Part VII

Surgical treatments

Aortoiliofemoral Reconstructions in the Management of Arterial Occlusive Disease

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The infrarenal abdominal aorta and iliac vessels are the most common site of atherosclerosis in patients with occlusive disease of the lower extremities (1).

Aorto-iliac obliterative disease frequently coexists with the inguino-crural disease (2).

In patients with multilevel disease, the correction of significant inflow disease can frequently provide adequate revascularization of the extremities and clinical relief of ischemic symptoms (Table I).

The assessment of adequacy of arterial inflow is also a crucial point (Table II).

The aortobifemoral bypass in the management of aortoiliac occlusive disease dates back to the early 1950s (3). This treatment is probably the best standardized therapeutic procedure in vascular surgery. The history of its use is among the longest and its prevalence among the highest.

The aortobifemoral bypass is the preferred operation for patients with bilateral aortoiliac disease, but for those with unilateral occlusion, without significant stenosis of the controlateral iliac artery, alternative reconstructions, such as femoro-femoral bypass or ilio-femoral bypass, are used also.

However, aortobifemoral bypass is citated as a prime example of the need for doing only a proximal reconstruction when faced with multilevel disease. Aortobifemoral bypass alone is sufficient in most cases; the ecceptions are the patients with poorly developed profunda femoris – geniculate collateral circulation, severe occlusive disease of the popliteal artery or its branches or presence of advanced ischemic lesions in the foot.

In the last decade, since the introduction of initial methods of revascularization by means of homograft and endarterectomy, a wide variety of therapeutic options have been developed and advocated for management of aortoiliac disease (3,4).

In patients with unilateral iliac artery disease, other than discrete stenoses that are tractable with angioplasty, alternative types of reconstruction, indicated for high risk patients, are applicated in some istances (5,6).

These procedures can be categorized as anatomic or indirect bypass that avoid normal anatomic pathways, and nonoperative endovascular treatment.

Although the availability of these alternative treatments is beneficial, enabling the surgeon to select a procedure in consideration of the individual anatomy and risk status of each patient, decision making is often very complex (Table III).

However, previous surgical training and personal experience remain important factors in decision making.

TABLE I
Analysis of the lesions

√ Type of aortic lesion;
√ Level of the stenosis or obstruction of the aorta;
√ Concomitant lesions of the mesenteric arteries (Celiac Axis, Superior mesenteric artery, Inferior mesenteric artery);
√ Concomitant lesions of the renal arteries;
√ Nature, site and extension of the iliac and aortic carrefour lesions;
√ Bilateral or unilateral disease;
√ Grade of disease of the internal iliac arteries (stenosis and/or obstruction);
√ Associated lesions of the femoral carrefour;
√ Associated aneurismal disease;
√ Coexisting infrainguinal occlusive disease

TABLE II
Hemodynamic assessment

√ Prediction of hemodynamic results
√ Choice of proximal anastomosis
√ The influence of aortic size
√ Effect of proximal anastomosis on hemodynamic response and late outcome
√ The effect of profundoplasty on hemodynamic response
√ Correlation of initial hemodynamic response and run-off status with late outcome

TABLE III
Surgical program

√ Type of surgical approach
√ Site of proximal clamping (below or above the renal arteries)
√ Site of proximal anastomosis
√ Site and type of the distal anastomosis
√ Type of proximal anastomosis (end-to-end or end-to-side)
√ Revascularization of the inferior mesenteric artery
√ Revascularization of the hypogastric artery

From Critical Lower Limb Ischemia Edited by R Bartolucci, L Battaglia, V D'Andrea, E De Antoni ©2002

TABLE IV
Types of surgical approach

• Transabdominal	Transabdominal vertical incision Transabdominal transverse incision Minimal incision aortic surgery
• Retroperitoneal	Retroperitoneal approach Left flank retroperitoneal approach

Choice of surgical approaches (Table IV)

The superiority between transabdominal or retroperitoneal approaches for aortic surgery is controversy. Although it is generally agreed that the retroperitoneal approach offers advantages in selected patients with iuxtarenal and suprarenal aortic aneurysm, previous abdominal surgery, horseshoe kidneys, inflammatory aneurysms, obesity or previous aortic surgery (8,9,10,11), it has failed to gain widespread acceptance for routine infrarenal aortic reconstruction (12).

Since the original description by Rob (13), the advantages of the retroperitoneal approach for aortic reconstruction have been described at irregular intervals (10,14,15).

A citated advantage of the retroperitoneal approach is the avoidance of intestinal evisceration during operation with its associated evaporative heat and fluid losses (14,16).

Sicard (15) claimed a highly significance reduction (mean decrease: 1.5 litre) in intraoperative fluid requirement and he noted significantly less blood turnover with the retroperitoneal approach.

If Leather demonstrated (17) less blood loss for abdominal aortic aneurysms repair when the aneurysm was excluded and bypassed through a retroperitoneal approach, some author (18) affirmed no superiority of retroperitoneal versus transperitoneal reconstruction with conventional operation.

Williams (19) recommended that the retroperitoneal approach isn't applicable to patients with bleeding disorders, because this approach results in a larger surface area of exposed tissue.

The first randomised prospective study performed by Cambria in 1990 (20), comparing the two approaches with the same reconstructive techniques, concluded: *"no important advantage for the retroperitoneal approach and thus no support for its adoption as the preferred tecnique for routine aortic reconstruction".*

Sicard in his second work in 1995 (21), a prospective and randomised trial, concluded that *"retroperitoneal approach for abdominal aortic surgery is associated with fewer postoperative complications, shorter stays in the hospital and intensive care unit, and lower cost. There is, however, an increase in long term incisional pain. Current methods of postoperative pain control seem to decrease the incidence of pulmonary complications"* (Table V).

TABLE VI
Types of Transabdominal exposure

- Traditional infracolic approach
- Left medial visceral rotation

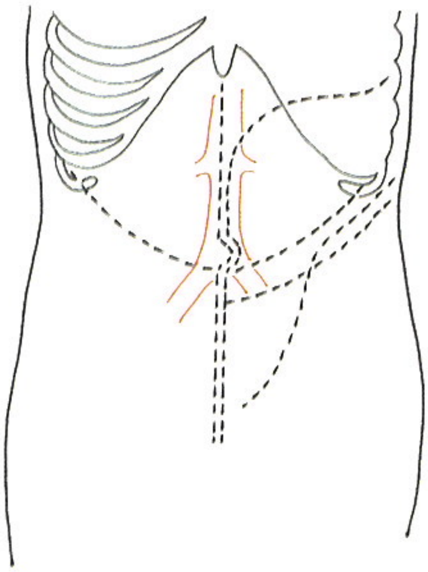


FIGURE 1
Transabdominal approach: different types of incision

TABLE V
Retroperitoneal (RP) versus transperitoneal (TP) approach to aorta (21)

	Patients		Ileus %			Hospital stay (days)			Mortality %		
	RP	TP	RP	TP	P	RP	TP	p	RP	TP	p
Cambria 20	54	59	3.7	6.7	ns	10.3	12.5	ns	0	1.7	ns
Darling 22	15	12	2.1	4.0	<0.05	6.7	9.0	0.157	0	0	ns
Gregory 23	53	119	3.3	4.9	<0.01	9.0	13.0	< 0.01	0	4.2	ns
Leather 17	193	106	0.5	10.4	<0.02	7.0	12.0	< 0.02	3.6	3.8	ns
Sicard 21	70	75	0	11.0	0.005	9.9	12.9	0.10	0	3.0	ns

Transabdominal approach (Figure 1) (Table VI)
Transabdominal vertical incision

The midline skin incision extended from the xiphisternum to the pubic bone, with a curve to the left of the abdomen to circumvent the umbilicus.

The linea alba is divided in the midline, and the retroperitoneum is divided to the left of the falciform ligament.

A midline incision is the most common approach in abdominal surgery and particularly in aortic surgery. Generally, it is the preferred incision if the lower anastomosis is expected to involve the iliac arteries and if the upper control is likely to be suprarenal.

Transabdominal transverse incision

The transverse abdominal incision commences with a straight skin incision across almost the full width of the anterior abdominal wall, about 4 cm. above the umbilicus and just below the lower costal margin.

The anterior rectus sheath and underlying rectus muscle is divided transversely.

Lateral to the rectus muscle, the external oblique fibers are also split, the external oblique fibers are split and retracted.

The more medial internal oblique fibers are also split, but laterally the internal oblique muscle requires division for full exposure. The transverse muscle fibers are split in continuity with the posterior rectus sheath and the parietal peritoneum.

Minimal incision aortic surgery

The minimal incision aortic surgery is an alternative approach in the treatment of patients with infrarenal aortic aneurysms and aortoiliac occlusive disease.

