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ORIGINAL ARTICLE

# Relationship between the two surgical access of aortoiliac occlusive disease and recovery of ED

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Aortoiliac occlusive disease (AIOD) can occur anywhere from the distal abdominal aorta to the common femoral arteries. Patients with AIOD may be asymptomatic or may have intermittent claudication or critical limb ischemia. ED in the young males may be the first symptom of aortoiliac disease. The aims of this study were to determine the outcome of ED in patients who underwent aortoiliac surgery and evaluate the effect of revascularization upon erectile function (EF) by using the international index of EF questionnaire and color duplex Doppler ultrasonography. A total of 60 patients under 65-year-old age eligible for elective repair of AIOD s were included in this study. The patients were randomly divided into two equal groups. The first group (group A) patients were operated by minimally invasive retroperitoneal approach (RPA) and the second group (group B) patients were operated by transperitoneal approach (TPA) to the aorta. The quality of sexual function scale was evaluated preoperatively and at 6 months postoperatively. Surgical revascularization when appropriate, symptomatic AIOD and ED are often improved. As a result of our study, RPA to the aorta is superior to TPA because of recovering with the higher systolic velocity values of penile Doppler in ED cases.

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## INTRODUCTION

Transperitoneal approach (TPA) to the aorta is the most widely accepted surgical approach in aortoiliac occlusive disease (AIOD) surgery as it is simple, fast and provides excellent exposure of the intra-abdominal cavity and vascular structures. In recent years, there has been an increasing interest in retroperitoneal approach (RPA) to the aorta as it has been described as having a better outcome, that is, preserving pulmonary function and gastrointestinal physiology, reducing the intra-operative blood loss, minimizing patient discomfort or pain, decreasing the incidence of wound complications and shortening intensive care unit and hospital stay. The majority of patients with AIOD suffer from ED. ED is characterized by the inability to achieve or maintain a penile erection of sufficient quality for satisfactory sexual intercourse for at least 6 months. Penile erection is a complex neurovascular phenomenon that may be affected by AIOD, peripheral arterial disease, increased age, urologic disease, insulin-dependent diabetes mellitus and use of β-blockers. But ED is a symptom of many other conditions and aforementioned diseases. Any condition that affects penile artery, nerve, endothelium, smooth muscle or tunica albuginea can cause ED. Malfunction of vascular endothelium seems to be a common final pathway to sexual dysfunction. ED may signal serious underlying life-threatening diseases, such as cardiovascular disease, peripheral vascular disease, hypertension and other neurological and endocrine disorders.[1] Reduced penile arterial inflow is important in the pathophysiology of ED in patients with AIOD. There is two-way relationship between AIOD and ED. AIOD may begin with ED at first; or ED may develop as a result of AIOD surgery.[2] AIOD can be medically or surgically cured with a low mortality and low morbidity; but ED problem associated with AIOD had been ignored by clinicians for a long time. The purpose of this study is to compare of the safety and efficacy of the RPA and TPA anatomic revascularization surgery on the recovery of ED.

## MATERIALS AND METHODS

### Patients

The study was approved by the local ethical committee. All patients were informed about the study protocol and gave their written consents. Investigations in all patients included duplex scanning of the aorta and lower limbs. In addition, a standard contrast-enhanced spiral computed tomography was performed. Control imaging conducted 30 and 90 days after the revascularization procedure confirmed patency of all cases. The cardiopulmonary examination included echocardiography, functional respiratory evaluation and determination of arterial blood gas levels. Renal functions were defined with blood and urine biochemistry values. A total of 202 AIOD patients were prepared for aortoiliac bypass operation between January 2005 and December 2008 in our high volume tertiary center. Sixty non-diabetic patients (30%) under the age of 65 years were included. The patients older than 65 years, cases of abdominal aortic aneurysm and who had several co-morbidities were excluded from the study. The mean age at revascularization operation was 59.7 ± 4.5 years old (range 49–65 years). Preoperatively, 60 eligible patients were randomly divided in two equal groups: group A (candidate for RPA) and group B (candidate for TPA) then they underwent aortobifemoral bypass operation for correcting stenotico-obstructive lesions of the aortoiliac district in our hospital.

