

## Thoracic aortofemoral artery bypass: an alternative procedure for initial treatment of critical aortoiliac occlusive disease

*Torasik aortofemoral arteriyel baypas: Aortoiliyak tıkkayıcı hastalığın ilk adım tedavisinde alternatif bir yöntem*

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**Background:** The aim of this study is to report our results on the use of thoracic aortobifemoral bypass (TABFB) as an initial surgical approach in treatment of aortoiliac occlusive disease.

**Methods:** Between July 2006 and October 2010, six male patients (mean age 56.3, range 54 to 65 years) who underwent TABFB surgery were included. Five patients were in Fontaine IIA, while one patient was in Fontaine IIB class. Diagnosis was based on conventional angiography in five patients and contrasted computed tomography in one patient. None of the patients had suprarenal involvement. Two had isolated infrarenal involvement, whereas four had additional juxtarenal involvement. Thoracic aortobifemoral bypass surgery was performed on all patients and an additional coronary artery bypass graft (CABG) surgery was performed in two patients. A 16x8 mm PTFE graft was used in all operations. Its proximal end was anastomosed to the distal thoracic aorta and distal ends were anastomosed to the common femoral arteries bilaterally.

**Results:** The mean time of surgery was 124.16 minutes. The mean time to extubation was 8.3 hours. The mean drainage volume of postoperative bleeding was 291.6 ml. Two patients suffered from mild dyspnea and pain. None of the patients had pneumothorax and obstruction-related atelectasia. Pleural effusion occurred in one patient (16%) on postoperative third day. Early graft obstruction or wound infection was not seen. The mean time to discharge was eight days.

**Conclusion:** Thoracic aortofemoral bypass procedure offers an alternative as an initial option to conventional abdominal aortofemoral technique for the treatment of aortoiliac occlusive disease.

**Key words:** Aorta, abdominal; aortofemoral artery; thoracotomy.

**Amaç:** Bu çalışmada, torasik aortobifemoral baypas (TABFB) tekniğinin aorto iliak tıkkayıcı hastalığın tedavisinde ilk adım cerrahi yaklaşım olarak kullanımına dair sonuçlarımız bildirildi.

**Çalışma planı:** Temmuz 2006 - Ekim 2010 tarihleri arasında kliniğimizde TABFB ameliyatı geçiren altı erkek hasta (ort. yaş 56.3 yıl, dağılım 54-65 yıl) çalışmaya dahil edildi. Beş hasta Fontaine IIA ve bir hasta Fontaine IIB sınıfındaydı. Tanı beş hastada konvansiyonel anjiyografi, bir hastada ise kontrastlı bilgisayarlı tomografi ile konuldu. Hiçbir hastada suprarenal tutulum yoktu. İki hastada izole infrarenal tutulum, dört hastada ise juktarenal tutulum vardı. Torasik aortobifemoral baypas ameliyatı tüm hastalarda uygulandı, buna ilaveten iki hastada koroner arter baypas greftleme (KABG) ameliyatı uygulandı. Tüm ameliyatlarda 16x8 mm politetrafloroetilen (PTFE) grefti kullanıldı. Greftin proksimal ucu inen torasik aorta, distal uçları da her iki tarafta ana femoral arterlere anastomoz edildi.

**Bulgular:** Ortalama ameliyat süresi 124.16 dakikaydı. Ekstübasyona kadar geçen ortalama süre 8.3 saattir. Ortalama ameliyat sonrası drenaj hacmi 291.6 ml idi. İki hastada hafif düzeyde dispne ve ağrı gelişti. Pnömotoraks ve obstrüksiyon atelektazisi hiçbir hastada gelişmedi. Bir hastada (%16) ameliyat sonrası üçüncü gün plevral efüzyon gelişti. Erken greft obstrüksiyonu veya yara enfeksiyonu görülmedi. Taburculuğa kadar geçen süre ortalama sekiz gündü.

**Sonuç:** Aortoiliyak okluzif hastalığın tedavisinde TABFB ameliyatı ilk yaklaşım olarak konvansiyonel abdominal aortofemoral baypas tekniğine bir alternatif teşkil etmektedir.

**Anahtar sözcükler:** Aort, abdominal; aortofemoral arter; torakotomi.



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Thoracic aortobifemoral bypass (TABFB) is a known alternative approach for reoperations due to the failure of previous aortoiliac revascularization procedures.<sup>[1]</sup> It has also been implemented when the classic transabdominal aortic approach is considered to be too risky because of previous surgery or radiation treatment or because of extensive atherosclerosis of the diseased aortoiliac segment.<sup>[2]</sup> Thoracic aortobifemoral bypass may even be an appropriate option for a second intervention for cases of graft infection,<sup>[3]</sup> but it is infrequently performed as a first intervention.

