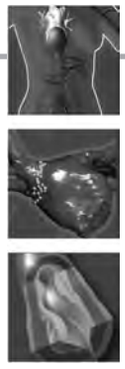

Choice of stent in iliac occlusive disease

Percutaneous transluminal angioplasty has become widely spread as the initial treatment in patients with iliac occlusive disease. Although not confirmed by the current TransAtlantic Inter-Society Consensus (TASC) II recommendations, endovascular repair of complex aortoiliac lesions is feasible and gives similar angiographic and clinical outcome compared with open surgery at both short- and long-term follow-up, even in complex lesion configurations. Besides the commonly accepted TASC A and B lesions, TASC C and D lesions could also be treated endovasculary with the current devices, techniques and modalities. This opens new perspectives for a group of patients presenting with severe comorbidities.

KEYWORDS: iliac occlusive disease ▪ kissing stents ▪ percutaneous transluminal angioplasty ▪ PTA ▪ stent grafts ▪ stents ▪ TASC II classification

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The prevalence of peripheral arterial occlusive disease is estimated to be 3% in middle-aged patients, increasing to 20% in patients older than 70 years. Its most common clinical manifestation is intermittent claudication involving the upper thigh, often in combination with lower claudication [1,2]. Clinical symptomatology related to iliac arterial lesions are erectile dysfunction in males and, occasionally, a blue toe syndrome when embolization out of an ulcerated iliac plaque occurs. Patients with critical limb ischemia (rest pain, tissue loss) often have multilevel occlusive disease with an aortoiliac component, which is mostly diffuse and complex, in combination with infrainguinal occlusive disease.

Percutaneous transluminal angioplasty (PTA) has become widely accepted as the initial treatment in patients with iliac occlusive disease. Because of advancements in endovascular techniques and technology, there has been an evolution to treat complex iliac lesions and iliac occlusions with minimally invasive procedures. Traditionally, endovascular treatment of stenoses yield better results than of occlusions, and the outcome of endovascular treatment with PTA alone are worse than those after stent placement. In 1997, Bosch and Hunink published a meta-analysis on iliac lesions, comparing the results of six PTA studies in 1300 patients to eight stent studies in 816 patients, confirming this thesis [3]. The meta-analysis revealed 4-year primary patency rates of 67% after PTA alone and 81% after stent placement. Subanalysis revealed 4-year primary patency rates of 65% for stenoses versus 54% for occlusions in patients presenting with intermittent claudications and 53% for stenoses versus 44% for occlusions in patients with critical limb ischemia. After stenting, primary patency rates after 4 years of 77% for the treatment of stenotic lesions versus 61% in occlusive lesion configurations were reported in claudicants, and 67% for stenting of stenoses versus 53% for stenting of occlusions in critical limb ischemia patients. In its conclusion, this meta-analysis stated that complication rates after PTA alone and after stent placement are comparable, but that the risk of long-term failure is reduced by 39% after stent placement compared with PTA.

Current treatment guidelines

In 2000, the TransAtlantic Inter-Society Consensus (TASC) working group published their recommendations for the management of peripheral arterial occlusive disease, based on the evidence available at that time. This document also included an aortoiliac lesion classification, with the goal to indicate the best form of treatment for each specific arterial lesion configuration. For lesions belonging to the TASC A category, endovascular therapy is the treatment of choice. For TASC D category lesions, classic surgery is indicated. The lesions without strongly supportive evidence, which are more likely to respond better to endovascular therapy, are categorized as TASC B. Those lesions for which more evidence is needed, but are more likely to respond better to surgery, are category TASC C [4]. In practice, the most complex iliac lesions are listed under TASC C and D categories. The endovascular evolution

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in terms of materials and techniques in the years following the TASC 2000 recommendations resulted in the publication of the TASC II document in 2007, containing a revision and update of their earlier recommendations [5]. An overview of the TASC aortoiliac lesion classification and its evolution over the past few years is shown in Figure 1.