### Questionnaires

These patients completed preoperatively International Index of Erectile Function (IIEF-5), self-administered short questionnaire.[3] The maximum

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IIEF-5 score is 25 and the minimum IIEF score is 5, with higher scores indicating greater erectile function (EF). The quality of sexual function scale was evaluated preoperatively and at 6 month postoperatively using the IIEF-5. Based on the final score, the patients were divided into four classes: severe ED (total score $<11$), moderate ED (total score 11–16), mild ED (total score 17–21) and no ED (total score $>21$).[4,5]

### Penile blood flow studies

Doppler Ultrasonography (The TOSHIBA SSA 270 A high-resolution system equipped with 8 MHz probe (TOSHIBA, Tochigi, Japan)) was used to monitor the penile hemodynamic changes with the patient in the supine position. Peak systolic velocities (PSVs) were measured at the junction of the proximal one-third and distal two-third of the penile shaft. When pharmacological testing was required, 10 μg prostaglandin E1 was injected to one of the corpora cavernosa laterally in the distal part of the penis with a 30-G needle because of the presence of a septum in between the two corpora cavernosa in the proximal part of the penis. The individual values of PSV in each group were averaged and the medians calculated for times 10 min, equivalent to tumescence and 15 min, equivalent to erection. PSV $<25\,cm\,s^{-1}$ are considered diagnostic, and velocities between 25 and $30\,cm\,s^{-1}$ borderline for arterial insufficiency. Normal cavernosal velocities are accepted as systolic inflow of $>30\,cm\,s^{-1}$ and end diastolic velocity (EDV) of $<5\,cm\,s^{-1}$ with full tumescence after pharmacostimulation. Venous ED on the basis of Doppler ultrasound can be diagnosed only if a patient had normal arterial function. Higher EDV values, especially with normal PSV, are a sign for veno-occlusive disorders or diseases of the corpus cavernosus. The resistance index was calculated as (PSV–EDV)/PSV. Resistance index of $<0.75$ is associated with venous leak in 95% of patients, and resistance index $>0.9$ is associated with normal results in 90%.[6] After AIOD operation, 5PDEIs were not used in ED patients while performing the penile Doppler ultrasonography. Side effects and interactions of 5PDEIs with nitrates could lead to severe vasodilation and hypotension, even fatal, and therefore, their coadministration had been prohibited by cardiologist in some of AIOD patients. Patients showing normal PSV value and the adequate duration of erection postoperatively with IIEF score $>21$ were accepted as a success of revascularization and sign of arterial patency.

### Operative technique

In both groups, the operations were performed under general anesthesia and managed with post-operative patient controlled analgesia. The RPA (group A) was performed through a 10- to 12-cm oblique incision from the left subcostal margin to the rectus abdominus muscle border. The retroperitoneum was reached without incising any of the muscles but dissecting them from their aponeurosis. TPA (group B) was performed through standard median laparatomy, 12–18 cm along the pubo-xyphoid line keeping the umbilicus in the midline. In both methods, the aorta was explored up to the infrarenal level. In group A, the aorta was transected with minimal incision without stripping paraaortic tissues for avoiding nervous plexus damage. Group B patients were operated by transperitoenal approach and abdominal aorta was carefully released from surrounding tissues. The aortoiliac occlusions were treated by bypassing the stenotic segments and revascularising both femoral arteries. Following the completion of operation, all patients were transferred to intensive care unit and discharged from intensive care unit after the stabilization of hemodynamic status.

### Statistical analysis

Data were analyzed for statistical significance using NCSS (Number Cruncher Statistical System) 2007 and Power Analysis and Sample Size 2008 Statistical Software (NCSS LLC, Kaysville, UT, USA). Categorical variables are presented as numbers and percentages. The methods of descriptive statistics (average, standard deviation, median, frequency, and ratio) as well as Mann–Whitney *U*-test (comparisons between groups) and Wilcoxon sign test (intra-group comparisons) were used for parameters of abnormal distribution. Yates Continuity Correction test and Mc-Nemar test were used for comparing qualitative data. A value of $P<0.05$ was considered to indicate statistical significance with 95% confidence interval and was the threshold to reject the null hypothesis.

