Computational haemodynamics in Turner syndrome patient-specific aortae with PC-MRI obtained boundary conditions.

Lauren Johnston[1], Ruth Allen[2], Pauline Hall-Barrientos[2], Avril Mason[2] and Asimina Kazakidi[1]

1: Department of Biomedical Engineering, University of Strathclyde, Glasgow
2: Royal Hospital for Children, Queen Elizabeth University Hospital, Glasgow

Women with Turner syndrome (TS), a chromosomal condition in which a female has complete or partial absence of the second sex chromosome, present a unique group of patients, with an increased risk of cardiovascular disease. Mortality rates are three times higher in TS women compared with the general population, and life expectancy is reduced by up to 13 years – the most common cause of death being from cardiovascular disease. Congenital heart abnormalities occur in up to 50% of TS individuals, with bicuspid aortic valve, coarctation of the aorta, and thoracic aortic aneurysm being the most prevalent. Women with TS also have a greater underlying predisposition to metabolic abnormalities, such as obesity, which can exacerbate coronary artery disease, myocardial infarction, and stroke in TS adults.

In this study, computational fluid dynamic (CFD) methods were used to analyse the arterial blood flow in children with Turner syndrome, who are known to present an increased risk of obesity and cardiovascular disease. Three-dimensional patient geometries were matched with patient-specific boundary conditions in the first unsteady simulation of blood flow in TS children. Morphological aortic differences between patients were found to have a strong effect on the haemodynamic environment and may be a marker for increased cardiovascular risk.