Current literature results

Several recent publications have demonstrated the excellent durability of iliac stenting in daily practice. They indicate that endovascular treatment could be extended to more aortoiliac lesion configurations than stated in the TASC II 2007 aortoiliac recommendations. Leville *et al.* reported primary and secondary patency rates of 76 and 90%, respectively, 3 years after stenting in iliac occlusions [6]. As their results were irrespective of the TASC categorization of the treated lesions, the authors concluded that endovascular treatment of iliac occlusive disease should be extended to TASC type C and D lesions. Furthermore, the authors pointed out that surgical repair of iliac occlusions should only be referred to when all endovascular attempts are exhausted, bearing in mind the decreased perioperative morbidity and good midterm durability. Park *et al*. described their long-term (up to 10 years) experience in their total cohort of iliac patients (TASC type A–D lesions) and presented impressive primary patency rates of 87, 83, 61 and 49% after 3, 5, 7 and 10 years of follow-up [7]. De Roeck *et al.* published their results after stenting of different types of iliac occlusions (TASC type B–D), and showed primary patency rates of 94, 89 and 77% after 1, 3 and 5 years [8]. They also stated that in their cohort of patients with complex aortoiliac lesions, stent failures can always be rescued endovascularly. They reported secondary patency rates of 100% after 1 year and 94% after 3 and 5 years. The success rate on midterm and long-term is also heavily dependent on the presence of concomitant infrainguinal disease.

Table 1 gives an overview of studies for endovascular treatment of complex iliac lesions. It shows that endovascular treatment of iliac artery occlusions can be accomplished via endovascular means with little morbidity and acceptable patency rates. Similar to these recent publications, we believe that in experienced hands, endovascular treatment of complex iliac lesions is always possible, except when the common femoral artery is occluded (for which a surgical aorto-bifemoral graft is indicated, preferably with profundaplasty), or when an aortic thrombosis is present.

Stent choice for aortoiliac endovascular treatment

Primary or direct stenting is generally accepted in clinical practice for chronic iliac artery occlusions and along complex stenoses (eccentric, calcified, ulcerated plaques), which are prone to cause distal embolization. [9] As the stent is placed without predilation, potential embolic material is trapped between the arterial wall and the stent mesh, which significantly reduces the risk of distal embolizations. Additional potential advantages of direct stenting include shorter procedural time and less radiation exposure.

■ Balloon-expandable stents

Lesion morphology and location are two important factors in choosing the most appropriate stent type. In lesions with a high elastic recoil, such as short, calcified and eccentric plaques at the ostium of the common iliac artery (CIA) or external iliac artery, balloon-expandable stents are often favorable because of their greater hoop strength [10,11]. Moreover, balloon-expandable stents have the advantage of enabling more accurate stent placement than self-expanding stents.

■ Self-expanding stents

The use of stainless steel balloon-expandable stents is not recommended in tortuous vessels owing to the risk of angulation or kinking of the artery at the distal end of the stent [11]. In these cases, self-expanding nitinol stents should be used, as they offer the flexibility and good vessel conformability that is needed in these arterial anatomies. These self-expanding stents also have better results in longer, less calcified lesions. Nitinol stents are also adequate for treating vascular segments in which there is an abrupt transition in size (e.g., stent placed proximally in CIA and distally in the external iliac artery, which is smaller in diameter). Another advantage is that self-expanding stents are available in long lengths, which makes it possible to cover longer lesions with only one stent.