Laparoscopic equipment isn't necessary.

The learning curve for retractor placement and the use of long instrumentations can be easily overcome.
The technique is indicated for treating infrarenal aortic aneurysm less than 10 cm. in diameter and can be used for the treatment of patients with coexisting common iliac aneurysms or occlusive disease. The average length of the abdominal incision is 10 cm (range 8-10 cm.).

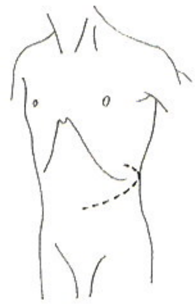
The length of the abdominal incision, however, makes suturing at the distal common iliac artery level difficult. Therefore, when distal iliac stenosis is present, it is easier to use the femoral artery for distal anastomosis.

This approach isn't controindicated for treating patients with previous abdominal surgery.

Incision size correlates with reduced perioperative pain and a quicker return to full function.

The most important aspect is limited manipulation and retraction of bowel. The mini incision aortic surgery isn't applicable to all patients, but provides an alternative tool for vascular sugeon to consider (24).

Retroperitoneal approach (Figure 2,3)



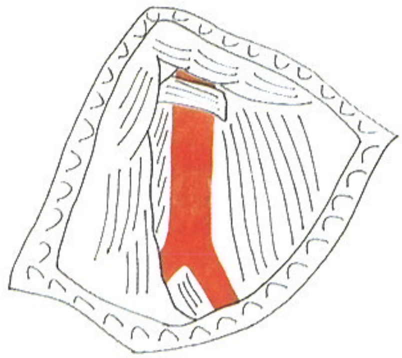


FIGURE 2
Retroperitoneal approach: Rob's approach

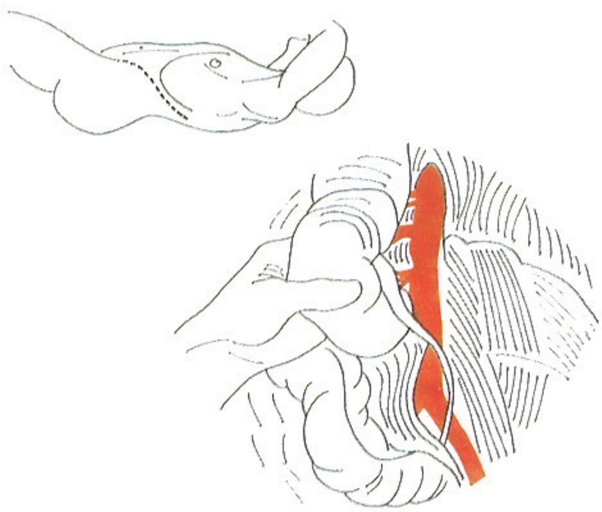


FIGURE 3
Retroperitoneal Approach: Jackson's Approach

In the last year there has been a reawakening of enthusiasm for a retroperitoneal approach for aortic surgery related to some potential technical considerations and possible physiologic advantages, such as less cardiac and pulmonary stress, decreased ileus and lessened third-space fluid losses (17,21).

In unilateral reconstructions may represent in selected cases the ideal approach.

Although perhaps advantageous in certain circumstances, as multiple previous abdominal surgical procedures, previous aortic surgery, inflammatory aneurysms, its use cannot be recommended in all cases (Table VII).

TABLE VII
Indications to retroperitoneal approach for aortic reconstruction

√ Previous intrabdominal procedures
√ Repeat aortic reconstruction
√ Iuxta / suprarenal aortic aneurysms
√ Large aortic aneurysms
√ Inflammatory aneurysm
√ Renal or visceral arteries requiring endarterectomy
√ Severe obesity
√ Horseshoe kidney

A major drawback is that the positioning often makes difficult an adequate exposure of the right femoral artery and the graft tunnelling to the right groin, particularly in obese patients. Access to the right renal artery is poor and, if control and possible repair of the right iliac artery may be necessary, this is difficult with a left retroperitoneal approach (Table VIII).

TABLE VIII
Controindications to retroperitoneal approach

ABSOLUTE:	- Distal right renal artery reconstruction
RELATIVE:	- Concomitant intraabdominal disease requiring evaluation and/or treatment - Extensive aneurismal involvement of right iliac artery

Left flank retroperitoneal incision

The patient is placed on the operative table in a modified left thoracothomy position with his shoulder at a 70 to 80 degree angle to the table and his hip rotated posteriorly as far as possible.

The midpoint patient's left costal margin and left iliac crest is centered over the break in the operative table and the table is flexed to open up the left flank.

An oblique incision is made from the lateral margin of the left rectus sheath midway between the symphysis pubis and the umbilicus, and extended laterally into the tenth or eleventh intercostal space. An eleventh intercostals space incision provides exposure for both infrarenal and suprarenal aortic control.

When renal artery endarterectomy or left renal artery reimplantation is contemplated, exposure may be improved by entering one interspace higher. A ninth intercostals space incision is reserved for visceral artery or pararenal aortic endarterectomy.

The retroperitoneal space is entered at the tip of the eleventh or twelfth rib.

In most patients a retrorenal plane is developed and the abdominal contents, left kidney and ureter are reflected anteriorly (Figure 4).

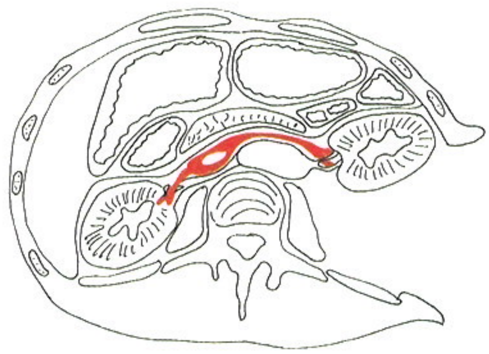


FIGURE 4
Left flank retroperitoneal approach: transverse cross section showing retrorenal approach, behind left kidney and ureter

When exposure of the superior mesenteric artery beyond its origin is required for endarterectomy or for endarterctomy of the pararenal aorta, a plane is developed anterior to the left kidney, which is left in situ. The left kidney also remains in situ when retroaortic left renal vein is identified.

When supraceliac clamp application is anticipated before operation a tenth interspace incision is used.

Exposure of the entire left and proximal right iliac arteries is readly obtained with this type of incision (25).

Choice of site and type of proximal anastomosis

Overall patency rates are not different when end-to-end anastomosis is compared with side-to-end anastomosis (26,27).

Some authors have achieved better patency with end-to-end bypass (28,29), but in these experiences end-to-side anastomosis may have suffered from sequential rather than parallel comparison, since it was performed earlier; therefore, the end-to-end group in these studies might be benefited from technical advances.

End-to-end anastomosis is absolutely indicated when aortoiliac occlusive disease coexisting with aneurismal disease or complete aortic occlusion extending up the renal arteries. It appears to be more sound on a hemodynamic basis, with less turbolence, better flow characteristics, and less chance of competitive flow with still patent host iliac vessel (30).

Such considerations have led to better long-term patency and a lower incidence of late aortic anastomotic aneurysm in grafts constructed with end-to-end proximal anastomosis in some series (28,29), although none has been a randomised prospective trial.

Other studies have not demonstrated any significant difference in late patency rates between the two types of grafts (26,27).

The application of partially occluding tangential clamps for realize an end-to-side anastomosis may convey a higher risk of dislodging intraaortic thrombus or atherosclerotic embolus, that may be difficult to remove and be irretrievably carried to the pelvic circulation or lower extremities when clamps are released and flow restored.

Resection of a segment of aorta allows the prosthesis to be placed in the anatomic aortic bed, thereby faciliting tissue coverage, retroperitonealization and separation from bowel.

End-to-side anastomosis appears to be advantageous in certain anatomic patterns of disease (31).

The type of the proximal anastomosis should be choosed on the basis of citated specific rather than expected differences in hemodynamic response (Table IX).

TABLE IX
Indications for the choice of proximal anastomosis

end-to-end	end-to-side
Total distal occlusion	Preservation of patency
Distal embolization	Hypoplastic aorta
Aneurismal change (evolution)	
Presence of the blebs	

Management of small "size" aorta (hypoplastic aorta)

Hypoplastic aorta is more common in female, with less severe symptoms than patients with normal aorta (32). However, this malformation has also been reported in male, who tends to present symptoms 10 years earlier than the patients with normal aorta (33).

The patients with small aorta also present small arteries in the leg (32).

It is supposed that arterial lesions caused by neointimal hyperplasia or atherosclerosis are more likely to cause hemodynamic compromise and therefore to become symptomatic sooner in small arteries.

