

# Pelvic Arterial Insufficiency and What to Do About It

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**ABSTRACT** Although vascular specialists are well informed about the aortoiliac and femoral distal arterial trees, the hypogastric circulation remains a *terra incognita* to most. Patients may have significant or chronic or, rarely, pelvic arterial insufficiency. This paper summarizes the anatomy and pathophysiology of this problem and outlines diagnostic options and treatment modalities for the occasional patient presenting with such problems.

**Keywords** Ischemia, hypogastric arteries, duplex scan

The recent advent of a small blue pill to treat male sexual impotence<sup>1</sup> has placed a new emphasis on the importance of—and our relative ignorance about—pelvic arterial blood flow. It is a curious anomaly that (with a few notable exceptions) vascular surgeons' clinical and investigative focus has been directed toward the large arteries of the abdomen and retroperitoneum and then those of the lower extremities, “bypassing” the vascular supply to the pelvis. However, the constellation of symptoms and signs accompanying pelvic arterial insufficiency results in reproducible clinical syndromes that are both identifiable and treatable. They clearly belong in the diagnostic and therapeutic armamentarium of the vascular specialist. Accordingly, this article reviews the normal and pathological surgical anatomy, clinical presentations, diagnosis, and therapeutic perspectives for various forms of acute and chronic pelvic arterial insufficiency.

## NORMAL AND PATHOLOGICAL ANATOMY AND PHYSIOLOGY

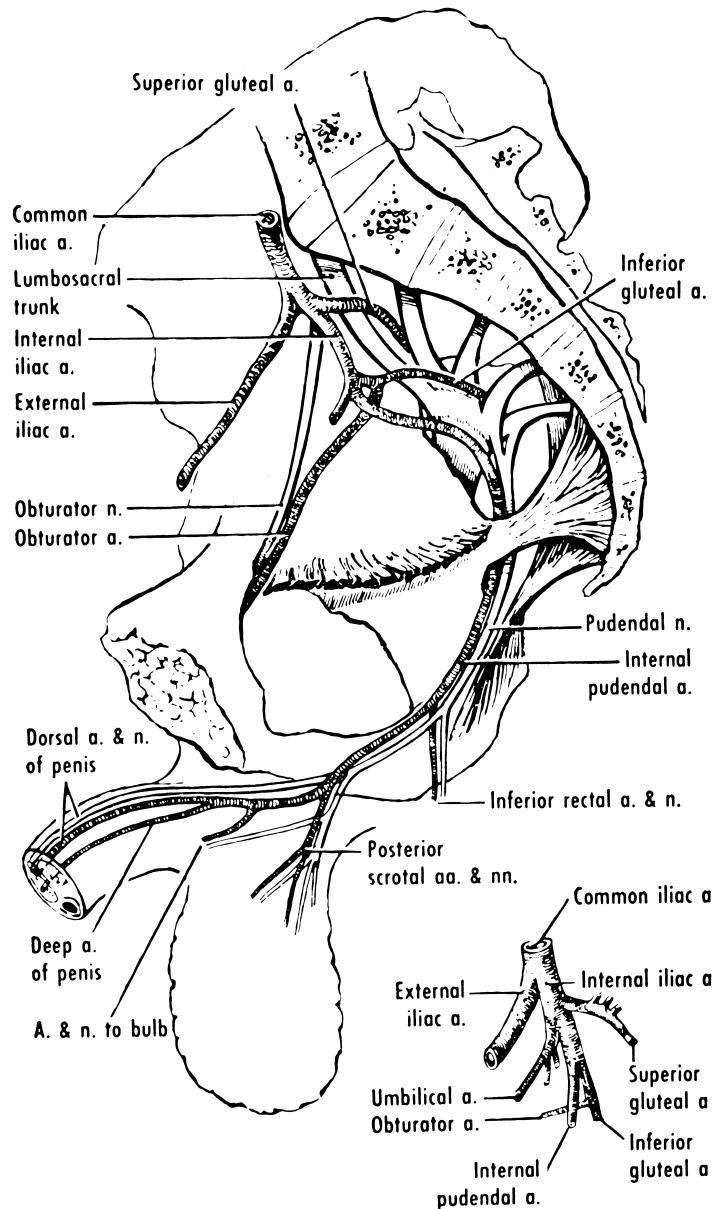
The primary blood supply for both the somatic and visceral components of the pelvis arises from the hypogastric (internal iliac) arteries. These are paired vessels that arise from the proximal or mid-common iliac arteries at the level of the sacroiliac joints and are directed inferiorly, posteriorly, and laterally (Fig. 1). Although numerous anatomic variations are observed, the general

