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Mini Review

Severe aorto-iliac occlusive disease: Options beyond standard aorto-bifemoral bypass

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According to recent guidelines, endovascular angioplasty is the standard treatment for TASC A and B primary aorto-iliac occlusive (AIOD) disease, and the first-line approach for TASC C lesions [1,2]. Extended TASC D occlusive disease is usually treated by open surgery yielding excellent patency rates at a cost of a higher mortality (2%-4%) and a severe morbidity (up to 10%) [3]. However, several studies have reported promising results after endovascular treatment of extensive AIOD and full reconstruction of the aortic bifurcation [4,5]. In a recent meta-analysis, Jongkind et al., concluded that endovascular treatment of extensive AIOD can be performed successfully by experienced interventionists in selected patients [6]. Although primary patency rates seem to be lower than those reported for surgical revascularization, reinterventions can often be performed percutaneously yielding a secondary patency comparable to surgical repair.

Common causes of chronic infrarenal aortic occlusion (CIAO) include: i) atherosclerotic occlusive disease; ii) middle aortic syndrome; iii) Takayasu arteritis; iv) fibromuscular dysplasia; v) neurofibromatosis; and vi) coral reef aorta [3,7-9]. Although standardized infrarenal aorto-bifemoral bypass (AoBFB) remains the surgical procedure of choice for CIAO, operative decisions may proceed beyond AoBFB in complicated cases. Different therapeutic strategies include axillo-(bi)femoral bypass (AxBFB), aortoiliac endarterectomy (AIE) or hybrid procedures. AxBFB grafting usually refers to patients of high risk for aortic clamping or patients with many comorbidities that prohibit an extensive transperitoneal procedure [10]. However, its primary patency is usually inferior compared to classic aortofemoral bypass surgery and AxBFB is associated with an increased risk for infections. In a recent systematic review, anatomical open procedures such as AIE showed very low perioperative mortality, with 5-year primary patency rates of over 80% [11]. Finally, hybrid procedures show equivalent midterm primary patency rates with the open procedures even for TASC D lesions while reducing perioperative mortality rates [12]. Hybrid procedures for aortoiliac disease usually include iliac stenting plus femoral endarterectomy or femorofemoral bypass.

Regarding our experience, operative decisions in a series of 58 consecutive patients with CIAO treated in our division, were based on: a) anatomic extension of the disease as presented in digital subtraction angiography (DSA), b) pattern and grade of calcification as presented in non-contrast computed tomography (CT) scan, c) grade of claudication and d) patients' medical status to assess the risk/ benefit ratio. A careful evaluation using proper imaging modalities plays a very essential role

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in decision making. Ultrasonography may still be the first approach for patients with AIOD, although further angiography is important for evaluating collateral pathways and planning any intervention [13,14]. Traditional DSA was formerly the golden standard for illustrating the entire aortoiliac tree although due to its invasiveness, it is now preferred when a concurrent endovascular treatment is scheduled [15]. Modern CT angiography and magnetic resonance angiography (MRA) are less invasive studies and they show an equivalent performance in illustrating the entire aortoiliac tree in detail, the extent of the calcifications and collateral pathways [16-18]. Therefore, they are preferred as first-line diagnostic tools compared to DSA.

In our series, patency of at least 2cm below the level of the lowest renal artery was considered sufficient for a standard AoBFB. However, juxtarenal occlusion was managed with thrombo-endarterectomy of the proximal infrarenal aorta and AoBFB, during either infrarenal (after endarterectomy) or suprarenal (before endarterectomy) clamping. Infrarenal aortic clamping is not feasible in cases with circumferential aortic calcification and calcium thickness more than 2mm on CT scan (coral reef aorta). Regarding clinical presentation, claudication distance of more than 100m and/or Ankle-Brachial Index (ABI)>0.7 were considered relative indications for surgery, whereas claudication of less than 100m and/or ABI<0.7 were considered strong indications for surgery. Operative risk assessment was considered based on cardiac, pulmonary and renal disease, using objective criteria [19,20]. Age and patient's preference were also taken into consideration. Imaging, clinical presentation and surgical procedures performed in six consecutive patients from our series are presented in table 1. Outcomes are also presented in table 1.

Coral reef aorta, which is a rare entity of extensive aorta calcification characterized by the unique consistency of lesions which are rock-hard, was an absolute contra-indication for AoBFB in our series (Figures 1-3). Therefore, in cases of higher surgical risk, AxBFB was selected in order to decrease perioperative morbidity although supraceliac AoBFB was selected in cases of juxtarenal occlusion and a lower surgical risk. Several authors have reported optimal results with aortic bypass following aortorenal thrombectomy under suprarenal aortic clamping or transient aortic compression for patients with juxtarenal occlusion [21,22]. However, when the aorta is fully calcified – such as in our cases, clamping in the proximity of the renal arteries is forbidding and supraceliac anastomosis may be an alternative in case of standard risk.

