AVOIDING PITFALLS IN SIZING THE DIAMETER OF ENDOGRRAFTS FOR TEVAR.
THE TIMING OF GATED CT SCANS MATTERS

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DISCLOSURES
PATENTS IN BOLTON AND ST GEORGE

• The high hemodynamic forces in the thoracic aorta place greater mechanical demands on thoracic endografts.
• The potential for device migration, kinking, and late structural failures are important concerns.
• An incidence of endoleaks as high as 29% has been reported after TEVAR.
• Four years after FEVAR migration rate is 21% (JVS October 2015).
• Migration rate after TEVAR to treat Type B dissections is almost universal.

HOW TO SELECT THE DIAMETER OF ENDOGRAFT
• Calipers

Irregular outline
Smooth outline

Non-Gated Scan
Gated Scan
Objective: This study was conducted to determine the differences in the diameter of the thoracic aorta when measured from electrocardiographic (ECG)-gated and nongated computed tomography (CT) angiography.

In addition, we analyzed the difference in diameters when measured in transverse or anteroposterior directions as well as the difference between transverse diameter and the diameter calculated from the area of a circle equal to the lumen area.

This study hypothesizes that measuring the diameter of the aorta at peak systole in ECG-gated CTA will give us its true value at the moment of its greater distension. In addition, diameter should be calculated from the virtual circle created from the area of the aorta.

Methods: The gated and nongated CT angiograms of 27 patients (mean age, 58 ± 6 standard deviation [SD] years) obtained on a 256-slice multidetector CT scanner were used. The transverse and anteroposterior diameters and the lumen areas were measured at 1, 4, and 8 cm below the origin of the left subclavian artery.

Data processing and statistical analysis were performed using Minitab 14 software (Minitab Inc, State College, Pa).

HOW TO SELECT THE DIAMETER OF ENDOGRAFT

Whatever software is used, is indispensable to use reliable information to elaborate with the software.

Diameters perpendicular to the center line are crucial to define the diameter of the device to be used.

Undersizing or excessive oversizing the endografts have deleterious effects such as endoleaks, rupture, dilatation, infolding and migration.

ENDOLEAKS, MIGRATIONS AND INFOLDING


HOW TO SELECT THE DIAMETER OF ENDOGRAFT

- Results: There was a significant difference in the aortic measurements of diameter between gated and nongated scans found in samples taken at 1, 4, and 8 cm distal to the left subclavian artery ($P < .0001$).
- We found a considerable difference between the systolic and diastolic diameters ($P < .0001$).

- Shapes
  - 94%
  - 4%
  - 2%

- Some colleagues take the minimum diameter as the true one, assuming that the cut is not perpendicular to the center line.
- Using methods without rendering the center line have inevitable errors in calculation.

- We studied wall thickness in our 27 cases and it resulted in a great variation, as a result of that, we assumed that the lumen of the aorta and not the outer wall, should be taken for measuring the true diameter.
- Taking the external diameter in cases with increased wall thickness and oversizing it to 20 or 25% could be an erroneous decision since the thicker the wall the more rigid and non distendable is the wall.

- The maximum change in diameter between systole and diastole was:
  - At 1 cm from the subclavian artery
    - $2.9 \pm 0.9$ (SD) (14.5%, $p < .0001$)
  - At 4 cm from the subclavian artery
    - $5.4$ mm (22.6%; median 1.7 mm; $p < .0001$)
  - At 8 cm from the subclavian artery
    - $4.4$ mm (16.9%; median 1.3 mm; $p < .0001$)

- There was a significant difference between the transverse and anteroposterior diameters in systole and diastole at all locations ($P < .0001$).
HOW TO SELECT THE DIAMETER OF ENDOGRAFT

- There was also a substantial difference between measuring the transverse diameter directly and deriving it from the lumen area (p<.0001)
- Calculating the diameter as an average of the maximum and minimum diameters is incorrect.
- Muhs KL, Vincken J van Prehn et al (European Journal of Vascular and Endovascular Surgery 32:5: 532-536, 2006) found very similar results but without using the diameter of a virtual circle constructed with the area obtained.

HOW TO SELECT THE DIAMETER OF ENDOGRAFT

- Conclusions: Our results showed an important difference between Non-gated and systolic and diastolic diameters measurements in ECG-gated scans.
- Conclusions: The standard protocol for measuring aortic diameters in gated scans of the thoracic aorta uses images at end diastole because the lack of wall motion at this time provides better resolution. This is likely to result in undersizing that, in some instances, may threaten stability and the proper seal of the stent graft.

- Conclusions: The dimensions of the aorta in a gated CT should be measured at peak systole rather than the conventional end diastole used today. Most medical centers use nongated CT or gated CT scans in end diastole to calculate sizes of endografts. In view of our findings, the latter method could result in potential complications.