152/80 mmHg with no appreciable gradient between the upper and lower extremities. As SMA was critically diseased, its stenting was planned. Since it was coursing downward from aorta at an acute angle, left brachial approach was chosen. 0.014” runthrough guidewire (Terumo, Japan) was parked distally in SMA using MP1 guide catheter (Fig. 4 A, B). As all the axial braches arises from anterior surface of the aorta, procedure were carried in left lateral view. Lesion was predilated with 4 x 10 mm Traveller balloon (Abott Vascular, UA) and stented with 6x18 mm stent (Herculink, Boston, USA) with excellent result (Fig. 4 C, D). The postoperative course was uneventful and the abdominal pain resolved completely. Patient was discharged in stable condition with dual antiplatelets, statin, antihypertensive medication, and oral hypoglycaemic agents. Abdominal CT at 6 months later showed well apposed stents with excellent patency (Fig. 5 A, B, C).

Discussion

The abdominal viscera are supplied by three main visceral arteries off the abdominal aorta: the celiac, superior, and inferior mesenteric artery. The pancreatic-duodenal arcade is collateral system between the CA and the SMA, while arc of Riolan and the marginal artery of Drummond serve collaterals between the SMA and IMA. In the presence of occlusive disease, they tend to compensate by forming collaterals, and their prominence on angiogram speaks of underlying involvement. Although it is generally accepted that compromise to flow in 2 of 3 mesenteric vessels is required to cause CMI, it and the disease of the mesenteric vessels are known to be caused by aortic disease rather than the mesenteric vessels itself.

A typical presentation of CMI includes unexplained, chronic abdominal pain (mostly post-prandial), diarrhoea, food fear, and weight loss. An epigastric bruit may be present on physical examination in approximately half of patients with CMI [4]. Since these are quite non-specific, its identification becomes challenging. These patients are typically older (age > 50), and may have either underlying coronary artery disease or shares the same underlying risk factors for atherosclerosis like diabetes, hyperlipidemia, hypertension, renal disease, smoking, and obesity [5].

Selective mesenteric angiography is the gold standard for diagnosis; however, it is generally performed when endovascular treatment is planned. However, abdominal ultrasonography, CT and magnetic resonance angiograms are other useful imaging modalities
for initial work-up. Moreover, volumetric reconstruction of data makes CT a useful tool during pre-procedural planning of a percutaneous approach. The treatment of the mesenteric vessels involves the aorta or mesenteric vessel origin more than 95% of the time [6–8]. The infrarenal abdominal aorta develops atherosclerotic changes earlier than the supra-renal aorta. In our case, it was contrary.

As a general rule, the single artery that supplies a major collateral vessel is given preference in situation of multi vessel involvement. In our case, SMA was stented rather than CA. As reported by Dahl et al in a study of mesenteric stent series of 140 patients, superior primary patency for SMA (55%) over CA (17%) at 1-year based on ultrasound duplex criteria was observed, which indicates that outcomes depends on primary anatomical target, lesion complexity and number of vessels treated [9]. However, if the SMA cannot be treated by endovascular means (e.g., due to calcification or presence of an ostial or long occlusion), celiac angioplasty may be beneficial [10].

The results from small series favours primary stenting over plain balloon angioplasty [11]. Also, it should be performed as a rescue procedure for dissection, acute occlusion, or failure to maintain adequate dilatation following angioplasty of a tight stenosis of the SMA or CA. It can be performed from either femoral or brachial approach but later suits better if mesenteric arteries are coursing downward as in our case, a narrow abdominal aorta, or downstream aorto-iliac obstructive disease precluding femoral access.

The choice of guiding catheter will depend on the anatomy. Multipurpose (MP), and Judkins right (JR) are preferred. However, pre-shaped reverse curved catheters such as Cobra, Simmons, SoS, and Visceral selective 1 may useful for selective cannulation. Clockwise manipulation of MP or JR in extreme left projection brings its tip near the ostia of visceral arteries, thereby making the procedure easy. With the use of premounted stents, one can avoid the pre-dilation thereby minimize distal plaque embolization. However, in severe and/or calcified lesions, pre-dilation may be required. Balloon expandable stents (BES) are preferred as they have low-profile, and therefore may track and cross a lesion more easily than self-expanding stents (SES). SES is used for more distal lesions or to treat post-stenting dissections.

PEVT is quite successful with low complications (0–10%), mostly attributed to access site complications, including access site hematoma, AV fistula, and pseudoaneurysm, iatrogenic dissection, rupture, or distal embolization in the mesenteric circulation [12]. In spite of excellent outcomes using surgical bypass, many patients with CMI cannot tolerate an open procedure; therefore, these patients become candidates for endovascular
revascularization. For these reasons, the preferred strategy is to perform SMA and/or CA
revascularization whenever possible in patients with CMI.

Conflict of interest
None.

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**Figure legend**

**Figure 1.** Contrast CT angiogram of aorta showed a high grade, long segment stenosis (A); Mildly calcified abdominal aorta (B), Mild ostial stenosis of celiac artery, and critical ostial stenosis of superior mesenteric artery (SMA) (C)

**Figure 2.** Catheter based angiogram showing a high grade, long segment stenosis of mildly calcified abdominal aorta (white arrowhead, A); Critical ostial stenosis of superior mesenteric artery (SMA) (white arrow, B)

**Figure 3.** Aorta was stented with two overlapping Epic self-expanding stents (Boston Scientific, USA) — 12 mm × 60 mm proximally (A), 10 mm x 40 mm distally (B), Post dilatation with 12 mm × 40 mm Mustang balloon (C), Aortogram showing well apposed stents (D)

**Figure 4.** 0.014” runthrough guidewire (Terumo, Japan) was parked distally in SMA using MP1 guide catheter (A); Lesion was stented with 6 x 18 mm stent (Herculink, Boston, USA) with excellent result after predilatation (B, C, D)

**Figure 5.** Abdominal CT at 6 months follow up showing well apposed stents (A, C — volume rendered reconstruction), (B- non-contrast image)