Computed tomography is necessary to resolve wheter the infrarenal aorta is intrinsically smaller or has a luminal narrowing caused by atherosclerosis. Howerver, the diameter of the infrarenal aorta is the only predictive variable.

Valentine suggests (34) that young men with infrarenal aortic diameter less than 18 mm, undergone to aortoiliac reconstruction for occlusive disease, can be expected to have the graft occlusion within 3 years, the same the women with aortic diameter less than 14 mm.

Van den Akker (35) has suggest that endarterectomy may be superior to aortobifemoral bypass in young patients with small aorta and occlusive disease limited to the aorta or common iliac arteries.

Burke (36) demonstred that PTFE prosthesis and profundoplasty improve patency rates in patients with small aorta compared with control groups.

Management of iuxtarenal aortic occlusion

Iuxtarenal aortic occlusion tends to occur in relatively young patients who have a history of tobacco abuse (37).

The most commonly associated symptom is claudication. Rest pain and tissue loss are not rare findings. The patients haven't acute ischemia, which supports the chronic nature of the iuxtarenal aortic occlusion and long-term development of lumbar and pelvic collaterals vessels. Male population have high incidence of impotence.

The pathogenesis of iuxtarenal aortic occlusion is that of iliac and distal aortic atherosclerosis disease progression with subsequent infrarenal aortic thrombosis. 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.

Many reports, however, describe thrombus progression to the suprarenal aortic segment (38,39).

When this situation occurs, the clinical symptoms are acute renal failure or visceral ischemia, followed by death.

The presence of aortic iuxtarenal occlusion in combination with renal artery stenosis is particularly ominous (40). As renal artery stenosis progresses in the presence of iuxtarenal aortic occlusion, the low resistance outflow to the renal parenchyma is compromised. This may results in a low flow state at the aortic stump, which could potentially allow for the ascent of proximal aortic thrombus (37,39).

Aortic occlusion of the iuxtarenal segment may be treated successfully by an aortobifemoral bypass.

The aorta must be thromboendarterectomized, either through the end of the divided infrarenal aorta so called "champagne cork operation", or through a longitudinal arteriotomy in the infrarenal segment (41,42).

The morbidity has been reported specifically with respect to suprarenal clamping and renal failure as long as the clamping time of renal arteries is less than 30 minutes and there is no embolization into renal circulation.

In contrast several reports of extra-anatomic bypass for the treatment of aortic iuxtarenal occlusive disease have been published (43,44). These procedures have been criticized because they do not address the infrarenal aortic thrombus and do not eliminate the risk of proximal thrombus propagation (37,39).

Mc Collough (45) reported a series of 13 patients treated medically or with an extraanatomic bypass. None of the patients in his series demonstrated progression of proximal aortic thrombus, thus the author questioned the dogma of using endarterectomy and in line aortic repair in aortic infrarenal occlusive disease.

However, extra-anatomic bypass may be considered when the patient have significant comorbidity conditions that preclude an abdominal approach.

Preservation of the infrainguinal arterial run-off in the majority of iuxtarenal aortic occlusive diseases is an interesting finding in these patients. This observation would suggest that iuxtarenal aortic occlusion is a localized pathology that saves the distal vessels. Two possible mechanisms that may explain this finding are that the iuxtarenal aortic occlusion occurs in a subset of patients who are predisposed having accelerated aortic atherosclerosis and/or occlusion of the proximal aortic inflow as a protective effect on the distal vessels, that is decreased influence of hypertension, tobacco or both as predisposing factors for the formation of distal occlusive disease.

Choice of distal anastomosis

In the patients with aortoiliac occlusive disease is always preferable to carry the graft to the femoral artery, where exposure is generally better and the anastomosis easier from a technical point of view. Several clinical series have demonstrated an increased late failure rate of the anastomoses at the external iliac level, with higher incidence of subsequent operations as a result of progressive disease at the site of the anastomosis or just beyond it (46,47).

Moreover, anastomosis at the femoral artery level provides the surgeon the opportunity to ensure an adequate outflow into profunda femoris artery.

Role of the profunda femoris artery

Coexsistent outflow disease, most tipically superficial femoral artery steno-occlusion, may limit hemodynamic improvement and hence the extent of symptom relief, resulting from an inflow procedure (26).

Because 50% or more of patients undergoing aortofemoral bypass have multilevel disease, the importance of an adequate profunda femoris flow is well recognized (48). It is mandatory in these clinical situations that any profunda stenosis must be identified and correct.

The importance of this has raised the question of whether some form of profundoplasty should be done in all patients undergoing aortofemoral bypass graft.

Howerver, the bulk of evidence suggests that "routine profundoplasty " does not improve the hemodynamic result or late patency of the graft (26).

Therefore, the anastomosis to the common femoral artery is indicated unless some proximal profunda femoris artery stenosis is evident at the time of the graft implantation (for more details see the chapter: The surgery of the profunda femoris artery).

Management of associated inguinocrural disease

Aortobifemoral bypass is cited as a prime example of the need of a single proximal reconstruction when faced with multilevel disease. Conventional thinking is that the proximal revascularization is sufficient in most cases (75-85%), when superficial femoral artery occlusion coexists with aortoiliac disease.

The exceptions are considered the patients with poorly developed profunda femoris – geniculate collateral circulation, severe additional occlusive disease of the popliteal artery or its branches, or presence of advanced ischemic lesions in the foot. However, many series have documented an high rate, from 25% to 33%, of patients with multilevel disease which should fail to have sufficient relief of ischemic symptoms after aortobifemoral bypass and may require later infrainguinal procedures (49,50).

If such categories of patients could be identified before surgery, it would be logical and benefical to perform simultaneous inflow and outflow revascularization. Accurate prediction remains elusive and no single reliable indicator has been determined.

Factors to be considered include demonstration of only modest degrees of proximal inflow disease particulary in the presence of obviously extensive and hemodynamically severe infrainguinal disease and a small or diffusely diseased profunda femoris not suitable for profundoplasty and likely to provide an adequate collateral run-off tract to the lower extremities.

Most important is the degree of distal ischemia. If the foot is severely ischemic as with ischemic necrosis or digital gangrene, likely to require local amputation, it is clear that the maximal revascularization is often mandated, if limb salvage is to be attained (Table X,XI,XII,XIII).

In these conditions synchronous proximal and distal reconstruction seems appropriate, avoiding the difficulties and possible complications of later groin redo surgery for staged bypass and providing the best chance of relief the ischemic symptoms or salvage of the threatened limb.

The frequency of combined operation appears to be increasing significantly in contemporary surgical series. Indeed, several recent reports suggest no significant difference in perioperative mortality or major complications with synchronous inflow and outflow procedures compared with proximal procedures alone (51,52).

Management of associated aneurismal diseases

These lesions don't contraindicate the surgical treatment of iliac stenosis or obstruction with iliofemoral or axillofemoral bypass.

On the contrary, aneurismal lesions of the abdominal aorta contraindicate the execution of a proximal aortic anastomosis for the risk of thromboembolic complication or pseudoaneurysm.

Thus, the surgical treatment of both lesions (aortic aneurysm and iliac stenosis or obstruction) may include aortobisiliac or aortobifemoral grafting, aortic bypass plus aortounifemoral graft and endovascular procedure of aortic lesions plus iliac stenosis.

Management of venous anomalies

Major venous anomalies encountered in the aortic reconstruction are retroaortic left renal vein, aortic collar (anterior and retroaortic left renal vein), double vena cava and left-sided vena cava (Figure 5).

Retroaortic left renal vein

A retro-aortic left renal vein should be considered whenever the left renal vein is not identified during the exposure of the upper anterior infra renal aorta.

If a retro-aortic renal vein is encountered, caution is essential in placement of the proximal aortic clamp. Most injuries occurred when the aorta is encircled.
Since recurrent technique consists of exposure of the anterior and lateral aspect of the aorta, injury to a left renal retro-aortic vein is less likely.

The use of extra peritoneal approach including mobilization of the left kidney, may pose an increased risk of injury to a retro-aortic left renal vein.