Furthermore, we have recently reported a hybrid technique for treating aortic aneurysms with a coral reef aorta as well [23]. Proximal endovascular occlusion of

Table 1: Anatomic and physiologic factors of patients with CIAO not amenable to standard aorto-bifemoral bypass (AoBFB). (DSA, digital subtraction angiography; CT, computed tomography; ABI, Ankle-Brachial Index; R, right; L, left)

Patients	Surgery	Dsa	Ct Calcium	Claudication/ Abis	Surgical Risk	Early Outcomes
Patient 1	Aortic endarterectomy and AoBFB	Juxtarenal occlusion	Sporadic	Severe/ R:0.6 L:0.7	Standard	Reversible renal dysfunction, troponin elevation
Patient 2	Supraceliac AoBFB	Occlusion 3cm below lower renal artery	Coral reef	Severe/ R:0.7 L:0.7	Standard	Atrial fibrillation
Patient 3	Axillary- bifemoral bypass	Juxtarenal occlusion	Coral reef	Severe/ R: No signal L:0.5	High	Pulmonary infection
Patient 4	Supraceliac AoBFB	Juxtarenal occlusion	Coral reef	Severe/ R:0.5 L:0.7	Standard	Reversible renal dysfunction
Patient 5	Axillary- bifemoral bypass	Juxtarenal occlusion	Sporadic	Mild/ R:0.8 L:0.7	High	Troponin elevation
Patient 6	Axillary- bifemoral bypass	Occlusion 3cm below lower renal artery	Coral reef	Severe/ R:0.6 L:0.6	High	Femoral wound healing delay

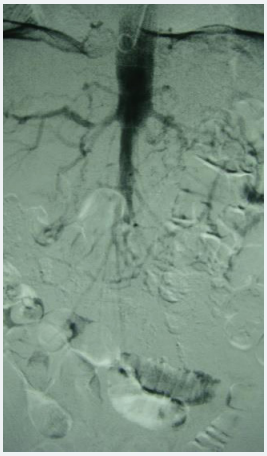

Figure 1: A digital subtraction angiography (DSA) image shows a short infrarenal segment of the abdominal aorta with limited patency.

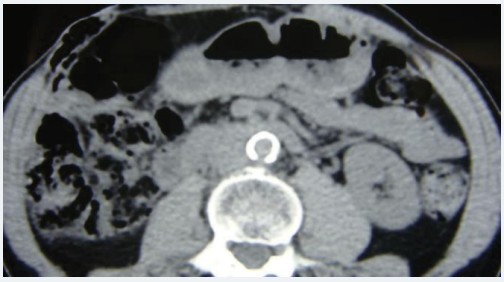

Figure 2: Non-contrast computed tomography showing a coral reef infrarenal aorta.

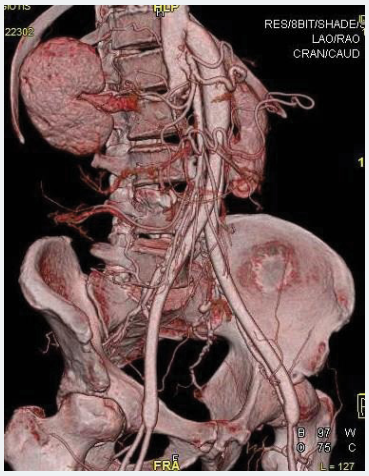

Figure 3: A 3D-computed tomography angiography (CTA) image shows a patent supraceliac aorto -bifemoral bypass.

the aorta, careful mobilizations, aortic wall drilling, and tight suturing of the graft yielded a satisfying result. Other techniques including clampless and sutureless aortic anastomosis have been described for patients with extensive aortic calcifications [24]. Hybrid or endovascular techniques are usually associated with lower perioperative mortality, especially in patients of high surgical risk although they could cause various complications. Cerebral infarction, peripheral embolism, access site complications and target lesion revascularization are more frequent in institutions with a low experience in endovascular procedures and especially in patients with TASC D lesions [25,26]. Therefore, treatment should be always individualized and performed in experienced vascular centers.

Finally, evidence based decisions towards best treatment of severe CIAO, when standard AoBFB is not feasible, are lacking. Although, major aortic surgery carries a considerable operative risk, we have shown that modern anesthetic and perioperative treatment strategies in abdominal aortic surgery result in decreased postoperative pain, decreased intensive care unit and in-hospital stay, and therefore, decreased morbidity and mortality, even patients with severe pulmonary disease [27]. Furthermore, proper antithrombotic coverage, early initiation of beta-blockage and statin treatment has been associated with improved outcomes in such patients [28-30]. However, there are cases suggesting excellent long-term outcomes by non operative treatment in patients with juxtarenal occlusion and mild claudication [31], and therefore, open surgery for CIAO warrants extremely prudent risk/benefit assessment.

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