## PATIENTS AND METHODS

The records of six consecutive male patients (mean age 56.3; range 54 to 65) who underwent a TABFB operation at the Kartal Kosuyolu Education and Research Hospital between July 2006 and October 2010 were retrospectively evaluated, and the feasibility of the procedure was investigated for the treatment of selected patients. All patients had complained of intermittent claudication (five were classified as Fontaine IIA and one as Fontaine IIB) for three to eight months (average 5.1 months). One patient had undergone coronary artery bypass graft (CABG) surgery three months prior to being admitted to our hospital, and another patient had undergone stent implantation for a circumflex coronary artery for stable angina pectoris (Table 1).

A definitive diagnosis was made for five of the patients using conventional angiography while contrasted thoracoabdominal computed tomography (CT) was used for the other one. In addition, those who had undergone lower extremity angiography also underwent coronary angiography. None of the patients had suprarenal involvement, but two had isolated infrarenal involvement and four had additional juxtarenal involvement. None of the patients had occlusion or critical stenosis below the level of the common femoral arteries. Involvement of the abdominal aortic segment was assessed as total occlusion based on the lack of contrast enhancement in both the conventional and CT angiographic studies.

Left internal thoracic artery (LITA) to left anterior descending (LAD) artery anastomosis was demonstrated to be patent via angiography in the patients with a history of CABG, and all were free of symptoms of originating in the heart. Furthermore, there was no history of a previous cerebrovascular event and renal insufficiency.

The TABFB was performed on all patients, and two patients with critical coronary artery stenosis had additional CABG surgery. All procedures were performed using general anesthesia and selective endotracheal intubation. The patients were positioned in the right lateral decubitus position with the left arm above the head, and the hip was placed horizontally on the table for femoral arterial exploration and anastomosis. The common and superficial femoral arteries and profunda branches were explored first. Then the left thoracic cavity was entered through a left anterolateral thoracotomy at the fifth intercostal space. The left lung was deflated and distal portion of the descending aorta was prepared as the inflow site. In two patients who underwent a concomitant CABG procedure, the LITA was harvested and skeletonized and then was anastomosed to the LAD in off-pump fashion. Next, the proximal end of a 16x8 mm polytetrafluoroethylene (PTFE) bifurcated graft (body diameter of 16 mm and limb diameter of 8 mm) was anastomosed to the distal segment of the descending aorta using a side-biting aortic clamp. The clamp was then removed, and the graft was subsequently clamped. This was followed by an additional left paramedian incision made for retroperitoneal exploration. After this, the distal ends of the graft were passed through the hilus diaphragmaticus and advanced in the inferior direction through the retroperitoneum (Figure 3, 4). Tunnels were then opened bilaterally from the femoral to the left retroperitoneal spaces, and the distal ends of the graft were passed through these tunnels. Femoral end-to-side anastomoses were performed, and the graft was declamped. In the patient who had an additional circumflex artery bypass, the proximal end

**Table 1. Patient characteristics**

Patients	Age/gender	Level of involvement	Fontaine class	Coronary artery involvement
1	58/M	Origin of the renal arteries and below	IIA	No
2	54/M	Infrarenal	IIA	No
3	65/M	Origin of the renal arteries and below	IIA	No
4	50/M	Origin of the renal arteries and below	IIB	Yes (critical LAD stenosis)
5	49/M	Origin of the renal arteries and below	IIA	No
6	62/M	Infrarenal	IIA	Yes (critical LAD and circumflex artery stenosis)

LAD: Left anterior descending artery.

**Table 2. Postoperative data**

Patients	Operation	Time of operation	Complication	Graft used
1	TABFB	90 min	None	Polytetrafluoroethylene
2	TABFB	85 min	None	Polytetrafluoroethylene
3	TABFB	110 min	Atelectasis	Polytetrafluoroethylene
4	TABFB + CABG	170 min	None	Polytetrafluoroethylene
5	TABFB	105 min	Atelectasis	Polytetrafluoroethylene
6	TABFB + CABG x 2	185 min	Pleural effusion	Polytetrafluoroethylene

TABFB: Thoracic aorto bifemoral bypass; Min: Minutes; CABG Coronary artery bypass graft surgery.

of the saphenous venous graft was anastomosed to the proximal portion of the bifurcated graft using a side-biting aortic clamp.

## RESULTS

The mean time of the operation was 124.16 minutes, and the mean time for extubation was 8.3 hours. Additionally, the mean volume of postoperative bleeding was 291.6 ml, and the mean level of postoperative serum creatinine was 0.8 mg/dl (Table 2).

Two patients suffered from mild dyspnea and pain, and minimal atelectasia of the left lung was present in these patients. However, pneumothorax and atelectasia due to bronchial obstruction were not encountered.