TABLE X
Indications to add a femoro popliteal bypass (Rutherford 1986) (26)

1) Rest pain or ischemic lesion on the foot
2) Low ankle pressure (> 35 mmHg)
3) TBI and/or ABI > 0.30
4) Preoperative TBI > 0.85

TABLE XI
Factors influencing patency (Nevelsteen 1991) (53)

1) concomitant femoropopliteal occlusive disease
2) site of femoral anastomosis
3) date of the operation*

** importance of profunda femoris artery disease and the date of operation*

TABLE XII
Mandatory treatment of coexisisting inguino-crural disease (Tasc 2000) (54)

a) poor hemodinamically proximal lesion;
b) occlusive disease in the profunda-geniculate collateral pathway beyond that can be dealt with by concomitant profundoplasty;
c) occlusion of the popliteal artery or of two its collateral branches (poor runoff);
d) MAJOR TISSUE LOSS OR INFECTION IN THE FOOT

TABLE XIII
Management of coexisting infrainguinal occlusive disease (TASC 2000) (54)

Recommendation (88): Intraarterial pressure measurements for assessment of multilevel disease. In a patient with multilevel disease, if there is doubt about the hemodynamic significance of partially occlusive disease , it should be determined by intraarterial pressure measurements at rest and with induced hyperemia before reconstructing an out-flow bypass. This may performed at the time of angiography.
Critical issues (11): Use of pressure gradients to assess hemodynamic significance of stenoses. Pressure gradient criteria with or without vasodilators for assessing hemodynamic significance in iliac lesions remain to be established.
Critical Issues (33): Effect of distal disease on iliac artery pressure gradients. There is a need for future studies to investigate the extent to which severe distal disease may cause an underestimation of translesion iliac artery pressure gradients.

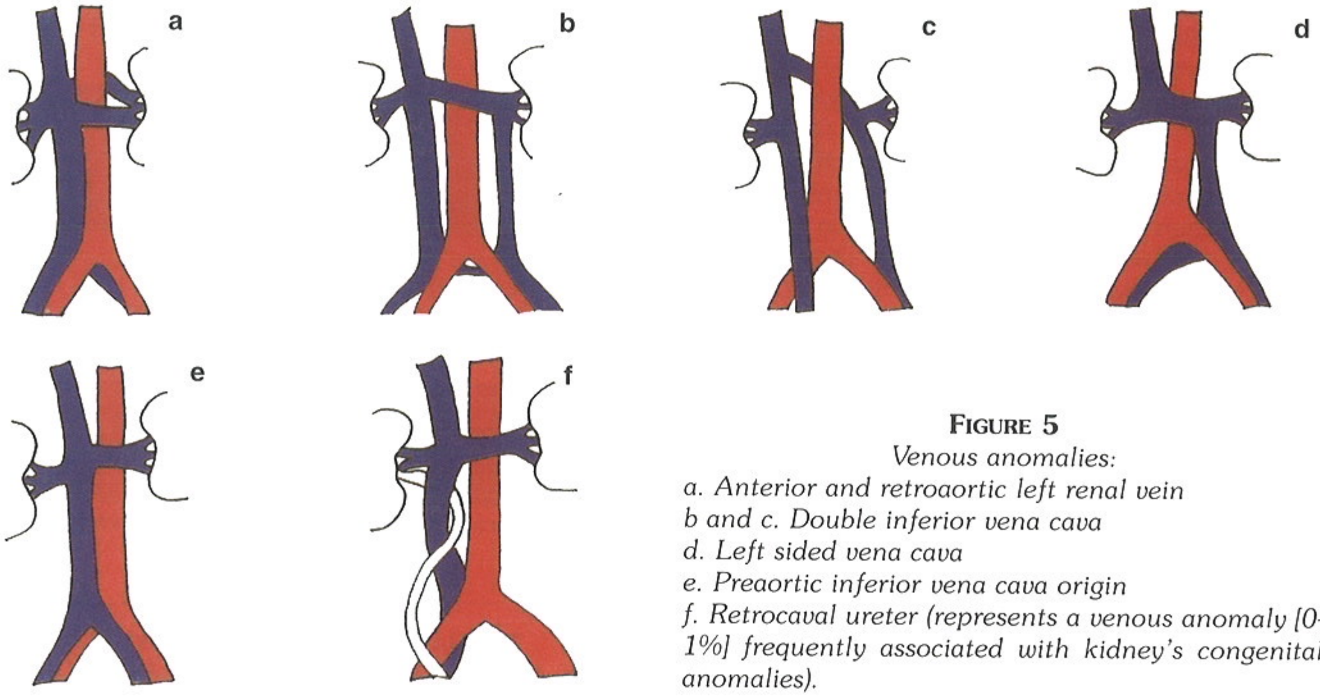


FIGURE 5
Venous anomalies:
a. Anterior and retroaortic left renal vein
b and c. Double inferior vena cava
d. Left sided vena cava
e. Preaortic inferior vena cava origin
f. Retrocaval ureter (represents a venous anomaly [0-1%] frequently associated with kidney's congenital anomalies).

High exposure of the aorta by this approach usually entails ligation and division of the posterior lumbar branch of the normal left renal vein; a retro-aortic left renal vein could be mistaken as this lumbar of the normal left renal vein. Because this, vein may constitute the only venous drainage of the left kidney (55), its division could result in dysfunction or loss of the left kidney.

This risk is avoid if the retro peritoneal approach is developed in the anterior plane to the left kidney.

Circumaortic venous collar

The anterior and retro-aortic left renal vein is a very rare condition and usually remains unindentified unless injury is caused. As with retro-aortic left renal vein, injury can cause severe bleeding.

Double inferior vena cava and left-sided inferior vena cava

The major obstacle to the aortic reconstruction occurs when a bridging vein crosses obliquely anterior to the aorta; this can occur with the short right renal vein crossing to the left-sided vena cava or the double vena cava crossing to the right over the proximal infrarenal aorta (56).

Additionally, has been encountered anomalous crossing of the iliac veins (57).

The aortic reconstruction in these cases requires careful dissection, on rare occasions transection of the vein may be unavoidable.

Management of renal anomalies

Concomitant renal artery stenosis

Approximatively 5 to 10 per cent of patients undergoing aortic reconstruction presented concomitant significant renal artery stenosis (58).

Olin (59) in his study revealed renal artery stenosis of greater than 50% on arteriography of 33% of patients with aortoiliac occlusive disease and 33% of patients with abdominal aortic aneurysms and 39% of patients with infrainguinal disease (59,60).

Despite this substantial prevalence of atherosclerotic renal disease, it has been difficult to exclusively link hypertension and renal dysfunction in these patients with renal artery disease because embolism, nephrosclerosis and diabetic nephropathy are also common presently.

Nevertheless, growing information on natural history has indicated a causative role of atherosclerotic renal disease not only in hypertension but also in progressive renal failure because of ischemic nephrophaty (61,62).

Eyler (69) was among the first to describe that one third of patients undergoing aortography for other reasons presented renal arteries stenosis, yet did not have hypertension. Brewster (70) founded that in patients affected by abdominal aortic aneurysm, 22% presents renal artery stenoses and more than half are asypmtomatic. Holley (71) documented, in an autopsy study, moderate or severe arteriosclerotic renal arterial disease in 49% or normotensive patients.

The operative mortality rate for renal revascularization combined with aortic reconstruction increases from 3 to 12% with respect to the mortality rate for aortic reconstruction only (72,73).

Valentine (74) has documented the associated coronary risk of unsuspected renovascular disease, demonstrating a correlation between the severity of the renovascular and coronary disease.

Stanley (75) in a report of the combined operation described that 70% of the patients underwent coronary angiography and 28% had preoperative coronary artery bypass.

Hallet (76) noted myocardial infarction, but not renal failure, as the principal causes of early and late death in a series of patients who underwent surgery for renovascular disease in the presence of a creatinine of 2.0 mg/dl or greater.

Such increased risk requires that the decisions regarding management of asymptomatic renal artery stenoses, identified during aortography for aortic disease, must be predictated on the natural history of such asymptomatic lesions.

Wollenweber (77), reporting on 30 patients followed for an average of 28,1 months, founds that there was progression of disease in 19 (63%). Meaney (78) reported progression of renal arterial disease in 14 of 39 patients (36%) in a follow-up that ranged from 6 months to 10 years. Schreiber (79) reported that progressive renal artery narrowing and a 16% incidence of occlusion developed in 44% of patients.

Zieler (80) has described the progression of anatomic renal artery stenosis detected by duplex- ultrasound in patients who were evaluated for hypertension and/or decreased renal function. The results indicate that renal artery stenosis in such patients is often progressive. The cumulative incidence of progression in his series, from normal to < 60% renal artery stenosis, was 0 % at one year, 0% at 2 years and 8% at 3 years, whereas progression of a > 60% renal artery stenosis was 30% at 1 year, 44% at 2 years, and 48% at 3 years. Seven per cent of renal arteries with > 60% stenosis progressed to occlusion. Progression occurred at a rate of 7% per year for all patients.

Prophylactic repair of asymptomatic renal artery stenosis has been defined as repair of lesions in the absence of hypertension or renal insufficiency and has been the indication for renovascular in 30% of modern series, where an aggressive posture to the clinically silent renovascular lesion has been advocate (80,81).

