Endovascular treatment of aorto-iliac TACS D occlusions with fusion imaging, outback catheters, dedicated wires and stent grafts

Klaus Overbeck
Speaker name: Klaus OVerbeck

I have the following potential conflicts of interest to report:

X Consulting

- Employment in industry
- Stockholder of a healthcare company
- Owner of a healthcare company
- Other(s)

☐ I do not have any potential conflict of interest
TASC II consensus: TASC D Aorto-iliac occlusions should be treated with open surgery.

Type D lesions:
- Infrarenal aortoiliac occlusion
- Diffuse disease involving the aorta and both iliac arteries requiring treatment
- Diffuse multiple stenoses involving the unilateral CIA, EIA, and CFA
- Unilateral occlusions of both CIA and EIA
- Bilateral occlusions of EIA
- Iliac stenoses in patients with AAA requiring treatment and not amenable to endograft placement or other lesions requiring open aortic or iliac surgery

Open surgery for TACS D aorto–iliac occlusions why not?

The good:

- Around since 1950
- Large diameter grafts
- Long-term 5 year patency > 85%
- Not so good in younger patients (<50 years 66%; 50 to 59 years 87%; > 60 years, 96%))

1 Oudot J. La greffe vasculaire dans les thromboses du carrefour aortique. Presse Med 1951;59:234-6
2 The impact of patient age and aortic size on the results of aortobifemoral bypass grafting Amy B. Reed, Michael Belkin J Vasc Surg 2003;37: 1219-25
Open surgery for aorto – iliac occlusions

The bad:

- Mortality around 3 - 6 % \(^3,4\)
- Increase of mortality older patients > 65 year 2 % > 5.4 % (OR 3.3 95% CI) \(^3\)


\(^4\) Results of aortic bifurcation grafts for aortoiliac occlusive disease: A meta-analysis Sybolt O. de Vries, MD, and Maria G. M. Hunink, MD, PhD, J Vasc Surg 1997;26:558-69
Aortic bifurcation open graft surgery mortality

### Table II. Mortality, morbidity, and patency data

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<tr>
<th>Author</th>
<th>Operative mortality (%)</th>
<th>Systemic morbidity (%)</th>
<th>Local morbidity (%)</th>
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Occl; Occlusion; Sten; stenosis; ReTx; reintervention; Amp, amputation; Sxs, recurrence of symptoms; ISCVS/SVS; ISCVS/SVS criteria.  
*Life table data were obtained from the first author personally.  
†Defined explicitly as death ≤30 days after procedure.  
‡From a separate publication.  
§Corrected, see text.  
||Defined as the proportion systemic/local complications of all complications listed times the percentage of patients with a complication.

2 Results of aortic bifurcation grafts for aortoiliac occlusive disease: A meta-analysis Sybolt O. de Vries, MD, and Maria G. M. Hunink, MD, PhDJ Vasc Surg 1997;26:558-69
Open surgery for aorto–iliac occlusions ....?

**Early morbidity**
- Cardiac events (high prevalence of IHD in PAD)
- Pulmonary complications (failure, infection, ARDS)
- Renal dysfunction
- Wound infection/graft infection
- Lymph-leaks

**Late morbidity:**
- Laparotomy needed (wound failures, hernias, adhesions)
- Sexual dysfunction (damage to para-aortic and hypogastric plexus)
- Graft infections
- Aorto-enteric fistula
- Aortic pseudo-aneurysms
- Femoral pseudoaneurysms – up to 10% *Rutherford textbook* and Mulder et.al.¹
- Limb occlusions

Endovascular treatment of TASC D aorto-iliac CTO’s

The good

1. Minimal invasive
2. Good primary and excellent secondary patency $^{9,10,11}$
3. Very high success rates $^{10,11}$
4. Low mortality $< 1\%$ $^{11}$
5. Low morbidity $^{11}$
6. Re-interventions usually percutaneous as well
7. No anastomotic pseudo-aneurysms
8. No prosthetic graft in the groin that gets infected