Morbidity was not seen in five of the patients in the early and late postoperative courses. One patient (16%) who underwent an additional two CABGs suffered from left pleural effusion on the postoperative third day. The pleural effusion was drained percutaneously. A CT scan showed no leakage or blood extravasation. This patient was discharged from the hospital on the postoperative 18<sup>th</sup> day (Figure 1, 2).



**Figure 1.** Postoperative computed tomography scan of the patient with two coronary artery bypasses. The white arrow shows the circumflex artery bypass.

Early graft obstruction or wound infection was not seen in the patients, and the average time for hospital discharge for the other five patients was eight days.

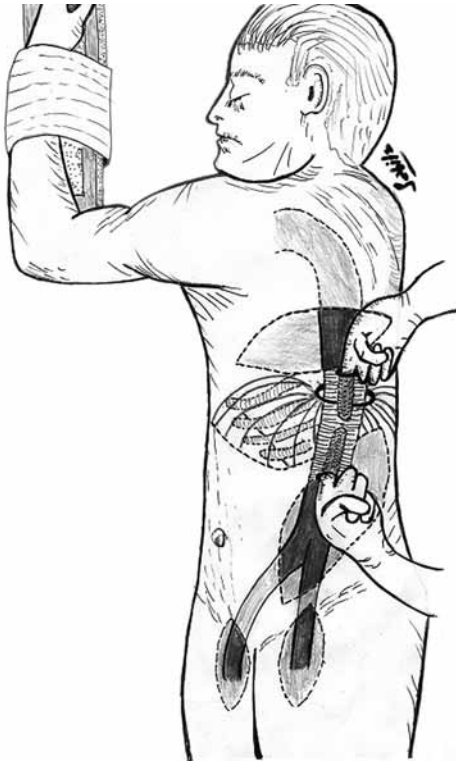
## DISCUSSION

We present our early experiences from six consecutive cases who underwent a TABFB as the initial approach for the treatment of aortoiliac occlusive disease. Total occlusion of the aortoiliac portion of the abdominal aorta due to aortic calcification was the main pathology. The thoracic aorta was the only source of graft inflow, and the femoral arteries were bilaterally revascularized in all patients.

Juxtarenal aortic occlusion makes up 8-10% of all aortoiliac segment occlusions.<sup>[4]</sup> The three most common open surgical techniques for treating this are aortofemoral bypass, iliofemoral bypass, and an aortoiliac endarterectomy, all of which have excellent long-term



**Figure 2.** Postoperative computed tomography scan of the same patient from the posterior view.

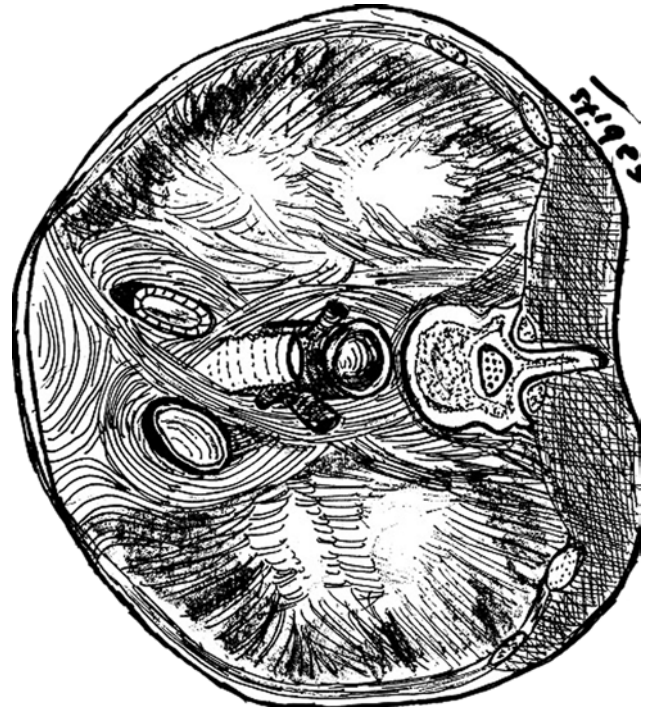


**Figure 3.** Opening of the tunnel from the left thoracic cavity to the left retroperitoneal space.

patency rates (86.3%, 85.3%, and 88.3, respectively).<sup>[5]</sup> The preference for aortobifemoral bypass as a primary treatment has limited the usage of the thoracofemoral bypass over the past two decades. Being a popular treatment option, aortofemoral bypass had a wide range of use. Its long-term patency rates have been reported to be as much as 97%; however, accumulated experience with this procedure indicates a true long-term occlusion rate of 6-13%.<sup>[6,7]</sup>

The TABFB approach has been approved by many investigators in high risk patients such as those with graft infection, aortoiliac graft occlusion, or a hostile abdomen.<sup>[1,2,6]</sup> However, the application of the technique as the primary approach in patients with severe aortoiliac occlusion is controversial. Bowes et al.<sup>[8]</sup> reported that the 42-month cumulative patency rate for TABFB was 86%, with the procedure being the primary intervention in eight patients. In addition, TABFB was the first line of treatment for aortoiliac occlusive disease in a series reported by Passmann et al.<sup>[9]</sup> in 1999, and the five-year patency rate was 81%.