■ Stent grafts

Stent grafting is generally reserved for iliac aneurysms, iatrogenic rupture or perforation, and arteriovenous fistula. The stents are covered with Dacron (Atrium) or polytetrafluoroethylene. When arterial rupture following

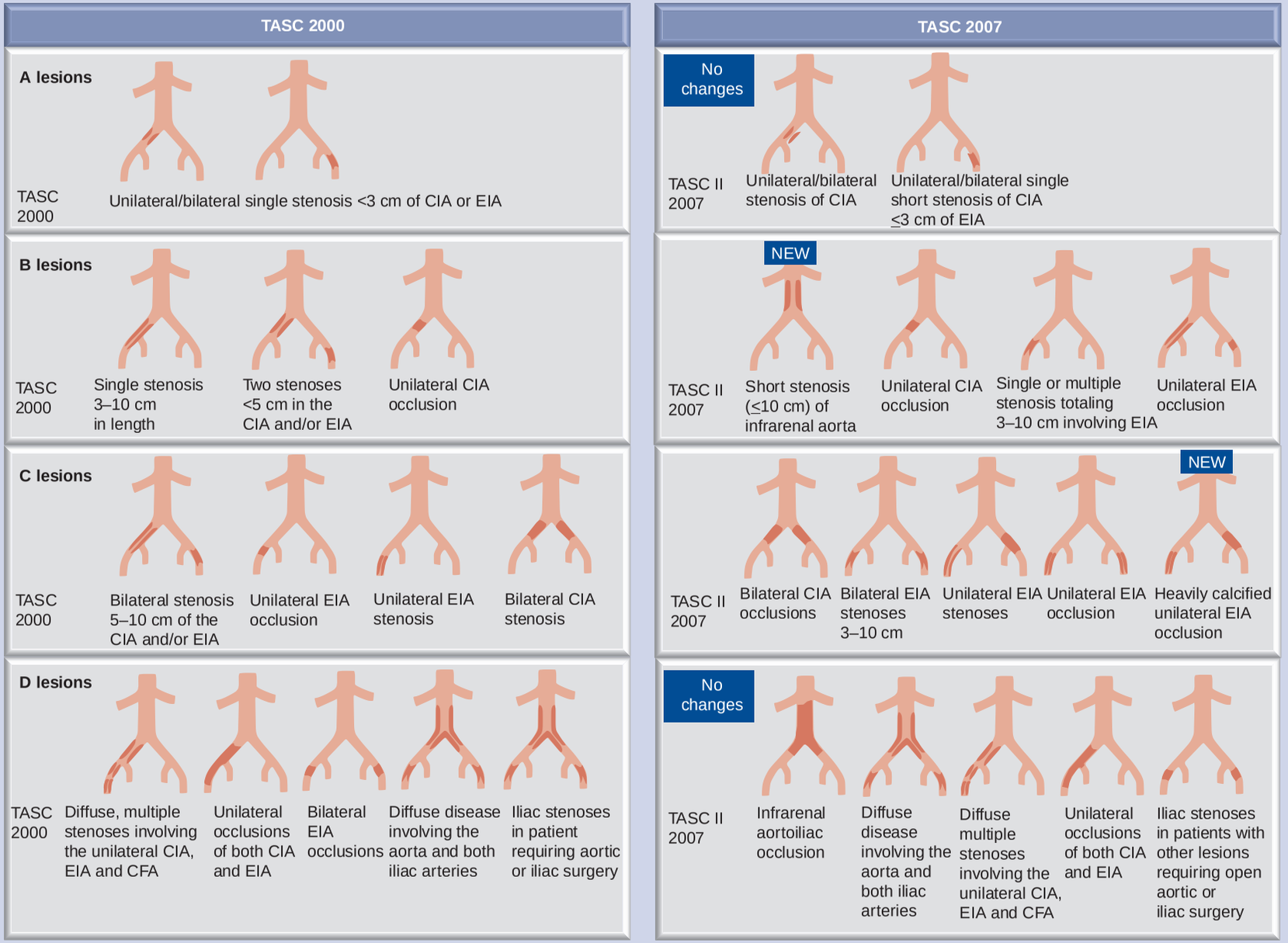

Figure 1. TASC classifications for aortoiliac lesions: evolution from 2000 to 2007.
CIA: Common iliac artery; EIA: External Iliac artery; TASC: TransAtlantic Inter-Society Consensus.

Table 1. Literature overview for complex iliac lesions.