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pattern of branching of the hypogastric artery includes the superior gluteal artery directed in a rostral fashion, then an inferior gluteal artery directed posteriorly and caudally, an inferior pudendal artery directed toward the genitalia, and an obturator artery directed toward the pelvic floor.



**Fig. 1** Anatomy of the pelvic arterial circulation. (Reproduced with permission from Gardner E, Gray J, O’Rahilly R, eds. *Anatomy*. Philadelphia: WB Saunders; 1965.)

Extensive collateral ramifications may develop in the presence of arterial obstruction occurring due to atherosclerosis, thrombosis, trauma, or iatrogenic intervention. These sources of pelvic collateralization are based on several different sites and include:

*The opposite hypogastric artery.* In the presence of unilateral hypogastric arterial stenosis or occlusion, robust collateralization occurs via cross-pelvic collaterals from the opposite patent hypogastric artery.

*The ipsilateral common and external iliac artery.* Side branches from the common and especially the external iliac artery, such as the circumflex iliac artery, can hypertrophy and provide substantial pelvic blood supply.

*The blood supply to the hindgut.* The inferior mesenteric artery commonly provides pelvic arterial collaterals via its inferior branches, including the superior hemorrhoidal artery.

*The upper retroperitoneum.* Significant pelvic revascularization may take place via enlargement of the lowest lumbar arteries and inferior extensions of phrenic, intercostal, and superior epigastric arteries from above.

*The groin.* Iliopoulos and colleagues<sup>2</sup> have demonstrated substantial pelvic collateralization from ascending and medially directed branches of the profunda femoris artery in the groin as well as the inferior epigastric artery off the common femoral artery.

These multiple collateral sources of pelvic blood supply explain the relative infrequency of overt symptoms and signs of acute or chronic pelvic arterial insufficiency. Only in the setting of pathological states that widely and diffusely interrupt both major arteries and their collateral branches—advanced atherosclerosis, diabetes mellitus, pelvic irradiation, and massive crush injury—is overt ischemia manifest.

Another reason that symptoms of pelvic arterial insufficiency are uncommon, besides extensive sources of collateral blood supply, is the relatively low resting metabolic demand of the visceral and parietal pelvic tissues. Resting blood flow requirements of the skin and skeletal muscles of the buttocks, the bladder, the distal rectum and anus, and the internal and external genitalia are low. Only during times of increased blood flow demand, that is, pregnancy, vigorous exercise involving the gluteal and other voluntary pelvic musculature, or sexual arousal, do metabolic demands and the need for increased blood supply rise.

The physiology, and especially the hemodynamics, of penile erection and impotence have been extensively studied and are continuing to be elucidated.<sup>3,4</sup> Although an extensive discussion of this topic is outside the purview of this paper, it bears emphasis that the adequacy of pelvic arterial blood flow, as well as the absence of certain penile cavernosal and venous abnormalities, are implicit in normal male sexual function.

The hemodynamics of normal female sexual function are just as likely to be dependent upon adequate pelvic arterial blood supply. However, this is a topic that has been less adequately studied, and much remains to be clarified regarding this topic.