The bad

- Primary patency is lower that ABFG (so far)
- Graft size may not reach ABFG sizes ( = and patency)
- Contrast and radiation
- Expensive stent-grafts and consumables
- CFA disease still requires mostly open surgery

9 Endovascular Treatment for Steno-Occlusive Iliac Artery Disease: Safety and Long-Term Outcome A Mu¨ller et. al. Angiology 07/2017
Which stents for complex aorto-iliac CTO’s

- Gaines et. al. STAG RCT lower distal embolization for primary stent of CTO¹
- COBEST RCT showed better long-term patency for covered stent in iliac CTO²
- AbuRahma et. al. Clinical success and patency superior for primary stent in TACS C/D³
- Mueller et. al. Stent diameter strongly predicts patency 2017 (P> 0.002) ⁴
- A covered stent-graft reduces bleeding risk from a rupture so adequate sizing is safer

Level I and II evidence that well sized covered stent grafts are safer and show better patency for AI TASC D CTO’s

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² Durability of the balloon-expandable covered versus bare-metal stents in the Covered versus Balloon Expandable Stent Trial (COBEST) for the treatment of aortoiliac occlusive disease. Bibombe P. Mwipatayi JVS July 2016 Volume 64, Issue 1, Pages 83–94.e1


⁴ Endovascular Treatment for Steno-Occlusive Iliac Artery Disease: Safety and Long-Term Outcome. A Muller et. al. Angiology 07/2017

Veith symposium 2017
Conventional brachial antegrade and retrograde approach in a subtotal aorto-bilateral occlusion.

51 year old security guard
Ex-smoker
100 yard bilateral IC

Transbrachial 90 cm
8 Fr Ansel sheath
Subintimal aorto-bi-iliac recanalisation

0.035" terumo wire advanced supported by 120 cm 5 Fr MP re-entry CFA both sides
Subintimal aorto-bi-iliac recanalisation
Subintimal aorto-bi-iliac recanalisation
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Subintimal aorto-bi-iliac recanalisation
Retrograde Insertion of two 9 x 150 mm Viabahn ® (Gore) stent grafts supported proximally with two 9mm balloon expandable bare stents
Endovascular ABFG

Patent at 8 years

Aorto bifemoral Graft
Combined sub-intimal retro and antegrade approach

The good:

• Very cheap
• Good success rate
• Currently the standard technique once luminal approach fails

The bad:

• Only safe with contralateral or brachial contrast imaging (unless fusion)
• Often complex and time consuming
• Prolonged screening and repeated contrast injections
• Significant failure rate especially if no proximal stump, calcified bifurcation or worst an aneurysmal aorta (very high failure rate)
Retrograde luminal treatment of aorto-iliac CTO’s

Technical success rate as low as 33 % in iliac occlusions with conventional imaging and wire technology

“However, the course of a long occlusion, longer than a few centimeters, is unpredictable and therefore extreme caution must be taken in insertion of the guide wire through the occlusion. If there is any resistance the procedure should be terminated”

Motarjeme 1980

Contralateral and brachial artery access to image the aorto-iliac arteries. Why does it matter?

Contralateral transfemoral puncture complications:
• 0.5 – 1 % \(^1\) but potentially life threatening

Brachial artery puncture complications:
• Diagnostic use with <= 5 Fr access complications are rare > 0.5 % \(^1\)
• Brachial access for interventions complications up to 6.5 % \(^2,3\)

1 Sigstedt B, Lunderquist A. A Complications of angiographic examinations. AJR Am J Roentgenol. 1978 Mar;130(3):455-60
Why can it difficult to stay luminally in AI CTO’s?

• Plain fluoroscopy does not show (non–calcified) vessels
• Road mapping to show the target is static and 2-D only it requires repeated acquisition if one moves the gantry

• We could continue to use “The force” .....

