

## Surgical management of chronic total occlusion of the abdominal aorta

### *Kronik total abdominal aort oklüzyonunun cerrahi tedavisi*

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**Background:** In this study, we evaluated patients who underwent surgery for chronic total occlusion of the abdominal aorta in our clinic retrospectively.

**Methods:** Twenty consecutive male patients (mean age 61.8±8.0 years; range 44 to 76 years) who underwent surgery in our clinic for chronic total occlusion of the abdominal aorta between March 2001 and December 2009 were included in this study. All patients were operated on electively. Four patients (20%) had undergone previous coronary artery bypass grafting surgery. The occlusion of the abdominal aorta was documented with angiography in all patients. Juxtarenal aorta occlusion occurred in six patients (30%), occlusion of the suprarenal aorta in three patients (15%), and occlusion of the infrarenal abdominal aorta in 11 patients (55%). An aortobifemoral bypass and abdominal aortic thromboendarterectomy were performed in all patients. The left kidney was revascularized with a saphenous vein graft in one patient (5%).

**Results:** There was complete immediate success with no mortality. No complications occurred during or after the operation. The average duration of hospital stay was 7.1±1.4 (range 5 to 11 days) and an average intensive care unit stay was 2.4±0.6 (range 1 to 3) days. Neither revision nor reintervention was required during hospitalization.

**Conclusion:** Considering our experience, aortic reconstructive surgery is a successful option for the management of chronic suprarenal, juxtarenal, and, infrarenal abdominal aortic occlusions.

**Key words:** Aortic occlusion; atherosclerosis; bypass graft; renal artery.

**Amaç:** Bu çalışmada abdominal aortun kronik total oklüzyonu nedeniyle kliniğimizde ameliyat edilen hastalar retrospektif olarak incelendi.

**Çalışma planı:** Bu çalışmaya Mart 2001 - Aralık 2009 tarihleri arasında abdominal aortun kronik total oklüzyonu nedeniyle kliniğimizde ameliyat edilen 20 ardışık erkek hasta (ort. yaş 61.8±8.0 yıl; dağılım 44-76 yıl) dahil edildi. Tüm hastalar elektif olarak ameliyat edildi. Dört hasta daha önceden koroner arter bypass greftleme ameliyatı geçirmişti. Abdominal aortun oklüzyonu tüm olgularda anjiyografi ile belgelendi. Altı hastada (%30) juxtarenal aort oklüzyonu, üç hastada (%15) suprarenal aort oklüzyonu ve 11 hastada (%55) infrarenal abdominal aort oklüzyonu tespit edildi. Tüm hastalarda abdominal aorta tromboendarterektomi ve aortobifemoral bypass yapıldı. Sol böbrek bir hastada (%5) safen ven grefti ile revaskülarize edildi.

**Bulgular:** Tüm olgularda tam başarı elde edildi ve mortalite görülmedi. Ameliyat sırası veya sonrasında herhangi bir komplikasyon gelişmedi. Ortalama hastanede kalış süresi 7.1±1.4 (dağılım 5-11 gün), ortalama yoğun bakımda kalış süresi ise 2.4±0.6 (dağılım 1-3) gün idi. Yatış sırasında ne revizyon ne de tekrar girişim gerekli oldu.

**Sonuç:** Deneyimlerimiz göz önüne alındığında aortik rekonstrüktif cerrahi, suprarenal, juxtarenal ya da infrarenal kronik total abdominal aort oklüzyonlarının tedavisinde uygulanabilecek başarılı bir seçenektir.