Consequently, it is suggested that in selected patients asymptomatic renal arterial stenosis (> 60% of diameter) merit repair, particularly in patients with solitary kidneys and those with bilateral lesions, when at least one should be repair. Such lesions, particularly those approximating 80% diameter stenosis, are prone to occlude (Table XIV).

Although it has been established that some renal arterial stenotic lesions progress to occlusion, no clinical markers have been reported to identify which individual renal arteries will develop progressive stenotic disease. Likewise, not all stenotic lesions develop progression.

Surgical techniques in renal artery stenosis

The choice of renal revascularization technique plays a role in the outcome of these patients.

Renal endarterectomy, although first used in 1952 (82), has been preferred less frequently because of the general success of bypass options and a relative lack of familiarity in endarterectomy. Given the fact that atherosclerotic renovascular disease is so often caused by plaque that is in continuity with adjacent aortic disease, endarterctomy should lend itself well to safe, expeditious renal revascularization, particularly in patients who require concomitant aortic surgery.

Patients' selection and operative tecnique are critical to outcome.

In general, patients with disease that extends beyond the proximal third of the renal artery are best treated with bypass rather than endarterectomy.

Total renal occlusion is not a contraindication to endarterctomy, if the main artery reconstituites just distal to proximal plaque and is of reasonable quality and size. Mobilization of the renal artery, for at least 1 cm

TABLE XIV
Simultaneous aortic replacement and renal artery revascularization

Author	Patients	Age (Years)	Follow-up (Months)	Indication Ht	Indication Scr	Bilateral renal rec N°	Bilateral renal rec %	Bilateral renal rec Improved %	Hypert result Unc %	Hypert result Worse %
Cambria (63)	170	68	100	71	20	28	16	68	Na	Na
Chaikof (64)	50	66	49	48	50	21	42	50	Na	Na
Clair (65)	43	68	23	38	28	32	74	83	17	-
De Rose (66)	21	67	39	21	11	7	33	100	-	-
Kulbaski (67)	43	63	44	43	0	20	47	50	50	-
Mc Neil (68)	101	64	40	66	23	36	36	74	23	3

Ht = hypertension; Scr = serum creatinine; Na = data non available beyond palpable plaque, is essential to the proper circumferential eversion technique, critical to securing a good endpoint.

Isolated transaortic renal endarterectomy is performed through a transverse or oblique aortotomy, allowing adequate exposure and simple closure without significantly altering the aortic diameter.

When aortic grafting is indicated, a longitudinal anterior aortotomy curved posterolaterally on both sides offers a good exposure and easy accommodation of the proximal prosthetic suture line.

Aortorenal endarterectomy should be avoided in the presence of degenerative, focally aneurismal or thin aorta at the renal orifice or when extensive calcification obliterates the normal deep medial endarterectomy plane, leaving nothing but excessively attenuated adventitia.

In view of the impact of catheter – based intervention, it now may be appropriate to consider the use of endovascular techniques in the treatment of patients with synchronous renovascular and infrarenal aortic disease.

The experience with staged percutaneous transluminal angioplasty/stenting before or after aortic replacement is anecdotal (83) and the results of renal PTA in conjunction with intraluminal stenting are at least comparable with those that previously have been described for surgical revascularization (84,85).

Wong (86) has warned that secondary operative repair for recurrent renal artery stenosis was made difficult by the failure of earlier PTAs. On the other hand, other authors have not found this to be the case in smaller series (87,88).

Accessory renal arteries

Accessory renal arteries are frequently encountered during aortoiliofemoral reconstruction. The accessory renal arteries usually arise from the lateral aspects of the aorta and should be revascularized rather than ligated or oversewn. Although preoperative angiography allows identification of these vessels, they can also be identified at the time of surgery.

Horseshoe kidney

Horseshoe kidney is an infrequently encountered anomaly. In most cases the horseshoe kidney is asymptomatic and is found only incidentally by CT scan.
Angiography is somewhat less helpful in making diagnosis but it may demonstrate some of the multiple renal arteries often associated with horseshoe kidney (89).

Unfortunately the angiography frequently does not demonstrate all accessory renal arteries, despite attemps at selective catheterization.

Some authors (90) prefer an extraperitoneal approach in patients with horseshoe kidney to more easily visualize the multiple renal arteries. This approach is particularly useful in those horseshoe kidney with a broad parenchymatous transverse portion that would otherwise inhibit exposure from an anterior approach and would also make reimplantation of the accessory renal arteries more difficult.

By the use of extraperitoneal approach the entire horseshoe kidney can be swept anteriorly and the aortic graft can be inserted in a routinary manner.

Any multiple accessory renal arteries may be reimplanted into the graft.

Management of hypogastric artery stenosis

The hypogastric arteries are caractherized by a network of anastomotic connections with arteries both cephalead and caudal to the pelvis.

The visceral branches receive collateral flow primarily from the inferior mesenteric artery via its superior rectal branch.

The parietal branches of the hypogastric arteries anastomose with the lumbar and midsacral arteries proximally and circumflex branches of the external iliac, common, and profunda femoris arteries distally.

This lumbar hypogastric circumflex arterial axis performs an important function in patients with chronic occlusive disease of the iliac arteries.

It not only perfuses the pelvis but also relays blood flow to the lower extremity (91).

The results of occlusion of a patent hypogastric artery on pelvic circulation are controversial. Ligation of one or both hypogastric arteries for kidney transplantation and hypogastric artery harvest for aortorenal bypass procedure have been performed without adverse effects (92).

The hypogastric arteries have been ligated to control hemorrhage in major pelvic fractures (93), and several studies in the obstetrics, gynaecologic and urologic literature suggest that hypogastric arteries can be interrupted without any adverse sequelae (94,95).

However, the importance of preserving the hypogastric vascularization is stressed in the vascular literature and the bilateral interruption has been reported to be associated with buttock necrosis, severe lower extremity neurological deficits, ischemic colitis, impotence and gluteal claudication (96,97).

Iliopolous (98) studied the pressure changes in the pelvic circulation with hypogastric artery interruption and demonstred that the major source of collateral supply to an acute occluded hypogastric artery comes predominantly from branches of the ipsilateral external iliac artery and femoral artery system rather than the controlateral hypogastric artery.

Threrefore, if a significant occlusive disease in the external iliac artery – profunda femoris artery system isn't corrected during aortoiliofemoral reconstruction it is particularly important to preserve forward flow into a

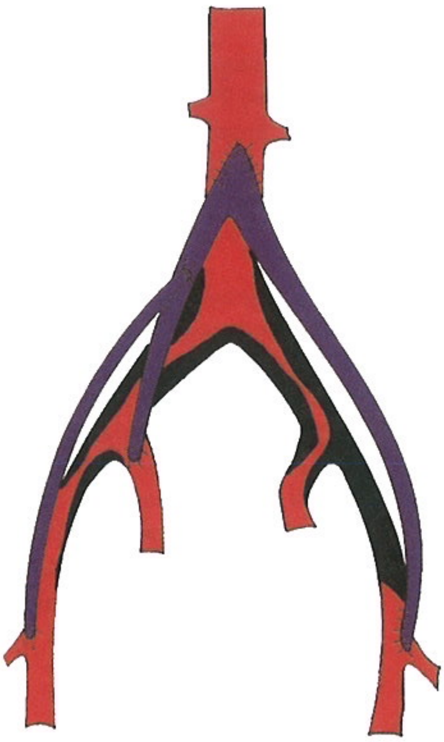


FIGURE 6
Aortofemoral bypass with protection of the flow into a patent ipsilateral hypogastric artery

patent ipsilateral hypogastric artery (Figure 6).
Buttock claudication

Buttok claudication occurs when blood flow through the pelvic collateral network is compromised. The collaterals vessels include the gonadal, lower lumbar, superior hemorrhoidal, profunda and superficial circumflex iliac, profunda and superficial external pudendal and inferior epigastric arteries.

Although much attention has been paid to impotence, little has been said about buttock claudication as an isolated symptom.

Diagnosis of buttock claudication can be difficult because symptoms are less severe than with intermittent claudication. Patients usually report fatigue when walking rather than actual pain. Neurogenic claudication must be ruled out by completing examination with computed tomography or MNR (99). The association of buttock claudication and impotence is highly suggestive of an hypogastric artery lesions (100).

Queral (101) suggests that in selected cases consideration be given to reimplantation of the hypogastric artery onto one limb of an aortobifemoral graft or that revascularization be achieved by interposition graft.

The patients who have recurrent or residual buttock claudication occurring after aortobifemoral bypass despite good pedal pulses and ankle pressures should alert the surgeon to the possibility of isolated ischemia of hypogastric artery distribution.