Where am I going?
Fusion of new technologies can facilitate crossing complex aorto-iliac CTO’s

Dedicated CTO wires

Fusion Imaging

Re-entry catheters
Fusion imaging

3D mask + fluoroscopy = 3D roadmap

Pre-op CT/MR, Per-op CBCT or rotational angiography

2D/3D registration

Fusion synchronized with the gantry
Creation of a centre line through an iliac CTO
(GE Vision 2 workstation)

GE Discovery 730 hybrid room
HU radio density (0 -60) used to create planning lines (ring targets) on AW workstation of GE Discovery 730
2D/3D registration of fusion using bone mask
Registration of the deep circumflex iliac and inferior epigastric arteries without needing contralateral access
Dedicated CTO wires

- Wire needs to be able to penetrate the fibrous cap
- Good visibility
- Good feedback
- Low friction
- Track around curvatures
- 0.014 “ safer if perforation
- Good tip strength for re-entry
- Stiff enough shaft to advance a exchange catheter then upsize to 0.018” wire for pre-dilatation balloon
- 6- 7 Fr Support sheath over 260 cm 0.035” wire

Cardiology CTO wires can work well in aorto-iliac CTO’s
Fusion mask

- 81 year old
- Ex-smoker
- Claudication 20 – 40 yards
- PMH:
  - CABG
  - CVA
- Ankle pressure 50 mmHg
Crossing the occlusion with a Asahi Confienza Pro 12 0.014" wire and a Cook Van Shie I Beavon tip curved catheter
65 year old female
5 weeks of rest pain left
PMH:
3 year bilateral claudication
BMI 50
Ex-smoker hypertensive
Luminal retrograde wire re-entry guided by fusion

Asahi Confienza 0.014"
Asahi Confienza 12 0.014” CTO wire crossing with fusion (green circle is re-entry target)
Stent graft deployment with renal balloon protection under fusion

- Two 5 Fr USS guided brachial punctures
- 0.018” V18 300 cm
- 6 mm Balloons during the first V12 inflation

Outline view with planning rings
Post procedure CTA
Re-entry catheters and needle use in iliac CTO’s:

- Use reported since 1997
- Custom made, Chiba or TIPS needles
- Outback LTD (now Outback Elite) (Cordis) 2003
- Pioneer plus (Volcano) with IVUS

Re-entry catheter use in iliac CTO’s with conventional imaging

Disadvantages:

- Contralateral or brachial imaging must be available and possible
- The gantry cannot be moved whilst visualising the aorta in real time
- Gives little information about the structure (e.g. calcifications) of the aortic wall at the re-entry point.
- Roadmap images may need repeating when moving from one plane to the other to confirm the orientation
Left iliac CTO
- 82 year old male
- Ex-smoker
- Hypertensive
- 4 years IC
- Recent 2 month rest pain and toe tip necrosis right

Rx: Left iliac stents and CFA EA
Retrograde injection

3 x AtriumV12 stent grafts dilated to 9 mm
Bilateral Outback re-entry no brachial imaging

- 59 yo female
- 50 yards bilateral IC
- Ex-smoker
- COPD
- Heavily calcified

Percutaneous bilateral Stent grafts (AtriumV12)
No re-entry
Outback LTD (Cordis) catheter re-entry

Outline view

Volume view
Bilateral Outback re-entry no brachial imaging

- 61 year old male
- hypothyroid
- 30 / day smoker
- 10 yard bilateral IC
- Aorto-bi-iliac CTO
Bilateral re-entry without brachial imaging
Bilateral re-entry without brachial imaging

6 x AtriumV12 stent grafts dilated to 9 mm
Bilateral EIA CTO and right CFA EA without brachial imaging

45 year old male
Current Smoker
20 yard bilateral claudication

CTA fur Fusion

Re-entry catheter
Fusion

Retrograde imaging
Outback re-entry into CIA after failed re-entry retrograde

Failed luminal crossing attempt left

Successful re-entry with Outback
Antegrade crossing second EIA CTO

Right EIA stent grafts
Outback re-entry with steerable catheter

(No fusion)