**Anahtar sözcükler:** Aort oklüzyonu; ateroskleroz; bypass greft; renal arter.

The infrarenal abdominal aorta and the iliac arteries are among the most common sites for chronic obliterative atherosclerosis.<sup>[1]</sup> Nearly 10% of patients operated on for chronic occlusive aortoiliac disease have totally occluded abdominal aortas, which is also known as Leriche

syndrome. This chronic abdominal aortic occlusion (CAAO) can extend as far as the renal arteries causing juxtarenal aortic occlusion. This is the case in 50-60% of patients with Leriche syndrome.<sup>[2]</sup> In particular, the fundamental argument over the prevalence of proximal

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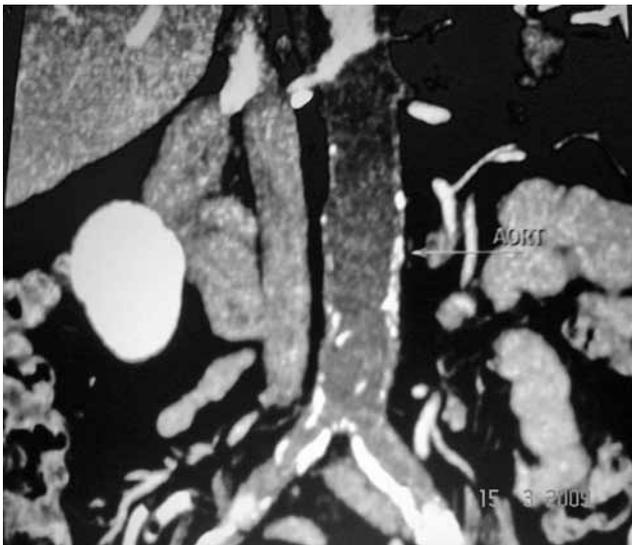
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thrombus propagation leading to renal and visceral artery occlusion has been a point of ongoing debate.<sup>[3]</sup> In this retrospective study, we evaluated patients who underwent surgery for chronic total occlusion of the abdominal aorta in our clinic.

## PATIENTS AND METHODS

Twenty consecutive male patients (mean age  $61.8 \pm 8.0$  years; range 44 to 76 years) who underwent surgery for chronic totally occluded abdominal aorta between March 2001 and December 2009 were included in this study. Four (20%) had previously undergone coronary artery bypass grafting (CABG). Diagnosis was by arteriography in all patients. Juxtarenal aortic occlusion occurred in six (30%), occlusion of the suprarenal aorta in three (15%) (Figure 1), and occlusion of the infrarenal aorta in 11 patients (55%). In one patient, arteriography demonstrated juxtarenal abdominal aortic occlusion and left renal artery duplication besides left renal artery stenosis (Figure 2). Risk factors associated with peripheral vascular disease included smoking in 14 patients, diabetes mellitus in four patients, hyperlipidemia in 10 patients, and hypertension in six patients. Surgical indications were intermittent claudication in nine patients, rest pain in 10 patients, and non-healing ulcers and gangrene in one patient. Their characteristics are summarized in table 1.

Each patient was screened for coronary artery disease before the operation. Ten patients who had anginal symptoms, ischemic changes on the electrocardiogram, dipyridamole thallium scintigraphy, or left ventricle



**Figure 1.** Computed tomography angiographic image of a suprarenal aortic occlusion.

wall motion abnormalities on stress echocardiography were evaluated with coronary angiography before the operation. It revealed severe coronary artery disease in six patients. Percutaneous transluminal coronary angioplasty with intracoronary stent implantation was performed on two patients, and CABG was performed on the other four. Operations for aortic occlusive disease were performed one month after the coronary intervention.

## Surgical technique

The patients had the operations electively and under general anaesthesia. Femoral arteries were exposed at first, and median laparotomy was performed thereafter in all patients. The abdominal aorta was exposed, and the renal arteries and left renal vein were dissected and controlled with vessel loops. A vertical aortotomy was performed. Atherosclerotic plaque and thrombus were removed until arterial bleeding started (Figure 3). After debridement of intimal plaque from the abdominal aorta, the suprarenal aorta was clamped, and renal arteries were screened for suspected atherosclerotic plaque. After debridement of the renal arteries, back bleeding was started, the infrarenal aorta was clamped, and the suprarenal aortic clamp was released. Aortobifemoral bypass (ABFB) with a bifurcated knitted Dacron graft was performed in all patients. In a patient with left renal artery duplication, visceral revascularization was performed from an abdominal aortic graft to the left renal artery with a saphenous vein graft (Figure 4). A concomitant femoropopliteal bypass was performed on four of these patients.