## RESULTS

The IIEF-5 score for all of the 29 ED patients was less than 21 before the operation and the mean age of ED patients was $59.7\pm4.5$ years. ED percentage declined from 53.3% (19 cases) to 20% (6 cases) and from 43.3% (13 cases) to 26.7% (8 cases) in group A and group B, respectively. Non-ED percentage increased from 46.7% (14 cases) to 80% (24 cases) and from 56.7% (17 cases) to 73.3% (22 cases) in group A and group B, respectively. Postoperatively, 33.3% decreasing in the number of ED cases, in other words, 33.3% increasing in the number of non-ED cases were estimated statistically significant in group A ($P<0.05$). However, only 16.6% variation in ED and non-ED cases of group B was statistically insignificant ($P>0.05$; Figure 1 and Table 1). Table 2 shows that no significant association could be evidenced between groups A and B according to patient distribution and mean IIEF scores before and after operations ($P>0.01$). The IIEF-5 score for all of the 29 ED patients is less than 21 and accepted as vasculogenic ED. Specifically, color duplex doppler ultrasound (CDDU) was only performed to these ED group after operation. Only one case among the non-ED patients in group B had postoperative ED complaint. But his nocturnal penile tumescence test result was normal and no other abnormalities in penile

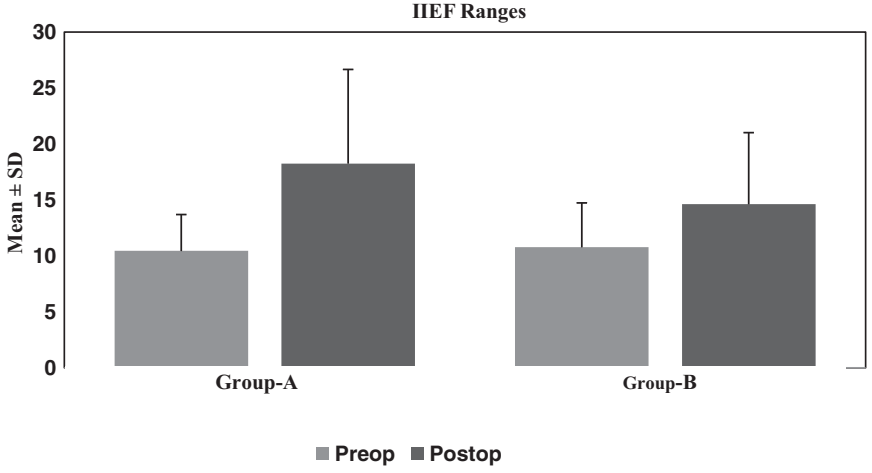


**Figure 1.** The International Index of Erectile Function (IIEF) domain in basaline, preoperatively (preop) and postoperatively (postop) in groups A and B, respectively.

CDDUS values after the operation. He was accepted as psychogenic ED and was excluded from vasculogenic ED group statistics.

The penile hemodynamic changes after intracavernous injection of PGE1 were observed in groups A and B. Table 3 shows that there was no significant difference in PSV values between two groups before intracavernosal injection (ICI; $P < 0.05$). However, the results of PSV were significantly different in both groups after ICI ($P < 0.05$). The PSV values after ICI were found highly statistically significant in group A ($P < 0.01$). But, there was no significant difference of PSV values after ICI in group B ($P > 0.01$). However, differences of PSV values before and after ICI were also found statistically significant in favor of group A ($P < 0.05$; Figure 2). Mean EDV values were measured as $3.32 \pm 0.80$ mm and $3.74 \pm 0.93$ mm in groups A and group B, respectively. Only two cases had a borderline EDV in both group. However, mean resistance index values were estimated as $0.91 \pm 0.02$ and $0.88 \pm 0.03$ mm in groups A and B, respectively. There was no significant difference between groups A and B ($P > 0.05$). Interestingly, no meaningful veno-occlusive dysfunction was defined in the penile CDDU among the patients whose ED was cured after operation.