A markedly increased demand in pelvic blood supply is required during pregnancy. Because females of child-bearing age only rarely suffer the disease states that result in chronic pelvic arterial insufficiency, aberrant physiological consequences of inadequate pelvic arterial blood supply have rarely been observed in this setting. Relative pelvic and placental vascular insufficiency is felt to explain some of the abnormalities occurring during pregnancy in diabetics.<sup>5,6</sup>

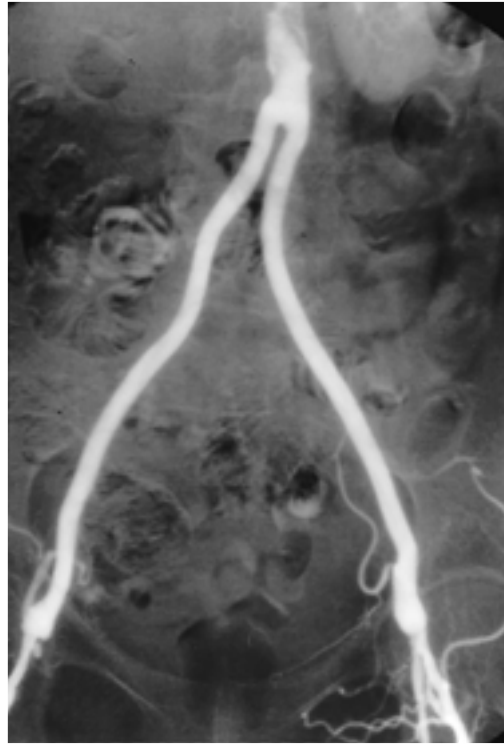
## CLINICAL PRESENTATION AND DIAGNOSIS

The most common manifestation of pelvic arterial insufficiency arises in patients manifesting the Leriche syndrome. In 1923, René Leriche first characterized a constellation of stereotypic clinical findings that includes buttock muscle claudication, absent or diminished femoral pulses, proximal (thigh and gluteal) muscle atrophy, and (in males) erectile impotence.<sup>7</sup> The Leriche syndrome almost always results from high-grade occlusion or atherosclerotic stenosis of the infrarenal abdominal aorta or of the common iliac arteries. Because of the adequacy of collateral blood supply sources outlined above and the successful results of interventions such as surgical bypass or endarterectomy or transcatheter angioplasty, the Leriche syndrome does not commonly progress to actual tissue loss. However, incapacitation due to buttock claudication may be severe, sometimes occurring in as little as a few steps.

A *forme fruste* of the Leriche syndrome resulting from bilateral occlusion of the hypogastric arteries has been proposed.<sup>8</sup> In this clinical scenario axial arterial circulation may be intact, with good femoral pulses and satisfactory distal perfusion, but buttock claudication and atrophy as well as erectile dysfunction may be severe. This particular syndrome may arise iatrogenically, for example following aortofemoral grafting, which functionally bypasses the pelvic circulation bilaterally (Fig. 2).<sup>9</sup>

Upon rare occasions (usually resulting from diffuse pelvic arterial thrombosis or embolization) acute pelvic arterial insufficiency may result in cutaneous, skeletal muscle, pelvic visceral, or genital ischemia. As in similar circumstances in other vascular beds, little can be offered the patient with such massive acute arterial occlusion; actual gluteal or perineal infarction may occur<sup>10</sup> and mortality rates are high.

Certain unusual clinical syndromes may arise as a consequence of pelvic arterial insufficiency. For example, it is relatively underemphasized that blood supply to the distal spinal cord and the cauda equina may arise in part from the hypogastric arterial circulation. Interruption of pelvic arterial blood supply, for example by aortofemoral bypass graft in the setting of an end-to-end



**Fig. 2** Contrast aortogram of a 76-year-old man who survived a ruptured abdominal aortic aneurysm but who had severe symptoms of pelvic arterial insufficiency postoperatively. The likely cause was that his well-functioning aortofemoral graft had bypassed his pelvic circulation.