## Statistical analysis

For statistical analyses, SPSS (SPSS Inc., Chicago, Illinois, USA) 15.0 version software for Windows was used. The data was summarized in tables. The Kruskal-Wallis test was used for suitability of normal distribution. All the parameters were compared by the chi-square test within groups with  $p < 0.05$  considered to be significant.

## RESULTS

There was no operative or postoperative mortality. Immediate success was obtained in all patients upon physical examination and Doppler ultrasound. The mean ankle/brachial pressure index of the patients before the operation was 0.32, and after the operation it was 0.86. Transient increased serum creatinine levels were detected in four patients in the postoperative period. Hemodialysis was not needed in any patients.

**Table 1. Patients' characteristics**

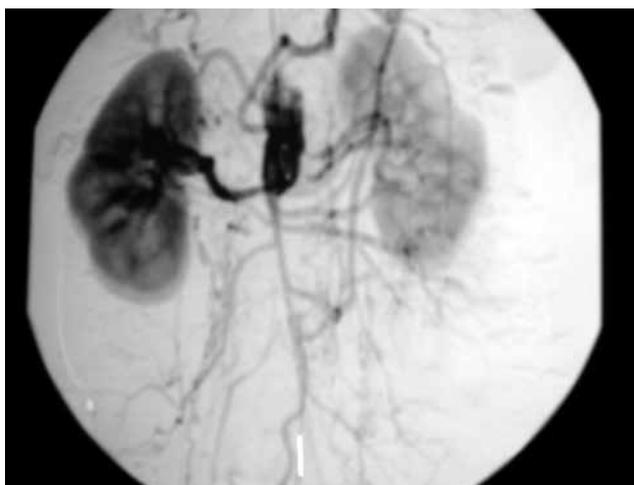
	n	%	Mean±SD	Range
Age (years)			61.76±8.01	44-76
Male	20	100		
Previous coronary artery bypass graft	4	20		
Juxtarenal aorta occlusion	6	30		
Suprarenal aorta occlusion	3	15		
Infrarenal aorta occlusion	11	55		
Smoking	14	70		
Diabetes mellitus	4	20		
Hyperlipidemia	10	50		
Hypertension	6	30		
Claudication	9	45		
Rest pain	10	50		
Ulcers or gangrene	1	5		
Ankle/brachial pressure index (preoperative)	0.32			
Ankle/brachial pressure index (postoperative)	0.86			
Aortobifemoral bypass	20	100		
Aortorenal bypass	1	5		
Concomitant femoropopliteal bypass	4	20		
Postoperative transient increased serum creatinine	4	20		

SD: Standard deviation.

In statistical analyses among evaluated cases, no significant correlation was found between juxta, supra, and infrarenal aortic occlusion and the coexistence of smoking, diabetes, hyperlipidemia and hypertension ( $p>0.05$ ). Smoking showed no correlation with the occurrence of claudication, rest pain, or ulcers and gangrene ( $p>0.05$ ). The existence of diabetes was not significantly correlated with the occurrence of claudication, rest pain, or ulcers and gangrene ( $p>0.05$ ). There was a correlation between hyperlipidemia and the occurrence of claudication ( $p=0.002$ ) along

with hyperlipidemia and the occurrence of rest pain ( $p=0.007$ ). However, no correlation was found between hyperlipidemia and the occurrence of ulcers and gangrene ( $p>0.05$ ; Table 2 and Figure 5). There was no correlation detected between the existence of hypertension and the occurrence of claudication, rest pain, or ulcers and gangrene ( $p>0.05$ ).