**Table 1.** Evaluation of EF, ED and non-ED in group A and group B Preop and Postop

| | | *Group-A (n = 30)* | | *Group-B (n = 30)* | | P[a] |
|---|---|---|---|---|---|---|
| | | n | % | n | % | |
| Preop–EF | ED | 16 | 53.3 | 13 | 43.3 | 0.606 |
| | Non-ED | 14 | 46.7 | 17 | 56.7 | |
| Postop–EF | ED | 6 | 20 | 8 | 26.7 | 0.761 |
| | Non-ED | 24 | 80 | 22 | 73.3 | |
| P[b] | | 0,002** | | | 0.063 | |

Abbreviations: EF, erectile function; Preop, preoperatively; Postop, postoperatively. $^{**}P < 0.05$. [a]Yates Continuity Correction.[b]Mc-Nemar test.

**Table 2.** Evaluation of IIEF scores Preop and Postop

| *IIEF scores* | *Group A ED (n = 16)* | *Group B ED (n = 13)* | P[a] |
|---|---|---|---|
| | *Mean ± s.d. (median)* | *Mean ± s.d. (median)* | |
| Preop | 10.44 ± 3.26 (10.00) | 10.77 ± 3,94 (10.00) | 0.929 |
| Postop | 18.25 ± 8.42 (24.00) | 14.62 ± 6.40 (12.00) | 0.156 |
| P[b] | 0.006** | 0.138 | |
| *Postop-Preop Difference* | *Mean ± s.d. (median)* | *Mean ± s.d. (median)* | P |
| | 7.81 ± 7.90 (9.50) | 3.85 ± 8.33 (0.00) | 0.193 |

Abbreviations: IIEF, International index of Erectile Function; Preop, Preoperatively; Postop, postoperatively. $^{**}P < 0.01$. [a]Mann–Whitney *U*-test. [b]Wilcoxon Signed Rank test.

## DISCUSSION

Isolated infrarenal AIOD is rare and can occur anywhere from the distal abdominal aorta to the common femoral arteries. More commonly, distal aortic occlusive disease extends into the common iliac arteries and named as Leriche syndrome. Lerich syndrome first described by Rene Lerich in 1923 and characterized by the classic triad of claudication, absent or weak femoral pulses and ED.[7] Etiopathogenesis of AIOD include smoking, diabetes mellitus, hyperlipidemia, hypertension, age, male gender, non-white ethnicity, chronic renal insufficiency, C-reactive protein elevation, hyperhomocystinemia and hyperviscosity/hypercoagulability. Patients with AIOD may be asymptomatic or may have intermittent claudication or critical limb ischemia. Intermittent claudication of the lower extremity is classically muscular pain appears with activity and relieved by short rest. ED in the young males may be the first symptom of aortoiliac disease.[8,9]

The evaluation for AIOD includes a focused history and complete physical examination, color flow duplex ultrasonography, computed tomographic angiography and magnetic resonance angiography. Computed tomographic angiography may be used to localize and diagnose severity of stenoses in individuals with AIOD, especially in those with a contraindication to magnetic resonance angiography. Impaired renal function prevents using Gadolinium in magnetic resonance angiography because of the association with nephrogenic systemic fibrosis. Digital subtraction angiography is most often combined with simultaneous endovascular treatment, when appropriate. Another useful diagnostic technique is carbon dioxide angiography, especially in those patients with marginal renal function or severe contrast allergy. The American College of Cardiology/American Heart Association Guidelines suggest smoking cessation and hypertension, diabetes and hyperlipidemia management as well as antiplatelet medical therapy according to current treatment guidelines for asymptomatic patients.[10,11]

Current operation techniques for anatomical open surgical revascularization for patients with AIOD include the aortobifemoral bypass, the iliofemoral bypass and aortoiliac endarterectomy. All three techniques were equally effective in terms of long-term vascular patency. TPA to the aorta is the most widely accepted surgical approach in aortic surgery but in recent years,