aorto-graft anastomosis proximally and inadequate retrograde flow up the external iliac arteries distally, may result in spinal ischemia manifesting itself as paraparesis or paraplegia.<sup>11</sup> A prior left colectomy for cancer or diverticular disease may also increase the risk of pelvic arterial insufficiency following aortofemoral bypass graft because such procedures interrupt the inferior mesenteric arterial contribution to total pelvic blood flow.<sup>12</sup> Cases of massive pelvic hemorrhage treated by the now-obsolete technique of bilateral hypogastric artery ligation or by extensive pelvic arterial embolization risk the development of symptomatic pelvic arterial insufficiency.<sup>13,14</sup>

## DIAGNOSIS

Unlike the extremity vasculature, which may be readily evaluated by pulse palpation and the use of the hand-held Doppler, objective assessment of the pelvic arterial tree is more difficult and may require the use of specialized

diagnostic technology. As previously noted, assessment of the quality of the femoral pulses and auscultation of the lower abdomen for evidence for arterial bruits can provide indirect but accurate information regarding the possibility that pelvic arterial insufficiency is present.

Assessment of the nature of penile arterial blood flow by interrogation with a hand-held Doppler may be highly useful as a screening technique for ruling in or out pelvic arterial insufficiency. This technique is obviously not available for the assessment of pelvic arterial perfusion in women. The measurement of penile blood pressure using strain gauge plethysmography seems a highly accurate way of assessing pelvic arterial perfusion. The findings of triphasic Doppler arterial signals plus a penile-to-brachial arterial pressure index of  $>0.70$  are indicative of the relative normalcy of male pelvic arterial blood flow.<sup>15</sup>

Although only a few scattered reports characterize its use in assessing the pelvic arterial circulation, duplex ultrasonography is likely a highly accurate means for detecting stenoses of the large-artery pelvic circulation.<sup>16</sup> The duplex scanner has been used frequently for the assessment of penile vascular flow and is now a mainstay for the workup for erectile impotence.<sup>4,17</sup> The specific capabilities of duplex scanning allow it both to interrogate arterial wave forms and also to provide a direct ultrasonographic image of the arterial lumen. As elsewhere in the body duplex scanning can both demonstrate normalcy of the arterial wave form as well as detect stenoses or occlusions, aneurysms, or other abnormalities of the hypogastric arteries and their primary branch vessels.

Several minimally invasive diagnostic techniques utilizing oximetric or pH probes, or laser flowmetry, have been utilized to examine rectal and left colonic mucosal perfusion in various disease states, for example, following aortic surgery.<sup>18,19</sup> Such techniques, which appear capable of providing semi-quantitative assessments of the adequacy of hindgut perfusion, could theoretically provide an assessment of pelvic visceral flow, for example, by placement of transvaginal or transurethral probes.

Although different forms of ultrasonographic diagnosis have supplanted contrast angiography as the vascular diagnostic “gold standard” in many other vascular beds, limited experience with noninvasive studies in the pelvic circulation and the remote location of these vessels deep within the pelvis clearly make arteriography the currently optimal study for assessing the hypogastric arteries and their branch vessels. Not only can these vessels’ location and degree of patency be determined but physiological assessment, such as pressures measured across stenoses and a determination of the degree of collateralization within the pelvis, is best assessed by contrast means. As noted below, the performance of transcatheter arteriography permits consideration of balloon angioplasty or stent placement for treatment of symptomatic hypogastric arterial stenoses or occlusions.

## TREATMENT

For reasons noted previously, it would be extremely unusual for chronic pelvic arterial insufficiency to present with symptoms or signs of impending tissue loss. Instead, symptomatic patients will have severe lifestyle-limiting buttock claudication or (in males) erectile impotence. Upon rare occasions unusual manifestations of chronic arterial insufficiency, such as claudication of the back muscles or micturition dysfunction, have been reported. Intervention is commonly warranted because no good “medical” therapy has been demonstrated to improve the symptoms of pelvic arterial insufficiency and because management of stenoses or occlusions in large vessels such as the hypogastric arteries should be feasible, successful, and durable.