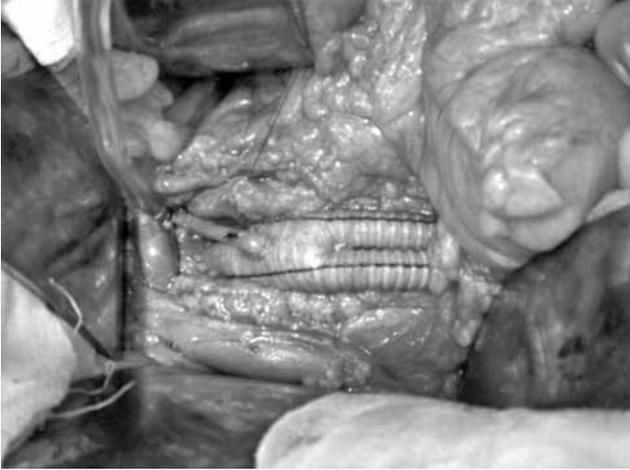
The duration of the hospital stay was  $7.1\pm 1.4$  (range 5-11) days, and the intensive care unit stay was  $2.4\pm 0.6$  (range 1-3) days. No surgically-related complications were seen during or after the operation. Neither revision



**Figure 2.** Angiographic view of a juxtarenal abdominal aortic occlusion, left renal artery duplication, and left renal artery stenosis.



**Figure 3.** Operative view showing thrombus removal from abdominal aorta.



**Figure 4.** Operative view of aortobifemoral and left renal artery bypass.

nor reintervention was required during hospitalization. One patient with lower extremity gangrene healed in the postoperative period. They were followed up for  $3.5 \pm 0.40$  years. In the follow-up period, no vascular problem was seen.

## DISCUSSION

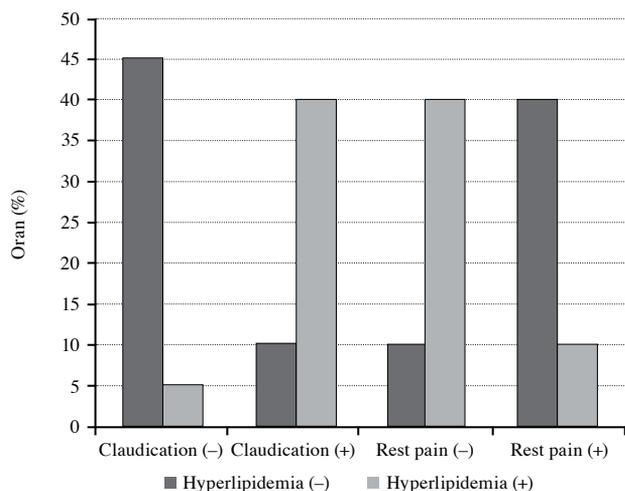
Chronic occlusive disease of the terminal aorta has been recognized to cause claudication and impotence since Leriche described the syndrome in 1923.<sup>[4]</sup> Symptoms and clinical findings of CAAO include bilateral lower extremity claudication and the absence of femoral pulses. There is a predilection toward

males with a strong history of tobacco abuse. Other features include ischemic rest pain and impotence. Acute ischemia is not a clinical finding because of the progressive nature of the disease and the opportunity for the development of collateral circulation.<sup>[5,6]</sup> Our patients also had similar symptoms and clinical findings. Thus, we easily diagnosed them before the surgical procedure.

Controversy remains about the pathogenesis of the lesion. It could be from either thrombosis developing on an atherosclerotic lesion of the terminal aorta or primary atherosclerosis of the infrarenal aorta.<sup>[7]</sup> The proposed pathogenesis of the CAAO is that of iliac and distal aortic atherosclerotic disease progression with subsequent infrarenal aortic thrombosis or primary atherosclerosis of the infrarenal aorta.<sup>[2,3]</sup> This thrombus organizes over time and typically ascends to the level of the renal arteries where outflow to the low-resistance renovascular bed maintains the patency of the suprarenal aorta.<sup>[3]</sup> Native arterial thrombosis results in varying degrees of limb ischemia that are dependent on the degree of collateral circulation development. Surgical management of these patients is more complex, and complications, especially involving renal function and morbidity, are more frequently seen than routine aortobifemoral grafting.<sup>[2]</sup> We had eleven patients who had infrarenal aortic occlusion, and all were successfully operated on with infrarenal aortic clamping.