The main occlusive lesion is usually localized to the origin of the hypogastric artery and can be disobliterated along with a segment of thrombus that has propagated up to the first branch. A widely patent anastomosis can be performed with the use of a button of the posterior wall of the iliac artery to enlarge the anastomosis.. Inflow may obtained from any nearby source, although a patent graft limb is the best choice, when present. The procedure may be performed by a retroperitoneal approach.

Management of inferior mesenteric artery vascularization

Ischemic colitis is a well recognized complication of aortoiliac reconstruction. This problem may develop in 1% to 2% of patients after abdominal aortic procedures (102). However, the true incidence of ischemic colitis may be much higher if subclinical cases are considered. Most surgeons recognize the importance of the superior mesenteric artery for collateral supply to the colon but also emphasize that branches of the hypogastric arteries provide significant collateral flow (102,103).

To prevent ischemic colitis, several authors recommended preservation or restoration of flow to both or at least one of hypogastric artery in aortoiliac reconstruction (102). However, colon ischemia has been reported in patients after abdominal aortic bypass procedures who had undergone ligation of the inferior mesenteric artery in the presence of patent hypogastric arteries (104,105).

In most patients the mesenteric inferior artery may be sacrificed, but in a small number of patients collateral circulation is inadequate. A large meandering artery seen on preoperative arteriographs may help to indentify this category of patients. Other indications that have been proposed classically include arteries greater than 5 mm, poor back bleeding, cyanosis of the colon when the inferior mesenteric artery is occluded, weak or absent Doppler signal in the inferior mesenteric artery along the antemesenteric border of the colon and back pressure in the occluded inferior mesenteric artery of less 50 mmHg (for major details see the chapter "Perioperative complications in aortofemoral reconstruction").

If reimplantation is necessary, a button of the aortic wall with the inferior mesenteric artery at its center is excided and sewn to the side of the graft (106).

Management of unilateral iliac disease: aortobifemoral versus unilateral reconstruction

Aortoiliac disease is generally a diffuse process eventually involving both iliofemoral arterial segments. It's common that patients manifest largely unilateral symptoms, presenting a normal femoral pulse and absence of ischemic symptoms in the controlateral limb. In this setting the question frequently arises as to whether a conventional aorto-bifemoral graft or a more limited reconstruction, aimed at treatment of only symptomatic side, should be done.

When the unilateral iliac artery disease is present and minimal or no symptoms are present in the controlateral side there are several options for improving the leg perfusion.

Artobifemoral bypass infact is the preferred operation for patients with bilateral aortoiliac occlusive disease, but for those with unilateral occlusion, without significant stenosis of the controlateral artery, alternative reconstructions such aortounifemoral, iliofemoral, extraanatomic crossover femoro - femoral bypass (107) or percutaneous transluminal dilatation (108,109) have been advocated.

Although aortobifemoral grafting is the reconstruction choice for non debilitated patient with extensive bilateral disease, many surgeons treating unilateral iliac diseases, not amenable with angioplasty, may favor reconstruction with a less extensive procedure than aortobifemoral bypass.

Traditionally femoro-femoral bypass has served this purpose (107,110,111).

In recent years, increasing interest has been shown in iliofemoral bypass (Figure 7 and 8).

Iliofemoral is a useful procedure when a non diseased segment of proximal common iliac artery exists, performing a bypass in alow or moderate risk patient and avoiding operation on an asymptomatic limb (112,113).

Proximal and distal endarterectomy adversely affects the patency of the iliofemoral bypasses in the Harrington's experience (Table XV) and probably reflects the extent of disease.

In some reports patency of superficial femoral artery indicates better outflow and less extensive atherosclerotic disease and it increases the patency of bypass (113,114,115), in other reports (110,112) the patency of superficial artery isn't a significant factor influencing the patency of iliofemoral bypass (Table

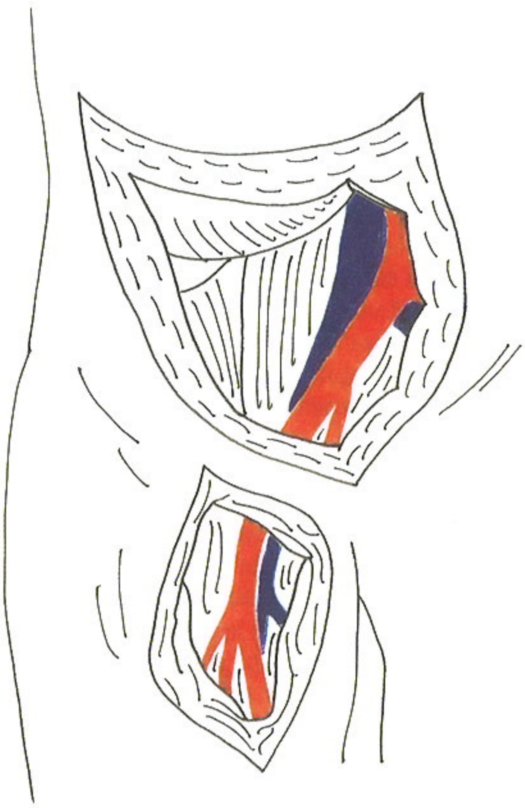


FIGURE 7
Iliofemoral approach with distinguished incision

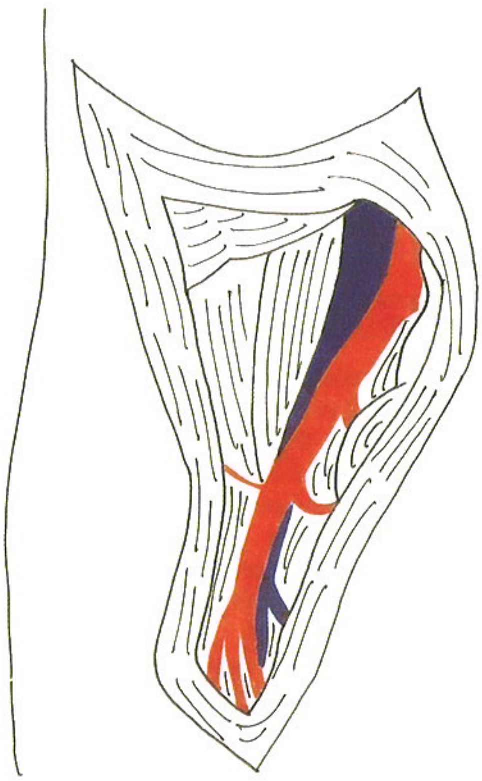


FIGURE 8
Iliofemoral approach with single incision

Table XV
Options by Harrington (116)

1. Moderate risk patients with satisfactory proximal common iliac artery who are not amenable to angioplasty: **iliofemoral bypass** (that avoids surgery in the asymptomatic leg);
2. No satisfactory ipsilateral common iliac artery but patent controlateral iliac arteries: **femoro-femoral bypass**;
3. Poor general conditions: **femoro-femoral bypass**;
4. Poor ipsilateral common iliac artery and a closed superficial femoral artery especially those requiring distal bypass: **aortobifemoral bypass**

Table XVI
Factors affecting primary patency for iliofemoral bypass (116)

Endarterectomy of the recipient (outflow) artery
Endarterectomy of the donor (inflow) artery
Distal anastomosis to the profunda femoris artery
Prior procedures

Table XVII
Iliofemoral Bypass: Results in Reviewed Studies

Author	Patients	Patency (%)			Morbidity (%)	Mortality (%)
		3yr	4yr	5yr		
Couch (118)	56	-	77	-	4	0
Kalman (110)	50	92	-	-	0	0
Levinson (117)	65	-	-	52	-	3.1
Piotrowski (115)	17	-	-	48	18	0

Table XVIII
Operative indications and types of surgical procedures

A) **Bilateral Disease**
Aortobifemoral bypass
Aortoiliac endarterectomy

B) **Unilateral iliac diseases**
Unilateral aortofemoral bypass
Unilateral iliofemoral bypass
Unilateral iliofemoral endarterctomy