**Table 3.** Postoperative PSV values in both groups before and after ICI

| *PSV (Postop)* | *Group-A (n = 16)* | *Group-B (n = 13)* | P[a] |
|---|---|---|---|
| | *Mean ± s.d. (median)* | *Mean ± s.d. (median)* | |
| Before ICI | 18.71 ± 4.17 (18.15) | 19.67 ± 4.17 (12.00) | 0.599 |
| After ICI | 33.07 ± 12.81 (33.27) | 24.23 ± 8.67 (22.25) | 0.048* |
| p[b] | 0.002** | F0.087 | |
| *Differencies of PSV (before and after ICI)* | *Mean ± s.d. (median)* | *Mean ± s.d. (median)* | P |
| | 14.37 ± 12.10 (14.49) | 4.57 ± 7.33 (2.57) | 0.023* |

Abbreviations: ICI, intracavernosal injection; PSV, peak systolic velocity. $^{*}P < 0.05$. $^{**}P < 0.01$. [a]Mann–Whitney *U*-test. [b]Wilcoxon Signed Rank test.

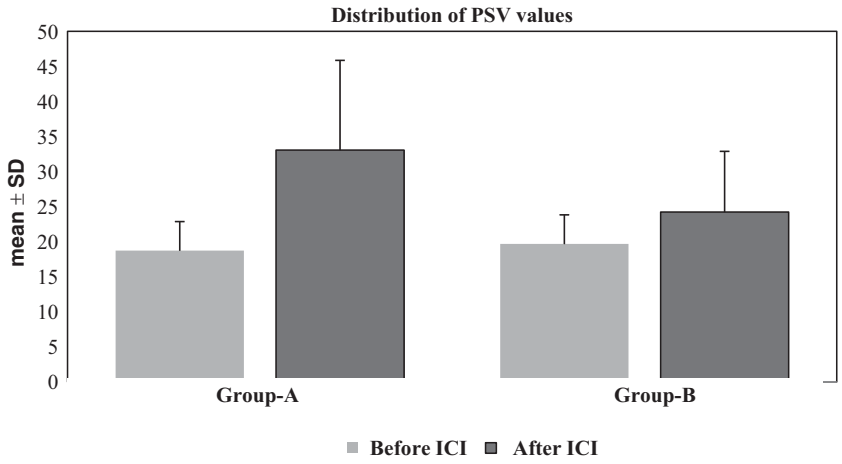


**Figure 2.** Distribution of peak systolic velocity (PSV) before and after intracavernosal injection (ICI) in both groups.

there has been an increasing interest in the RPA to the aorta as it has been described as having a better outcome, and minimizing post-operative complications and shortening hospital stay.[12] Anatomic AIOD repair surgery has been associated with a postoperative sexual dysfunction in 25% of the male patients, because of autonomic nerve injury and pelvic blood flow changes.[13] The autonomic nerves supplying the bladder neck, the vas deferens and the prostate are closely related to the abdominal aorta and its bifurcation. The erection is controlled by the autonomic nervous system. Parasympathic nerves from S2 to S4 are the principle mediators of erection, whereas sympathic nerves from T11 to L2 control ejaculation and detumescence. The arterial blood flow to the penis originates from the internal iliac arteries via the internal pudental arteries. The internal pudental arteries terminate as the penile arteries, which divide to form: the dorsal artery, the cavernosal artery and bulbo-urethral artery. Dysfunctional ejaculation and ED caused by disruption of efferent sympathetic pathways are a common complication after aortoiliac reconstruction surgery. Dysfunctional ejaculation is more common complication than ED after aortoiliac vascular reconstruction and may occur in as many as 49–63% of male patients. The main efferent sympathetic innervations of the intrapelvic organs is derived from the superior hypogastric plexus also called preaortic plexus, which is located in front of the abdominal aorta and its bifurcation. This knowledge has led to the development of ejaculation-erection preserving alternatives that are based on saving the main trunk of the superior hypogastric plexus.[14] In the light of anatomic knowledge, current surgical procedures can contribute to a better understanding of postsurgical morbidity and the development of new alternative approaches. Aortofemoral bypass graft is the most preferred surgical method whenever feasible extensive dissection anterior to the aortic bifurcation and proximal left iliac artery should be avoided because of the autonomic nerve plexus regulating erection and ejaculation in men sweeps over the aorta in this region.[15,16] However, surgical revascularization when appropriate, symptomatic aortoiliac disease and additional ischemic complications such as ED in males are often improved.[17,18]