- 56-year-old smoker
- bilateral 50 claudication (Fontaine IIb).
- Controlled hypertension and COPD.
TASC D trifurcation occlusion with difficult outback re-entry no CT for Fusion (wrong format for AW workstation)
Failed Outback re-entry

Re-entry close to IMA or thick atheroma
7 Fr TourGuide™ Steerable Sheath Medtronic (arrow) use to advance the Outback catheter subintimally along the ipsilateral distal aorta
Outback and Fusion TACS D

- 67 year old male
- Ex-smoker
- Claudicant short distance

- Right femoral endarterectomy and full length iliac stent
- Unilateral imaging for outback re-entry
Outback re-entry iliac CTO into AAA

AAA thrombus and width prevents conventional antegrade approach
Re-entry at the aortic bifurcation with fusion, Outback and CTO wire

46 year old male

2 year bilateral IC worsening to < 100 yards last 5 month

PMH:
Smoker
Fusion mask
Outback Re-entry use in an occluded aorta requires a CTO wire for re-entry

- Cordis Stabiliser plus wire
- Asahi Confienza Pro 12 CTO wire
Outback crossing with fusion and Asahi Confienza Pro

Bone mask to correct fusion

Right wire Re-entry
Insertion of 8 mm V12 Atrium and Viabahn stent grafts
Follow up CTA

Post-op CTA

Now walking unlimited
Stopped smoking
57 year old male
Neglected, malnourished, LVF, MI, recent PCI

H/o:
Rest pain, large infarct of skin left foot, heal ulcer and exposed Achilles tendon
6 month slow onset

CTA
acute and chronic occlusion of infrarenal aorta
right iliac and left CIA, left SFA and ATA occlusion

Approach:
Right percutaneous left femoral cutdown to control outflow

Veith symposium 2017
Luminal retrograde crossing with Fusion mask Confienza Pro 0.014” left CTO
Left successful re-entry

Right subintimal wire no re-entry
Peri-renal Outback re-entry using fusion and CTO wire
Endovascular aorto-bi-iliac bypass completion CT. Foot ulcer healed but the heel did not recover and required a below knee amputation 5 week post-op
# Results 17  TACS D consecutive cases with Outback (2015 – 2017)

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<td>flush aorto-iliac CTO</td>
<td>AtriumV12Viabahns</td>
<td>GA</td>
<td>femoral cutdown and AI stents</td>
<td>no brachial imaging</td>
<td>none</td>
<td>yes</td>
</tr>
<tr>
<td>69</td>
<td>restpain acute</td>
<td>bilateral</td>
<td>left iliac cto and right eia cto,AAA</td>
<td>AtriumV12Viabahns</td>
<td>GA</td>
<td>femoral EA and iliac stents</td>
<td>contralateral imaging</td>
<td>none</td>
<td>yes</td>
</tr>
<tr>
<td>74</td>
<td>50 yard</td>
<td>left</td>
<td>left iliac CTO</td>
<td>AtriumV12</td>
<td>LA and sed</td>
<td>left iliac stenting</td>
<td>no cl imaging</td>
<td>none</td>
<td>yes</td>
</tr>
</tbody>
</table>
Results in 17 consecutive cases

- 20 Outback re-entries 17 without CL or brachial imaging
- 100 % successful re-entry in target area
- 0% Mortality with follow up to 2 years
- 0 % fusion assisted re-entry complication (e.g. vessel perforations, dissections)
- One iliac CTO late occlusion ? CFA disease
- 96 % patency to date
- Morbidity 35 % (two delayed discharges, one CL iliac embolectomy, 3 additional stent insertions for an extravasation between Atriums, one kissing stent to treat dissection)
Conclusions

• This 2D/3D fusion complex aorto-iliac CTO’s may be treated successfully and safely without CL or brachial imaging and access

• Fusion may provide precise re-entry visualisation of the most suitable segment of the aortic wall in real time

• CTO wires can be used after re-entry into and through a occluded aorta
Thank you