Study (year)	Lesion type/device type	Technical success (%)	30-day mortality (%)	PP at 1 year (%)	PP at 3 years (%)	PP at 5 years (%)	PP at 10 years (%)	Ref.
Galaria *et al.* (2005)	TASC A and B	98	1.8	–	–	–	71	[18]
Bosch *et al.* (1997)	All iliac lesions – PTA	91	1	74	68	–	–	[3]
	All iliac lesions – stent	96	0.8	86	80	–	–	
Powell *et al.* (2000)	Multi-segment iliac occlusive disease	97	2	61	43	–	–	[19]
d'Othée *et al.* (2002)	Kissing stents	100	0	–	86	–	–	[20]
Haulon *et al.* (2002)	Kissing stents	100	0	–	79.4	–	–	[14]
Mohamed *et al.* (2002)	Kissing stents	–	–	94	–	–	–	[21]
Timaran *et al.* (2003)	Poor distal runoff – iliac stenting alone	97	–	76	66	55	–	[22]
	Poor distal runoff – iliac stenting + bypass	97	–	87	54	42	–	
Timaran *et al.* (2003)	TASC C and D – surgery	96	–	85	72	64	–	[23]
	TASC C and D – endovascular	96	–	89	86	86	–	
Park *et al.* (2005)	TASC A, B, C and D	–	–	–	87	83	49	[7]
De Roeck *et al.* (2006)	TASC B, C and D	97.4	2.7	94	89	77	–	[8]
Leville *et al.* (2006)	TASC C and D, with concomitant infrainguinal disease	91	–	–	76	–	–	[6]
Yilmaz *et al.* (2006)	Kissing stents	100	–	76	63	63	–	[24]
AbuRahma *et al.* (2007)	All iliac lesions – primary stenting	100	–	98	87	77	–	[25]
	All iliac lesions – selective stenting	100	–	83	69	69	–	
	TASC A and B – primary stenting	100	–	100	98	87	–	
	TASC A and B – selective stenting	100	–	100	85	85	–	
	TASC C and D – primary stenting	100	–	96	72	–	–	
	TASC C and D – selective stenting	100	–	46	28	–	–	
Bosiers *et al.* (2007)	Balloon-expandable covered stents	100	0	91.1	–	–	–	[16]
Houston *et al.* (2007)	Kissing stents	–	–	–	–	82	68	[26]
Piffaretti *et al.* (2007)	TASC C and D – kissing stents	95.4	–	92	–	80.7	–	[27]
Tsetis *et al.* (2008)	Cutting balloon for in-stent restenosis	92.8	–	100	–	–	–	[28]

PP: Primary patency; PTA: Percutaneous transluminal angioplasty; TASC: TransAtlantic Inter-Society Consensus.

iliac artery PTA occurs, stenting of the artery alone results in maintenance of flow through the ruptured segment and exsanguination. Treatment of these complications has been performed with covered stents with immediate exclusion obtained in 100% of patients and with primary and secondary patency rates of 87 and 100%, respectively, at just under 2 years [12].

Distal embolization is uncommon in uncomplicated lesions but occurs with greater frequency (up to 24%) in the treatment of ulcerated plaques [13], recanalization of aortoiliac bifurcation lesions [14] or iliac occlusions [15]. Covered stents have proven to effectively exclude the source of embolization. We published our study results using the Atrium Advanta covered stent in stenotic diseased iliac arteries. There was a successful deployment in all patients without any procedural complications including distal embolization and vessel rupture. Primary patency at 1 year was 91.1% [16]. However, even with covered stents, distal embolization can occur. Our policy is, once the occlusion is traversed with the guidewire, to perform gentle predilation with an undersized balloon followed by the implantation of a covered stent into the newly created channel. At present, there is insufficient data to support routinely stent grafting in iliac lesions.

■ Bifurcation stenting

Lesions at the aortic bifurcation are traditionally treated using the 'kissing balloons' technique. Simultaneous balloon dilatation at

Table 2. Recommended devices for complex iliac lesions.

