Eur J Vasc Endovasc Surg (2016) ■, 1–8

Iliac Seal Zone Dynamics and Clinical Consequences After Endovascular Aneurysm Repair

F. Bastos Gonçalves [a,b,*,e], N.F. Oliveira [a,c,e], M. Josee van Rijn [a], K.H.J. Ultee [a], S.E. Hoeks [d], S. Ten Raa [a], R.J. Stolker [d], H.J.M. Verhagen [a]

[a] Department of Vascular Surgery, Erasmus University Medical Centre, Rotterdam, The Netherlands
[b] Department of Angiology and Vascular Surgery, Hospital de Santa Marta, Centro Hospitalar de Lisboa Central, Lisbon, Portugal
[c] Department of Angiology and Vascular Surgery, Hospital do Divino Espirito Santo, Ponta Delgada - Azores, Portugal
[d] Department of Anesthesiology, Erasmus University Medical Centre, Rotterdam, The Netherlands

WHAT THIS PAPER ADDS

Failure after EVAR is most often associated with loss of seal and consequent re-pressurisation of the aneurysm sac. This study explores the evolution of the iliac seal zones after implantation, showing that progressive dilatation and retraction are very common occurrences, which in turn have clinical consequences. Careful attention to planning to take full advantage of the potential iliac seal, avoidance of "bell-bottom" limbs whenever possible, and attention to signs of excessive dilatation and/or retraction over the course of follow-up are practical recommendations derived from the conclusions of this study that may improve outcomes.

Objective: To evaluate the dynamics of the iliac attachment zone after EVAR, and the association with clinical events.

Methods: A tertiary institution's prospective EVAR database was searched to identify common iliac arteries at risk. Internally validated measurements were made, using centre lumen line reconstructions. Iliac dilatation and endograft limb retraction were the main endpoints. Associations between dilatation, retraction, oversizing, and distal seal length were investigated. Association with clinical events (sealing or occlusion) was also explored.

Results: Of 452 primary EVAR patients treated from 2004 to 2012, 341 were included (mean age 72 years, 12% female, 597 common iliac arteries). Median follow-up was 4.7 years. At 30 days, the mean iliac diameter increased from 14 mm to 15 mm ($p < .001$). Over follow-up, it increased to 18 mm ($p < .001$). Iliac dilatation $\geq$20% occurred in 295 cases (49.4%) and exceeded the implanted endograft diameter in 170 (28.7%). Limb retraction $\geq$5 mm was identified in 54 patients (9.1%) and was associated with iliac seal complications ($p < 0.001$). Iliac endograft extension diameter $\geq$24 mm (OR 3.3, 95% CI 1.7–6.4) and iliac artery dilatation beyond the endograft (OR 2.1, 95% CI 1.2–3.8) were independent risk factors. Overall, there were 34 (5.7%) iliac seal complications. Retraction of the iliac endograft (OR 1.17 per mm, 95% CI 1.10–1.24) and baseline AAA diameter (1.04 per mm, 95% CI 1.01–1.07) were independent risk factors for seal related complications. Greater initial post-operative iliac seal length was protective (OR 0.94 per mm, 95% CI 0.90–0.97).

Conclusions: Iliac dilatation and endograft retraction are common findings during follow-up, potentially leading to adverse clinical events. Optimisation of the iliac seal zone providing a long distal seal length and added attention to patients with large aneurysms or receiving $\geq$24 mm diameter iliac extensions are recommended. Also, long-term surveillance including CTA is advised to reveal and correct loss of seal at the iliac attachments before adverse clinical events occur.

Article history: Received 24 May 2016, Accepted 3 November 2016, Available online XXX

Keywords: Abdominal (MeSH), Blood vessel prosthesis implantation (MeSH), Iliac artery, Endoleak, Iliac occlusion, Risk factors, Aneurysm

INTRODUCTION

The importance of the iliac seal zones after endovascular aneurysm repair (EVAR) is not completely understood. The true incidence of iliac dilatation and retraction is largely unknown, and the potential consequences — loss of seal or occlusion — are undetermined.

While much attention over the years has focused on the hostile proximal neck, there is a lack of evidence regarding the risk of iliac complications that in turn may account for a

* Corresponding author. Erasmus University Medical Centre, 's-Gravendijkwal 230, 3015 CE Rotterdam, The Netherlands.
E-mail address: f.bastosgoncalves@erasmusmc.nl (F. Bastos Gonçalves).
[e] F. Bastos Gonçalves and N.F. Oliveira contributed equally to this paper.

1078-5884/

http://dx.doi.org/10.1016/j.ejvs.2016.11.003

Please cite this article in press as: Bastos Gonçalves F, et al., Iliac Seal Zone Dynamics and Clinical Consequences After Endovascular Aneurysm Repair, European Journal of Vascular and Endovascular Surgery (2016), http://dx.doi.org/10.1016/j.ejvs.2016.11.003

growing proportion of EVAR related complications. Clarification of the significance and particularities of distal sealing zone dynamics after implantation may help reduce iliac related complications and consequently improve clinical success of EVAR.