The TransAtlantic Inter-Society Consensus (TASC) guidelines classify aortic and iliac lesions by lesion morphology as A, B, C and D class. TASC recommends endovascular treatment for TASC A and B lesions and surgical therapy for TASC C and D lesions.[19] Endovascular treatment options include angioplasty and/or stenting, which do not require dissection of the iliac bifurcation, is associated with a lower incidence of retrograde ejaculation than open repair.[20] The hand-assisted laparoscopic surgery or robotic-assisted aortic surgery technique can be used according to surgeon's experience. Combined surgical and endovascular therapy may be used together, for example, endarterectomy with ipsilateral iliac artery stenting.[21,22]

ED is not a life-threatening disorder, but it influences the daily routine, social interactions, well-being and quality of life of the patient after AIOD surgery.[23] The Massachusetts Male Aging Study found that 52% of men between the ages of 40 and 70 years reported ED with 9.6% having mild, 22.2% moderate and 17.2% complete or severe ED.[24] The age-adjusted overall prevalence of ED in Turkey was 69.2% in men aged $>40$ years (mild 33.2%, moderate 27.5%, severe 8.5%) and increased with age.[25] The majority of patients with AIOD suffer from ED. Reduced penile arterial inflow is important in the pathophysiology of ED in patients with AIOD. Purpose of our study was to search out the development of arterial inflow and EF after nerve sparing aortoiliac surgery. In this study, a total of 60 patients were evaluated according to the IIEF results before and after operation and CDDU was applied to only ED group after operation. Results showed that in group A (RPA) 16 patients (53, 3%) and in group B (TPA) 13 patients (43, 3%) were in ED side. In group A 14 patients (46.7%) and in group B 17 patients (56.7%) were in non-ED side. Ten more patients (33.3%) in group A regained his potency and six patients (20%) remained impotent after revascularization procedure. Five more patients (16.6%) became potent in group B and eight patients (26,6%) remained as impotentafter revascularization procedure. Postoperatively, highly statistical significance at PSV values was determined in favor of group A ($P < 0.01$).

Only one patient among the non-ED patients in group B complained postoperative ED, but his penile CDDUS was normal after operation. There was no detected priapism case after CDDU procedure. One of the non-ED patients had an acute myocardial infarction after operation and he was recovered without any complication. On the other hand, AIOD surgery has another urologic complication: a 2–20% incidence of ureteral injury causing postoperative hydronephrosis frequently without symptoms. Ureteral obstruction can be self-limiting with insertion of ureteral stent. Symptomatic ureterohydronephrosis following AIOD surgery is a real complication and needs to be quickly diagnosed and treated with percutaneous nephrostomy and/or surgical exploration by urologist.[26] There was no significant ureteral obstruction following aortoiliac surgery in our study.

We present here a study of minimally invasive approach to aortoiliac region with less ED complication. ED should be considered as a neurovascular disorder. The high prevalence of AIOD and potential for severe lifestyle-limiting claudication, tissue

loss and also development of ED necessitate appropriate evaluation and management of this disease. AIOD and ED are often improved when diagnostic evaluation and endovascular/surgical revascularization with nerve-preserving approach to efferent sympathetic pathways is appropriate.

## CONCLUSION

In this study, parameters of the penile duplex ultrasound showed statistically significant improvements after revascularization surgery. And, it is concluded that RPA may be preferred over TPA as an open operation for postoperative maintaining or regaining EF with promising high PSV results, and with less postoperative complications.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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