Effect of Increasing Vessel Tortuosity on EVAR Outcomes
How to Quantitate and Offset It

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Background
Impact of vessel tortuosity
- Technical success
- Limb complications
- Long term outcomes

Methods of Assessment
Clinical judgment
- Caliber
- Calcification
- Tortuosity
- 2/3 problematic, consider alternative
- "Eyeball Test"

Clinical Judgment
Success
- Large caliber, minimal Ca++ - Vessel straightens out

Overcoming Challenges
Conduit – Open or Endovascular

Financial Disclosures
Clinical Events Committee – Lombard Medical
Speakers Bureau – Medtronic
Assessing Vessel Tortuosity

Methods of Assessment

Clinical judgment
“Eyeball Test”
“Good judgment comes from experience, and experience is the result of bad judgment.”

Quantitative methods
Validated models

Tortuosity Indices

PAI - Pelvic Artery Index
CAI - Common Iliac Artery index
DIS - Double Iliac Sign
Visual description of vessel tortuosity

Unfortunately…

Retrospective case control study looking at patients with iliac limb occlusions
Identify limb occlusion and 2 controls (preceding and subsequent case)
Compare baseline demographic data
Quantify iliac tortuosity on preoperative CTA
500 EVAR (all Cook Zenith) from January 2000 to December 2010
17 limb occlusions identified, 34 controls

On multivariate regression analysis, only BMI and DIS were predictive of limb occlusion
Examined primary adjunctive stenting cases
No limb occlusions
Similar rates of iliac tortuosity and extension into the external iliac as the limb occlusion group
DIS is easily defined and reproducible
Predicts limb occlusion
May predict who would benefit from adjunctive stenting
Retrospective, small study, with only one type of endograft
Assessing Vessel Tortuosity
An Artificial Neural Network Stratifies the Risk of Reintervention and Mortality after EVAR

Improve the prediction of endograft complications through the application of machine-learning techniques

Impact of aortic morphology on long-term outcomes is complex
May be well suited to Artificial Neural Network analysis

Artificial Neural Network approach used to predict whether patients would be at low- or high-risk of endograft complications (aortic/ limb) or mortality


Included all cases of EVAR for non-ruptured AAA at 2 centers from 2004 -2010
Preoperative morphology was quantified and endograft complications recorded up to 5 years following surgery
Centre 1 data was used for training and Centre 2 for validation
Performance assessed by Kaplan-Meier analysis in the low-versus high-risk cohorts
low risk group - no complication within five years
high risk group - complication within five years
unknown risk group - died within five years without complication


761 patients, Mean follow-up was 36 + 20 months
Morphological features including angulation/length/areas/diameters/volume/tortuosity of the aneurysm neck/sac/iliac segments


Freedom From Aortic Complications
High Risk vs. Low Risk

Development Dataset Validation Dataset
95.9% vs 67.9% at 5 years (p<0.001)

Freedom From Endograft Limb Complications
High Risk vs. Low Risk

Development Dataset Validation Dataset
99.3% vs 92% at 5 years (p<0.001)
Assessing Vessel Tortuosity

Freedom From All Endograft Complications
High Risk vs. Low Risk

- Development Dataset
- Validation Dataset

96.5% vs 85.6% at 5 years (p<0.001)

Freedom From Mortality
High Risk vs. Low Risk

- Development Dataset
- Validation Dataset

87.9% vs 79.3% at 5 years (p<0.001)

ANN Predictive With Excellent Discrimination Between Low- and High-Risk Group

- Best model required used 19 features of aortic morphology for maximum accuracy
- Compromises ease of use
- Model using 8 predictive features is easier to use but was less discriminatory
- More evidence based approach to patient selection and post-operative surveillance
- Possible to stratify the risk of key long-term outcomes after EVAR based on pre-operative data combined with accurate assessment of aortic morphology

Conclusions

- Validated models useful in predicting outcomes
- Not widely available
- Need to assess the role of device specific factors
- Many of the models don’t address this
- Until models become widely available, there will always be a role for clinical judgment