Indication	Point of interest	Strategy and materials
Bifurcation lesion	Symmetrical approach required	Kissing balloon or kissing stent techniques
Short lesion	Accurate placement needed	Balloon-expandable stent
Long lesion	Tortuous iliac anatomy	Self-expanding stent Oversizing of 10–15% advised
Calcified lesion	Strong radial force needed	Balloon-expandable stent, or postdilation of self-expanding stent Diameters should be estimated at the nominal vessel size
Calcified lesion with risk for rupture	'Sealing' of the plaque needed to avoid embolic events	Stent graft: • Short lesions: balloon expandable • Long lesions: self expanding

the origins of both CIAs is advocated, even in the presence of unilateral lesion, to protect the contralateral CIA from dissection, plaque prolapse and embolization. Because calcified lesions typically occurring at the aortic bifurcation are not amenable to balloon dilatation alone, 'kissing stents' or 'aortic reconstruction' technique is applied. The aortic bifurcation reconstruction technique is technically very successful, although some have expressed fears that the proximal ends of the stents that extend into the distal aorta may serve as a nidus for thrombus formation, or cause hemolysis. Nevertheless, this fear has not been realized as has been shown by the low complication rates of this procedure. In the available study publications, different types of stents have been described, without any indication of a significant outcome. It is, however, important that both stents used are of the same type and dimensions and that they are deployed and dilated simultaneously.

Table 2 gives a concise overview of the indications, points of interest during treatment and the recommended types of stents to treat iliac lesions.

Conclusion

Endovascular therapy for iliac artery disease is a well-established procedure in clinical practice. Although not confirmed by the current TASC II recommendations, endovascular repair of complex aortoiliac lesions is feasible and provides similar angiographic and clinical outcome compared with open surgery at both short- and long-term follow-up. Angioplasty is often associated with lower periprocedural morbidity and mortality rates. Conversely, surgery sometimes provides greater long-term patency, although late failure of percutaneous therapies may occur but still can be treated successfully with reintervention.

In the Bravissimo trial (Belgian–Italian–Dutch trial investigating Abbott Vascular stents in the treatment of TASC A, B, C and D iliac lesions), which includes 325 patients, self-expandable stents were often used in complex and long iliac lesions, while short and clearly calcified lesions were preferably treated with balloon-expandable stents [17].

It should be noted that when the common femoral artery or the femoral bifurcation is involved in the occlusive disease, we prefer a combined endarterectomy with a patchplasty and simultaneous endovascular treatment of the aortoiliac lesions.

With the currently available devices and techniques, endovascular therapy should be the primary approach in the commonly accepted TASC A and B iliac lesions, but also in TASC C and D lesions. This opens perspectives for a group of patients presenting with severe comorbidities.

Future perspective

In our opinion, the results of endovascular therapy for iliac lesions will be further improved by continuous technical evolution and new material developments.

In light of the current evolution towards minimally invasive techniques, an increasing number of experienced centers will be able to treat the vast majority of all arterial pathology by endovascular means.

Financial & competing interests disclosure

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Executive summary

- Endovascular therapy in iliac artery disease is a well-established procedure in clinical practice and there has been an evolution to treat more and more complex lesions.
- The type of stent should be well considered and depends on the morphology and localization of the lesion.
- Self-expandable stents are often used in complex and long iliac lesions, while short and clearly calcified lesions are preferably treated with balloon-expandable stents, which can also be placed very accurately. Stent grafts are a useful tool in selected cases but there is a lack of evidence to place them routinely.
- With the current devices and techniques, endovascular therapy should be the primary approach in the commonly accepted TransAtlantic Inter-Society Consensus (TASC) A and B iliac lesions, but also in TASC C and D lesions, except for aortic lesions close to the renal arteries. When the common femoral artery is involved, we prefer to carry out a combined procedure with an endarterectomy of the common femoral artery with patchplasty and an endovascular treatment of the aortoiliac disease.

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