Symptoms of pelvic arterial insufficiency are not commonly seen unless a combination of aortoiliac stenoses and occlusions has interrupted access of pulsatile arterial flow to *both* hypogastric arteries. Cross-pelvic collateralization is generally so profuse that a single patent hypogastric artery will suffice to perfuse the entire pelvis bilaterally.

Because most patients with symptoms of pelvic arterial insufficiency have their problem on the basis of aortoiliac occlusive disease, primary treatment of the latter will almost always relieve the former—as long as pulsatile perfusion is restored to at least one hypogastric artery. A crucial part of aortofemoral bypass grafting is to assure that the pelvis is reperfused on at least one side. For example, a patient with a distal aortic occlusion and bilateral external iliac artery stenoses will *not* necessarily have his buttock claudication and erectile impotence relieved by an aortofemoral bypass graft. Reperfusion of the pelvis by implanting one of the hypogastric arteries, either directly or by a “jump” graft to the nearby aortofemoral bypass graft limb, is obligatory if adequate pelvic perfusion is to be achieved.<sup>20</sup>

Recently noted has been a rare variant of the Leriche syndrome characterized by patent common and external iliac arteries (and thus good femoral pulses and lower extremity perfusion) but bilaterally stenotic or occluded hypogastric arteries (resulting in isolated gluteal claudication and, in males, erectile dysfunction).<sup>8</sup> Upon occasion this condition may be iatrogenic (Fig. 2). If these patients’ hypogastric arterial occlusions are proximal and there is patency of at least one hypogastric artery distal to an ostial occlusion, reconstruction of this hypogastric artery by endarterectomy, reimplantation, or bypass grafting can result in a highly satisfactory relief of pelvic arterial insufficiency.<sup>8</sup>

Transcatheter interventions such as balloon angioplasty or stenting have been reported upon occasion for hypogastric arterial lesions<sup>21,22</sup>; because atherosclerotic disease of the hypogastric arteries is generally, as elsewhere, focal and ostial, a reasonable expectation of technical success should be anticipated. This stated, angioplasty of a lesion in one of two branch vessels, such

as at the common iliac artery bifurcation, threatens the occlusion of one while reopening the other; angioplasty of a hypogastric artery lesion by the “kissing balloon” technique would seem a reasonable means to avoid this complication.<sup>23</sup>

Acute pelvic arterial occlusion, either because of embolization (e.g., from an aortic aneurysm) or occasionally because of small artery vasoconstriction (e.g., due to systemic administration of vasopressors), can result in acutely ischemia of the skin of the genitalia, perineum, or buttock and even infarction of the bladder, distal rectum, or gluteal musculature<sup>9,10</sup>; death is a common consequence. As for acute thrombotic or embolic episodes elsewhere, anticoagulation and supportive local care probably have the highest likelihood of stabilizing or reversing this catastrophic turn of events.

## CONCLUSION

Pelvic arterial insufficiency is underemphasized in the vascular surgical literature. This is likely because of its relative infrequency—due to multiple excellent sources of collateral blood supply into the pelvis—and because the vast majority of individuals with symptoms of pelvic arterial insufficiency either tolerate them or have them relieved *en passant* with successful treatment of concurrent aortoiliac occlusive disease. The occasional patient may have symptoms of pelvic arterial insufficiency as a consequence of isolated bilateral hypogastric artery stenosis or occlusion. In all circumstances, restoration of systemic arterial pressures into one hypogastric artery bed should suffice to relieve symptoms. The occasional circumstance of diffuse embolization into, or acute thrombosis of, the pelvic arterial bed is often catastrophic.