**Table 2.** There was a correlation between hyperlipidemia and the occurrence of claudication ( $p=0.002$ ) along with hyperlipidemia and the occurrence of rest pain ( $p=0.007$ ). However, no correlation was found between hyperlipidemia and the occurrence of ulcers and gangrene ( $p>0.05$ ).

	Claudication						<i>p</i>
	(-)		(+)		Total		
	n	%	n	%	n	%	
Hyperlipidemia							
(-)	9	45.0	1	5.0	10	50.0	0.002
(+)	2	10.0	8	40.0	10	50.0	
Total	11	55.0	9	45.0	20	100.0	
	Rest pain						
(-)	2	10.0	8	40.0	10	50.0	0.007
(+)	8	40.0	2	10.0	10	50.0	
Total	10	50.0	10	50.0	20	100.0	
	Ulcers and gangrene						
(-)	9	45.0	1	5.0	10	50.0	0.305
(+)	10	50.0	0	0.0	10	50.0	
Total	19	95.0	1	5.0	20	100.0	



**Figure 5.** Distribution of the claudication and rest pain among patients with hyperlipidemia

Surgical treatment of juxtarenal or suprarenal CAAO requires suprarenal aortic cross-clamping, causing temporary renal artery occlusion. It is reported that the suprarenal or supraceliac cross-clamping of the abdominal aorta is safe if it is applied in under 30 minutes.<sup>[2]</sup> We had three patients with suprarenal and six patients with juxtarenal aortic occlusion. We thought that the shorter duration of suprarenal aortic clamping and careful debridement of the thrombus and atherosclerotic plaque from both the aorta and renal arteries resulted in good postoperative recovery in those patients. The suprarenal aortic cross-clamping time did not exceed 30 minutes in our patients (six to 15 minutes). An ABFB after debridement resulted in satisfactory lower extremity revascularization with immediate success in all the patients postoperatively. Meanwhile, visceral revascularization with a saphenous vein in a patient with renal artery stenosis and renal artery duplication also prevented him from possible renal failure postoperatively. Transient increased serum creatinine levels were detected in four patients, including the one with renal artery stenosis and renal artery duplication, in the postoperative period, but there was no renal failure or mortality in our series.

Alternatively, an ascending or descending thoracic ABFB or an extra-anatomic axillo-femoral and femoro-femoral bypass can also be performed for CAAO<sup>[2,8]</sup> Nunn and Kamal<sup>[9]</sup> were the first to report a thoracic ABFB for CAAO in 1972 and Frantz et al.<sup>[10]</sup> performed an ascending aorta-to-femoral artery bypass procedure in a single patient with CAAO in 1974. Nowadays, an ABFB is the gold standard for treatment of aorto-iliac occlusive disease and

juxtarenal aortic occlusions. Other procedures must be reserved for situations in which the abdominal aorta is not suitable for anastomosis, for example, porcelain aortas, in graft infections to prevent contamination, or previous multiple operations not suitable for abdominal exposure.<sup>[2]</sup> In our study, we did not need any alternative techniques.

### Study limitations

There are two limitations that need to be acknowledged and addressed regarding the present study. The first limitation concerns the number of cases. Having more cases would have provided more opportunities for better assessment.

In conclusion, the surgical management of the totally occluded abdominal aorta is highly complex, and possible complications are more likely to be seen.<sup>[2]</sup> Our results indicated that aortic reconstructive surgery is a successful option for the management of chronic, totally occluded infra- or juxtarenal abdominal aortas.

### Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

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