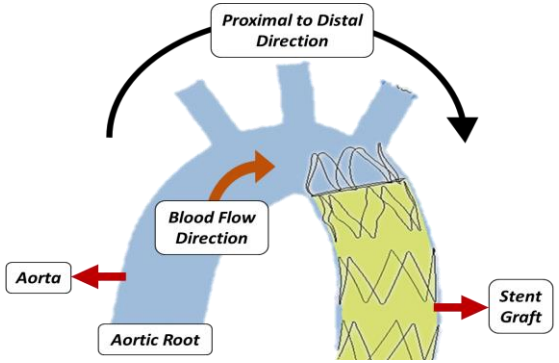
Prediction of Bird-beak Configuration Formation in TEVAR Using Finite Element Simulations

Negin Shahbazian, MASc
Matthew G. Doyle, PhD
Cristina H. Amon, ScD
Thomas L. Forbes, MD

BACKGROUND

- Thoracic endovascular aneurysm repair (TEVAR) is a minimally invasive method to treat thoracic aortic aneurysms (an enlargement of the artery) using a stent graft to isolate the diseased aorta from blood flow.
- Effective seal at the proximal attachment site of the stent graft is critical in TEVAR.
- Bird-beak (BB) configuration, a wedge-shaped gap at the proximal attachment site of the stent graft, can lead to incomplete seal and complications such as type Ia endoleaks.

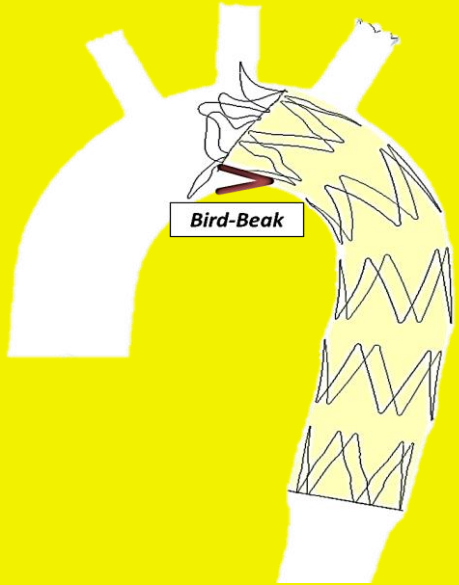


Stent graft deployed in the thoracic aorta in TEVAR

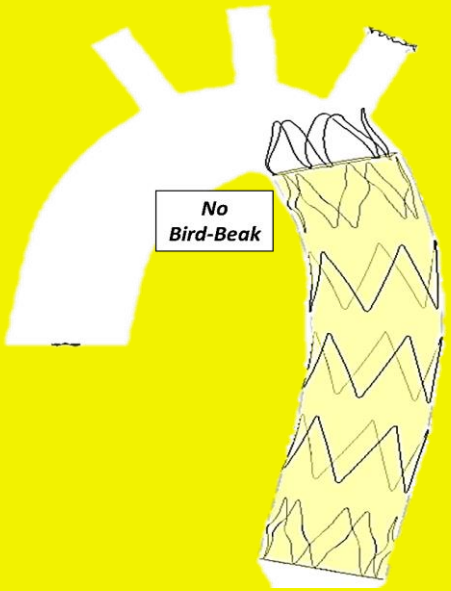
OBJECTIVES

Assess and quantify the impact of stent graft proximal landing position and stent graft design parameters on the occurrence of BB using computation models of TEVAR.

Computational finite element simulations of thoracic endovascular aortic repair (TEVAR) may be useful in **predicting the formation of bird-beak** configuration.



*Simulation image of TEVAR landing **zone 2** **0%** oversized stent graft **with bird-beak***



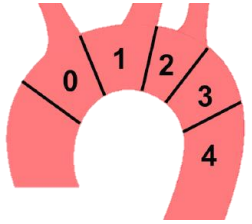
*Simulation image of TEVAR landing **zone 3** **5%** oversized stent graft **without bird-beak***

atoms laboratory

TORONTO VASCULAR

METHODS

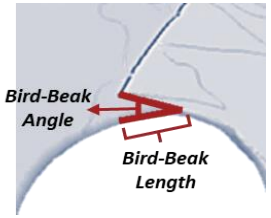
1. Realistic computational models of the aorta and two stent grafts with 0% and 5% oversizing were developed.
2. Stent graft was crimped and placed on the vessel centreline using a guidewire.
3. Stent graft was expanded and deployed in different landing zones along the aorta.
4. The length and angle of the BB were measured.



Definition of TEVAR landing zones

RESULTS

- Direct correlations found between BB length and angle and the proximal landing location of stent graft.
- BB length increased towards the thoracic aorta apex from either direction.
- BB angle decreased moving distally along the aorta.
- Average BB length and angle were smaller in 5% oversizing compared to 0%.



Bird-beak length and angle

DISCUSSION

Finite element simulations of TEVAR may be useful in surgical planning and predicting the risk of BB formation pre-operatively.