Aortic Coarctation Stenting Procedure Assisted by Patient-Specific Models

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Introduction:
Stent therapy is currently considered an effective alternative to surgery for treatment of aortic coarctation. However, procedural complications such as wall dissection and vessel obstruction are associated with multiple stent implantations. In this context, patient-specific models of stenting procedure might help the decision making process by realistically testing different treatments and comparing their outcomes.
In this study, we report the use of patient-specific models to optimise stent implantation in a case of aortic re-coarctation.

Methods:
The patient is a 19-year-old male with native aortic coarctation and aberrant right subclavian artery (aRSCA). A bare stent was used in 2001 to treat the coarctation and subsequently redilated (14mm) in 2007. Four years later, a follow-up catheter examination showed a 15mmHg pressure gradient across the stent. In addition, the angiogram highlighted the presence of an early aneurysm in the proximal portion of the bare stent. A covered stent was evaluated as potential treatment, but the origin of the aRSCA in the distal portion of the bare stent precluded immediate insertion. The patient was sent for computed tomography (CT) examination. CT images were used to print a three-dimensional (3D), transparent, physical model (figure, left) of the patient’s aorta and bare stent using rapid prototyping. In addition, computer analyses (figure, right) were performed to simulate different scenarios of CP stent implantation at diameters varying between 14 and 20mm.

Results:
The rapid prototyping model aided in fully understanding the patient’s implantation site anatomy and the 3D relationship between bare stent, aneurysm and origin of the aRSCA. Outcomes of the computer simulations suggested a maximum expansion diameter of 18mm in order to relieve the stenosis without obstructing the aRSCA. In agreement with the modelling results, the implantation of a 16mm CP covered stent was successfully performed and pressure gradient reduced to 1mmHg with no further obstruction of the origin of the aRSCA.

Conclusions:
A case of re-stenting of aortic coarctation was successfully approached by integrating the results of advanced patient-specific modelling techniques into conventional decision making process. This work suggests the benefits of such a multidisciplinary approach to optimise intervention in patients with congenital heart disease.