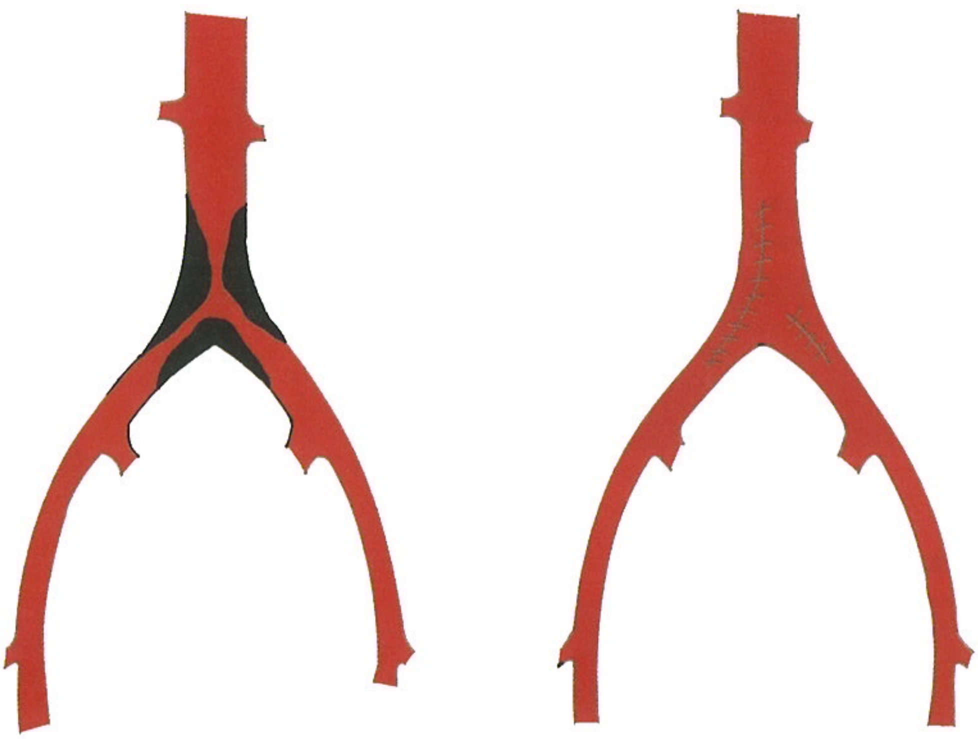


Figure 10
Longitudinal endarterectomy in aortoiliac lesions

XVI,XVII).

Surgical techniques (Table XVIII)

Endarterectomy

Endarterctomy as a method of restoring arterial continuity signaled the development of modern vascular surgery.

Because of its proved successful outcome in selected vessels some authors have continued its application, especially in the iliofemoral area.

The endarterectomy may be realized in two methods: longitudinal endarterectomy (Figure 10) and the eversion techniques.

The longitudinal endarterectomy frequently required a patch for the closure, because the direct suture in a long segment may results in stenosis.

The eversion method of endarterctomy for external iliac and common femoral artery may avoids these technical factors. This procedure was described by Inahara (119) for the first time in 1965. Although endarterctomy may also be performed for relatively localized unilateral iliofemoral disease (120,121), this is often supplanted by percutaneous angioplasty and stenting (Table XIX,XX,XXI,XXII,XXIII).

TABLE XIX
The principal factors of failure

- Unrecognised and persistent atherosclerosis disease
- Inadequate depth of endarterectomy
- Stenosis resulting from improper closure of longitudinal arteriotomy
- Failure to carry the endarterectomy to an appropriate level to ensure unobstructed flow

TABLE XX
Technical advantages

- Anatomic repair restoring a linear flow through a single end-to-end anastomosis
- Retroperitoneal approach well tolerated by patients
- Autogenous arterial repair with less incidence to infection and false aneurysm

TABLE XXI
Technical disadvantages

- Technically somewhat more demanding
- Difficult to learn, because it is performed infrequently
- Operating time is more prolonged than extra-anatomic bypass procedures

TABLE XXII
Principal causes of late failures

- Thrombosis of the external iliac artery
- Dilatation of the endarterectomized common and external iliac artery

TABLE XXIII
Primary patency rates in aortoiliofemoral endarterectomy in recent series

Author	Patients	CLI (%)	Mortality (%)	Patency (%) 1yr	3yr	5yr
Oskam (122)	94	11	0	-	83	68
Roder (123)	55	67	1.7	-	-	60
Van den Dungen (124)	93	39	0	94	-	83
Vitale (121)	60	35	0	88	86	80

Bypass

a) Bilateral disease:
Aortobifemoral bypass (Figure 11a)

b) Unilateral disease:
Aortofemoral bypass (Figure 11b)
Iliofemoral bypass

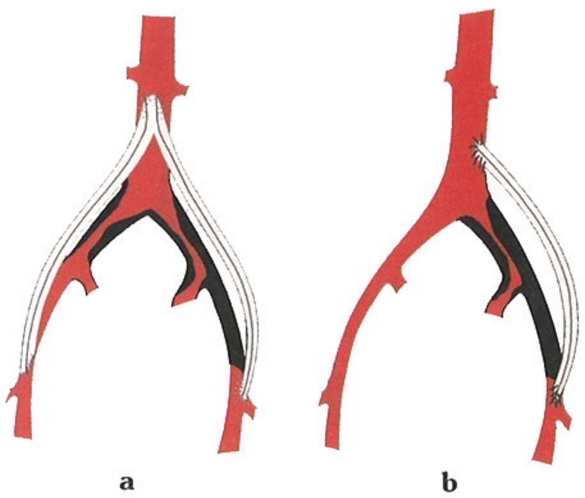


FIGURE 11
Surgical techniques:
a) Aorto-bifemoral bypass;
b) Aorto-unifemoral bypass

TABLE XXIV
Primary patency results for aortobifemoral bypass ranked by percentage>50% CLI patients

Author	Patients	CLI (%)	Operative mortality (%)	Primary patency (%) 1yr	3yr	5yr	10yr	Comments
Brewster (28)	261	52	1.9	99	95	91	-	-
Harris (125)	177	59	4	-	-	91	-	23 unilateral
Nevelsteen (53)	912	53	5	-	-	94	83	-
Prendville (126)	151	65	3	-	95	92	-	Profunda f. art.

TABLE XXV
Primary patency results for aortobifemoral bypass ranked by percentage<50% CLI patients

Author	Patients	CLI (%)	Operative mortality (%)	Primary patency (%) 1yr	3yr	5yr	10yr	Comments
Friedman (127)	34/26	35/31	0/0	100	100	98	-	PTFE/Dacron
Littoy (128)	224	37	4.9	97	90	88	73	-
Van den Akker (35)	518	23	3.3	-	-	91	-	-
Van der Vliet (129)	350	19	4.9	93	88	86	80	-

Results of aortoiliac reconstruction (Table XXIV, XXV)
Laparoscopic vascular procedures

The introduction and the acceptance of laparoscopy in general surgery has led several surgeons to suggest this technique in the vascular surgery.

In the recent years, infact, the use of laparoscopy in abdominal surgery has increased, especially in older and compromised patients, because it has been shown to decrease postoperative pain and lead to a quicker recovery toward a full functional status. The same benefit appear to hold true with its use in vascular surgery (Table XXVI,XXVII,XVIII).

TABLE XXVI
Advantages observed in laparoscopic vascular surgery

- Early removal nasogastric suction
- Limited fluid shifts
- Shorter intensive care unit
- Shorter hospital stays
- Prompt return to the functionally status

TABLE XXVII
Advantages observed in laparoscopic surgery

- Minimal tissue trauma
- Diminished risk of contamination
- Decreased blood loss
- Decreased wound pain
- Faster postoperative recovery

TABLE XXVIII
Controindications to laparoscopic aortic surgery

- Severe obesity
- Pulmonary disease
- Previous aortic surgery

Most surgical groups who have reported in this field are both vascular and general surgeons and therefore have a large experience of laparoscopic surgery.

This underlines the importance of the training in general surgery for vascular surgeons.

Dion was the first author, in 1992, who described a laparoscopy-assisted aorto-bifemoral bypass (130).

Berens (131) in the 1995 reported four video-assisted procedures on aorto-iliac vessels.

Dion (132) in the 1996 reported the first totally-laparoscopic-aortofemoral-bypass successfully performed through a retroperitoneal approach. The aortic end-to-end anastomosis was accomplished through a retroperitoneal approach.

Fabiani (133) in the 1997 reported seven cases of video-assisted aortofemoral-bypass and Ahn (134) in the same year reported one case of aortobifemoral bypass in 49-year-old male.

Anh and Fabiani inducted a pneumoperitoneum, in contrast to Dion and Berens that used a gasless exposure technique using a mechanical wall lifter.

