Patient-Specific Computer Simulation to Predict Long-Term Outcomes After TAVI

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Aims

Patient-specific computer simulation may predict the development of paravalvular regurgitation (PVR) after transcatheter aortic valve implantation (TAVI). We hypothesized that computer simulation might identify patients at risk for long-term adverse outcomes after TAVI.

Methods and Results

A multi-centre retrospective study was performed on patients with symptomatic severe aortic stenosis who had undergone TAVI with a self-expanding transcatheter heart valve (THV). Pre-procedural cardiac computed tomography imaging was used to create finite element models of the aortic root (Figure 1). Finite element analysis (FEA) was performed in order to simulate the interaction between the THV and the native anatomy. The blood domain was extracted from the FEA output and computational fluid dynamics (CFD) simulation undertaken. Predicted PVR was recorded in the left ventricular outflow tract. Patients were classified into those where computer simulation predicted a favourable clinical outcome (predicted PVR <16.0 mL/s) and those where computer simulation predicted an unfavourable clinical outcome (predicted PVR ≥16.0 mL/s). A total of 105 patients were included in the study. THVs implanted were CoreValve (n=20), Evolut R (n=52) and Evolut PRO (n=33). Post-procedural PVR severity was less in patients who were predicted to have a favourable clinical outcome (P<0.001) (Figure 2). At 2 years, the Kaplan-Meier estimate of the rate of death from any cause was higher in the group where CFD simulation predicted an unfavourable clinical outcome (45.8% vs. 15.4%; hazard ratio, 3.50; 95% confidence interval, 1.49 to 8.25; P=0.002 by log-rank test) (Figure 3).

Conclusion

Computer simulation may identify patients who are at a higher risk for death after TAVI.