There have been publications suggesting that adverse iliac anatomy increases the risk of complications.[1–6] However, difficulties in serial morphological assessment of iliac arteries have resulted in a gap in perception of post-implant iliac changes and possible complications.

This study aimed to identify the dynamics of the distal sealing zone over time and its association with clinical events.

METHODS

Sample

A retrospective study was conducted based on a prospectively kept database of AAA patients treated by EVAR in a single tertiary institution from 2004 to 2012. Inclusion criteria were treatment with an endovascular device with landing zone in the common iliac arteries and surveillance using computed tomography angiography (CTA). Patients with infected or anastomotic aneurysms were excluded from the analysis. Implants with extension to the external iliac artery were not included in the analysis. If a patient had both common and external iliac artery sealing zones, only the common iliac limb was considered.

Measurements

All measurements were performed by two observers trained in image analysis (FBG, NO), after manual centre lumen line (CLL) reconstruction using dedicated post-processing software (3Mensio, Bilthoven, The Netherlands). According to local practice, pre-operative CTA had to be performed no more than 3 months before operation, and the first post-operative CTA was performed within 30 days (typically at day 2 or 3, before hospital discharge). The local surveillance protocol during the study period included annual CTA, although a shift towards more duplex ultrasound based surveillance was noted during the last few years.

To assess iliac dilatation in a standardised fashion, the iliac bifurcation was used as landmark and the iliac diameter measured a fixed distance from this landmark. The first post-operative CTA was used as reference and the iliac diameter was measured 10 mm proximal to the distal edge of the implanted stent graft. The distance to the iliac bifurcation was recorded and the pre-implantation iliac diameter was measured at the same level. Using the same technique, the last available post-operative iliac diameter was obtained (Fig. 1). To assess endograft limb retraction over time, the distance from the most distal portion of the stent graft to the iliac bifurcation was measured at the first and last available exams. Validation of this technique was performed on a random sample of 30 patients. Inter-observer agreement was high (Spearman's Rho 0.969 for iliac diameter and 0.989 for distance from graft to iliac bifurcation, Fig. 2).

Iliac seal length measuring was performed according to previously reported methods.[7] In summary, the length of circumferential apposition between the iliac endograft and the iliac artery wall was measured in a CLL reconstruction (Fig. 3).

Definitions

Iliac dilatation was defined as an increase greater than 2 mm or 10% of the outer to outer iliac diameter. Dilatation

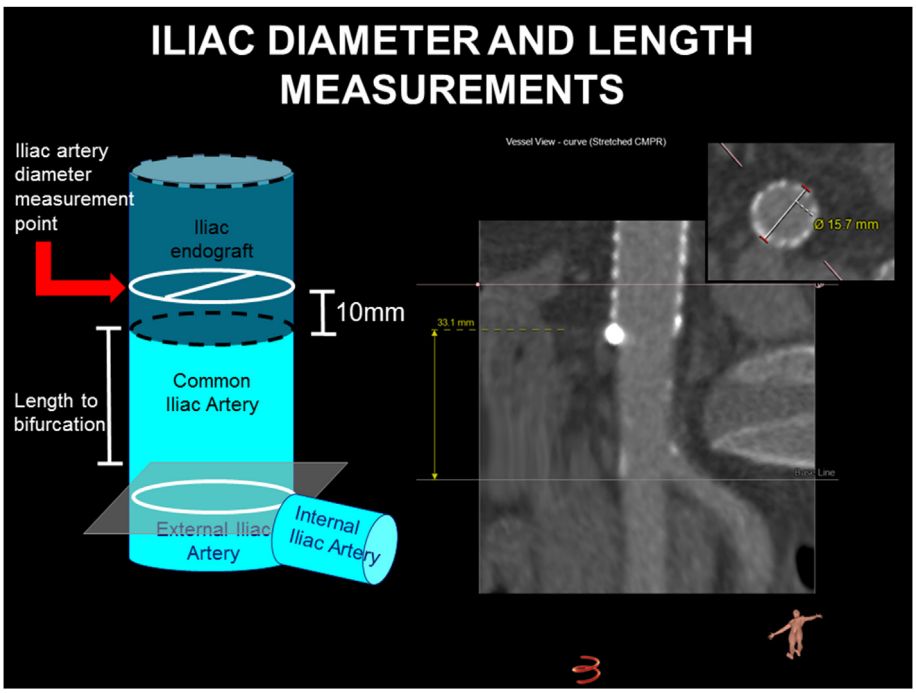

Figure 1. Method for serial length and diameter measurements at the iliac sealing zone.

Please cite this article in press as: Bastos Gonçalves F, et al., Iliac Seal Zone Dynamics and Clinical Consequences After Endovascular Aneurysm Repair, European Journal of Vascular and Endovascular Surgery (2016), http://dx.doi.org/10.1016/j.ejvs.2016.11.003