Barbera (135) in the 1998 reported 24 cases, 7 ilio-

TABLE XXVI
Principal reports at today in vascular laparoscopic surgery

Author	Year	Patient	Technique	Comment	Operation
Dion (130)	1992	1	LA	TP gasless	ABF
Berens (131)	1995	4	LA	TP gasless	2IF, 1AB, 1ATEA
Dion (132)	1996	1	Total	RP	ABF
Fabiani (133)	1997	7	LA	TP pneumoperitoneum	-
Ahn (134)	1997	1	Total	TP pneumoperitoneum	ABF
Kline (138)	1998	20	LA, 2 Conv	minilaparotomy	AAA – 20 AA
Barbera (135)	1998	24	Total	TP pneumoperitoneum	7IF, 5AF, 11ABF, 1ATEA
Geier (139)	1999	1	LA	Infected ABF bypass	Crossover IF obturator
Arous (137)	2000	5	LA	TP pneumoperitoneum	5ABF
Alimi (136)	2001	27	7 Total, 19 LA, 1 Conv	5 RP, 21 TP, 1 SM	3AA, 4 AF, 20 ABF
Konvelbach (140)	2001	24	LA	TP	13 AA

LA= laparoscopic assisted, Conv= conversion to open surgery
RP= retroperitoneal approach, TP= transperitoneal approach, SM= standard midline
IF= iliofemoral bypass, AF= aortounifemoral, ABF= aortobifemoral bypass, ATEA= aortic thromboendarterectomy, AA= aorto-aortic bypass

femoral, 5 unilateral aortofemoral, 11 aortobifemoral bypass procedures and 1 aortic endarterectomy.

Alimi (136) in 2001 reported 27 case, 20 aortobifemoral, 4 aortofemoral and 2 aorto-aortic bypass grafting (Table XXIX).

Arous (137) in 2000 described five aortobifemoral bypass grafting performed with an alternative technique, the hand-assisted laparoscopic surgery (HALS), in which a hand is introduced into the laparoscopic field while pneumoperitoneum is maintained by a specialized device so-called hand port system. The author believes that this approach considerably reduce operative time compared with the totally laparoscopic approach to aortobifemoral bypass grafting. The operative hand facilitates the laparoscopic dissection of the aorta offering more control (Table XXX).

TABLE XXX
Type of laparoscopic approach in vascular surgery

- Video - assisted
- Hand - assisted
- Totally laparoscopic

Choice of the therapeutic options in aortoiliac disease

The decision about the type of endovascular, surgical or combined treatment of aortoiliac disease should be realized considering some important issues that may influence the recommended decision (Table XXXI).

The lesions are defined in four groups. The extremes are type A lesions, in which endovascular approach is considered the treatment of choice, and type D lesions in which surgery is considered the treatment of choice (Table XXXII and Figure 12, 13, 14, 15).

About the best treatment for TASC types B and C lesions, more evidence is needed to make any firm recommendations.

At present, endovascular treatment is more commonly used in type B lesions, and surgical treatment is more commonly used in type C lesions.

TABLE XXXI
Surgical / Endovascular selection criteria by TASC (54)

1) lesion morphology
2) risk of surgery
3) previous procedures
4) patient's life expectancy
5) experience with particular surgical or endovascular procedures

TABLE XXXII
Recommendation (31): Morphological Stratification of iliac lesions (TASC) (54)

TASC Type A iliac lesions:
1: Single stenosis < 3cm. of the CIA or EIA (unilateral/bilateral)
TASC Type B iliac lesions:
2: Single stenosis 3 – 10 cm. in artery, not extending into the common femoral artery (CFA)
3: Total of two stenoses <5cm. long in the CIA and/or EIA and not extending into the CFA
4: Unilateral CIA occlusion .
TASC Type C iliac lesions:
5: Bilateral 5-10 long cm. stenoses of the CIA and/or EIA, not extending into the CFA
6: Unilateral EIA occlusion not extending into the CFA
7: Unilateral EIA stenosis extending into the CFA
8: Bilateral CIA occlusion
TASC Type D iliac lesions:
9: Diffuse, multiple unilateral stenoses involving the CIA, EIA, and CFA (usually > 10 cm.)
10: Unilateral occlusion involving both CIA and EIA
11: Bilateral EIA occlusions
12: Diffuse disease involving the aorta and both iliac arteries
13: Iliac stenoses in a patient with an abdominal aortic aneurysm or other lesion requiring aortic or iliac surgery

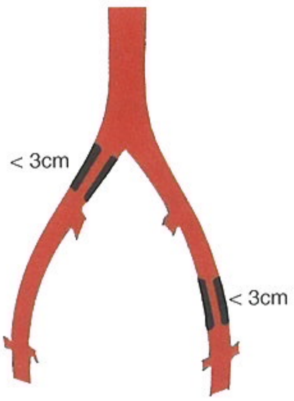


FIGURE 12
Iliac lesions of type A: interventional treatment

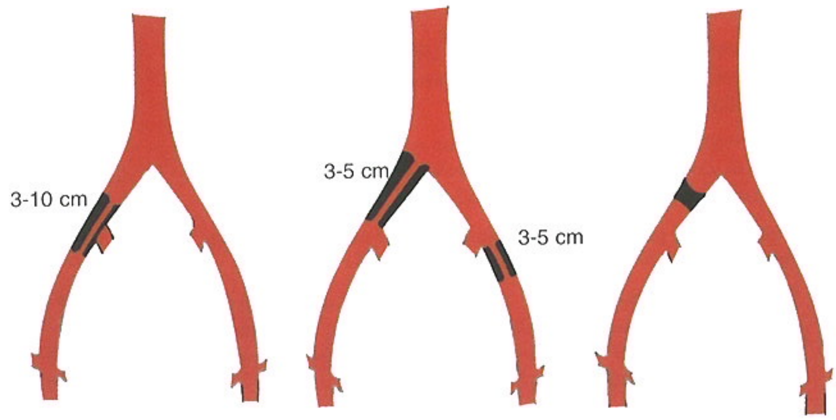


FIGURE 13
Iliac lesions of type B: endovascular treatment

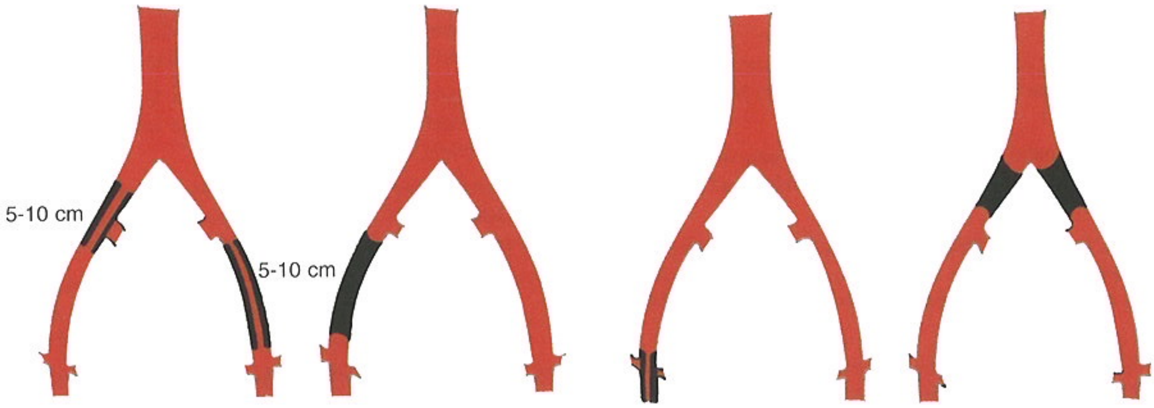


FIGURE 14
Iliac lesions of type C: surgical treatment

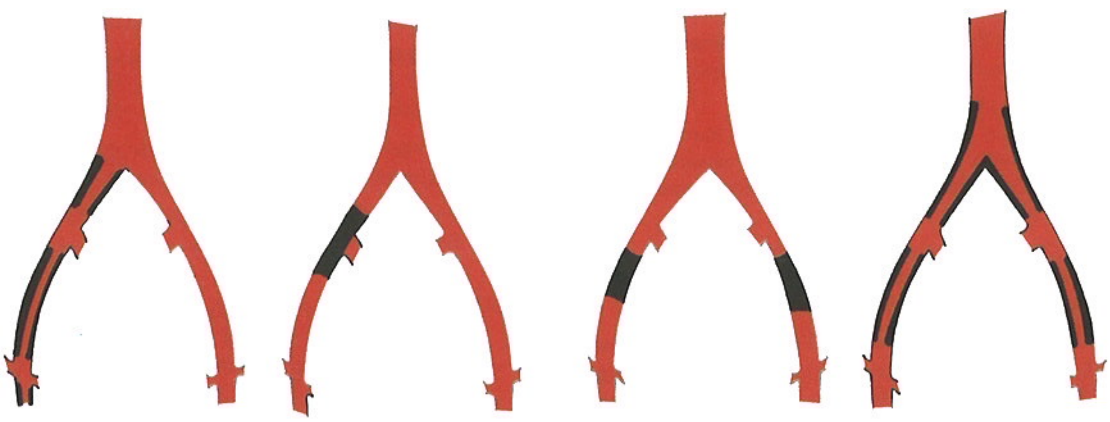


FIGURE 15
Iliac lesions of type D: surgery is the treatment of choice

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