## REFERENCES

1. Goldstein I, Lue TF, Padma-Nathan H, et al. Oral sildenafil in the treatment of erectile dysfunction. *N Engl J Med* 1998;338:1397–1404
2. Iliopoulos JI, Howanitz EP, Kushkerian SM, et al. The critical hypogastric circulation. *Am J Surg* 1987;154:671–675
3. DePalma RG. New developments in the diagnosis and treatment of impotence (review). *West J Med* 1996;164:54–61
4. Chiu RK, Pomeroy BD, Chen WS, et al. Hemodynamic patterns of pharmacologically-induced erection: Evaluations by color Doppler sonography. *J Urol* 1998;159:109–112
5. Lunell NO, Nylund L. Uteroplacental blood flow (review). *Clin Obstet Gynecol* 1992;35:108–118
6. Olofsson P, Laurini RN, Marsal K. A high uterine artery pulsatility index reflects a defective developmental of placental bed spiral arteries in pregnancies complicated by hypertension and fetal growth retardation. *Eur J Obstet Gynecol Reproduct Biol* 1993;49:161–168
7. Leriche R. Des obliterations arterielles hautes (obliteration de la termination de l'aorta) comme causes d'insuffisances circulatoires des membres inferieurs. *Bull Mem Soc Chir* 1923;49:1404–1406



8. Johansen K. Pelvic revascularization by direct hypogastric artery re-construction. *Am J Surg* 1996;171:456–459
9. Gloviczki P, Cross SA, Stanson AW, et al. Ischemic injury to the spinal cord or lumbosacral plexus after aorto-iliac reconstruction. *Am J Surg* 1991;162:131–136
10. Senapati A, Browse NL. Gluteal necrosis and paraplegia following postoperative bilateral internal iliac artery occlusion. *J Cardiovasc Surg* 1990;31:194–196
11. Szilagyi DE. A second look at the etiology of spinal cord damage in surgery of the abdominal aorta (editorial). *J Vasc Surg* 1993;17:111–113
12. Salam AA, Sholkamy SM, Chaikof EL. Spinal cord ischemia after abdominal aortic procedures: Is previous colectomy a risk factor? *J Vasc Surg* 1993;17:1108–1110
13. Clark SL, Phelan JP, Sze-Ya A, et al. Hypogastric artery ligation for obstetric hemorrhage. *Obstet Gynecol* 1985;66:353–356
14. Duff C, Simmen HP, Brunner U. Gluteal necrosis after acute ischemia of the internal iliac arteries. *Vasa* 1990;3:252–256
15. Chiu RCJ, Lidstone D, Blundell P. Predictive power of penile-brachial index in diagnosing male sexual impotence. *J Vasc Surg* 1986;4:251–256
16. Currie IC, Jones AJ, Wakeley CJ, et al. Non-invasive aortoiliac assessment. *Eur J Vasc Endovasc Surg* 1995;9:24–28
17. Montorsi F, Guazzoni G, Bocciardi A, et al. Improved minimally-invasive assessment of penile haemodynamics: The combination of colour Doppler sonography and injection-stimulation test. *Int J Impotence Res* 1995;7:33–40
18. Fiddian-Green RG. Gut mucosal ischemia during cardiac surgery. *Semin Thorac Cardiovasc Surg* 1990;2:389–399
19. Vahl AC, Ozkayhal-Yilmaz E, Nauta SH, et al. Endoluminal pulse oximetry combined with tonometry to monitor the perfusion of the sigmoid colon during and after resection of abdominal aortic aneurysm. *Cardiovasc Surg* 1997;5:65–70
20. Seagraves A, Rutherford RB. Isolated hypogastric artery revascularization after previous bypass for aortoiliac occlusive disease. *J Vasc Surg* 1987;5:472–474
21. Cook AM, Dyet JF. Percutaneous angioplasty of the superior gluteal artery in the treatment of buttock claudication. *Clin Radiol* 1990;41:63–65
22. Smith G, Train J, Mitty H, Jacobson J. Hip pain caused by buttock claudication: Relief of symptoms by transluminal angioplasty. *Clin Orthop Rel Res* 1992;284:176–180
23. Tegtmeier CJ, Kellum CD, Kron IL, Mentzer RM. Percutaneous transluminal angioplasty in the region of the aortic bifurcation. *Radiology* 1985;157:661–665