The TABFB procedure has the advantage of possessing similar patency rates to those of abdominal aortobifemoral bypass while offering an optimal inflow source.<sup>[7]</sup> The conventional approach may carry the risk of renal artery embolization because of thrombus



**Figure 4.** Final location of the graft passing through the hilus diaphragmaticus in horizontal section.

propagation. Miani et al.<sup>[10]</sup> analyzed postoperative renal functions in a group of 206 patients with juxtarenal aortic occlusion and indicated that the conventional strategy may pose the potential risk of renal artery embolization. Suprarenal clamping may dismiss this risk of embolization, but it also compromises renal blood flow.

The additional advantages for preferring the thoracic descending aorta as the inflow source are that it prevents the occurrence of aortoenteric fistula and it minimizes the risk of embolization due to the lower risk of atherosclerosis at this level. Furthermore, the application of a side-biting aortic clamp to the descending aorta would not jeopardize the perfusion of the spinal cord and splanchnic area.<sup>[6,7]</sup>

The mean operation time was acceptable in our study (124.16 minutes), and the postoperative course was uneventful for all but one patient who suffered from left pleural effusion (16%). This patient improved significantly after drainage of the fluid. There were no complications that were particularly related to TABFB in the remaining patients; however, the relatively longer duration of mean extubation time (8 hours) may have been related to postoperative pain. Postoperative gastrointestinal disturbances and renal dysfunction were not encountered (mean postoperative creatinine was 0.8 mg/dL) in any of the patients, which was seen as favorable.

The TABFB procedure offers an alternative as an initial option to the conventional abdominal aortofemoral technique for the treatment of aortoiliac occlusive disease. Further studies on larger patient populations, and comparisons of midterm and long-term results with previous cumulative data should provide additional valuable information regarding the usefulness and reliability of this potentially promising technique.

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#### **REFERENCES**

1. Schultz RD, Sterpetti AV, Feldhaus RJ. Thoracic aorta as source of inflow in reoperation for occluded aortoiliac reconstruction. *Surgery* 1986;100:635-45.
2. Barrett SG, Bergamini TM, Richardson JD. Descending thoracic aortobifemoral bypass: an alternative approach for difficult aortic revascularization. *Am Surg* 1999;65:232-5.
3. Hughes R, Moawad M, Harvey JS, Von Oppell U, Byrne J. Thoracofemoral bypass using spliced femoral vein with removal of an infected axillobifemoral bypass graft. *Eur J Vasc Endovasc Surg* 2005;29:429-32.
4. Tapper SS, Jenkins JM, Edwards WH, Mulherin JL Jr, Martin RS 3rd, Edwards WH Jr. Juxtarenal aortic occlusion. *Ann Surg* 1992;215:443-9.
5. Chiu KW, Davies RS, Nightingale PG, Bradbury AW, Adam DJ. Review of direct anatomical open surgical management of atherosclerotic aorto-iliac occlusive disease. *Eur J Vasc Endovasc Surg* 2010;39:460-71.
6. Criado E, Keagy BA. Use of the descending thoracic aorta as an inflow source in aortoiliac reconstruction: indications and long-term results. *Ann Vasc Surg* 1994;8:38-47.
7. Branchereau A, Magnan PE, Moracchini P, Espinoza H, Mathieu JP. Use of descending thoracic aorta for lower limb revascularisation. *Eur J Vasc Surg* 1992;6:255-62.
8. Miani S, Piglionica MR, Giordanengo F, Bergamaschi E, Ruberti U. Subrenal aortic occlusion. *Minerva Chir* 1990;45:653-7. [Abstract]
9. Bowes DE, Youkey JR, Pharr WP, Goldstein AM, Benoit CH. Long term follow-up of descending thoracic aorto-iliac/femoral bypass. *J Cardiovasc Surg (Torino)* 1990;31:430-7.
10. Passman MA, Farber MA, Criado E, Marston WA, Burnham SJ, Keagy BA. Descending thoracic aorta to iliofemoral artery bypass grafting: a role for primary revascularization for aortoiliac occlusive disease? *J Vasc Surg* 1999;29:249-58.