is negligible. We simulated flow through an artery (3 mm diameter) with the presence of a DW situated (i) perfectly centered and aligned (DW_c); and (ii) 0.5 mm from the wall, with a tilted wire tip (last 2 cm at 1.5° tilt; DW_t). Pulsatile flow conditions (mean flow: 215 ml/min, frequency: 60 bpm) were used as input and Newtonian blood properties were assumed (density: 1060 kg/m^3, viscosity: 4 mPas; peak Reynolds number: 546; Womersley number: 1.94). The 'no-slip' condition was imposed on the walls of the vessel and the DW. Simulations are performed with the computational fluid dynamics software package Fluent 6.1. Velocity was assessed in cross-sections every 0.13 mm (range gate step of the Doppler wire) perpendicular and distal to the tip of the DW until 2 cm distal from it. The flow velocities as would be measured by the DW (ultrasound beam opening angle 26°) were compared to the velocities that would exist in absence of the DW (reference), in terms of their relative difference (averaged over time) and this for range gates typically used for measurement, i.e. between 4 mm and 10 mm. In case of DW_c, the measured maximum velocity underestimates the reference velocity. The error decreases from 17.5% (4 mm) to 11.5% (10 mm), and reaches 3.2% at 20 mm. In case of DW_t, the measured velocity overestimates the reference velocity. The relative error remains more or less constant (slight decrease from 4.9% to 4.8%) between 4 and 10 mm, and reaches 1.9% at 20 mm. In conclusion, the influence of the flow wire on VP and measured velocities is not negligible, and DW_c results in higher errors than DW_t when measuring maximum velocity.

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Issues in 3D ultrasound scanning affecting arterial CFD simulation

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Background: Image guided modelling, consisting of 3D ultrasound (US), segmentation and computational fluid dynamics (CFD), can give enhanced diagnostic information about arterial disease. However, numerous issues in 3D US scanning can give rise to inaccuracies in the reconstruction of artery geometries.

Methods: 3D US scans were carried out using Stradwin software [1] with a standard US scanner and optical position sensor. 3D artery geometries were created using registration based segmentation software [2] and imported into CFD software. Visualisations of 3D blood flow and wall shear stress patterns were created.

Results: Segmented 3D artery geometries were created from the 3D US scans. Issues affecting the reconstruction were examined, including

– Gating Problem: variations in gating produce movement between adjacent images. Solution: gate at near end diastole.
– Image spacing Problem: irregular spacing gives a variable reconstruction resolution. Solution: select regularly spaced slices for reconstruction.
– Image registration Problem: true artery shape is lost through probe pressure. Solution: use image registration to correct for deformation.

These issues and their solutions will be explored in more depth.

Conclusions: This study demonstrates the effect of 3D US scanning errors on the reconstruction of 3D artery geometries and their effect on CFD simulation.

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6854 Mo–Tu, no. 57 (P66)

Numerical and experimental study of influence of stenosis shape on flow pattern in distal end-to-side anastomosis

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We present the results of the part of the project and its objective is to optimise the shape of anastomosis (end-to-side), which is used for the bypass, and thus to minimize the negative impact of the flow dynamics on the vascular walls and blood, thanks to which the bypass failure risk can be successfully reduced. The research presented continues the previous research [1,2] and describes flow behind the distal end-to-side bypass junction in dependence on the stenosis shape and stenosis distance from anastomosis by steady conditions both experimentally and numerically.

A number of glass end-to-side bypass models with asymmetry stenosis were made. The bypass connection angle of all models was chosen 45° because of production technology. The stenosis narrowing was 75% (area narrowing). In part of models the stenosis asymmetry narrowing was placed on the floor site and in other models stenosis asymmetry narrowing was placed on the opposite site of bypass floor. The stenosis was placed in the distance of two, four and six diameters from bypass connection.

The flow patterns were obtained from visualization. The flow fields in symmetry plain of model were measured by the Particle Image Velocimetry method. The numerical models were derived from experimental models. 3D flow fields were obtained from numerical solutions. Experimental and numerical results were compared.

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5789 Mo–Tu, no. 58 (P66)

Volumetric particle image velocimetry in the developing chicken heart

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There is evidence that fluid forces regulate the activity of flow-sensitive proteins and modulate gene expression [1]. Blood flow induced wall shear stress is therefore believed to be a key factor in angiogenesis [2], atherogenesis [3], and cardiogenesis [4]. The underlying mechanisms of shear responsiveness can be understood much easier, if the flow induced wall shear stress is measured in vivo [5]. Micro particle image velocimetry has proven to be a suitable instrument for determining the velocity distribution in the heart of a chicken embryo at day three of incubation [6]. The product of the wall normal velocity gradient and the apparent, local, dynamic viscosity yields the wall shear stress.

Latest measurements exhibit a spatial resolution of 4 μm. This is a significant improvement with respect to earlier measurements [6] at a resolution of 40 μm. Volumetric measurements resolve the three dimensional velocity distribution at multiple, parallel planes and allow for the identification of low and high wall shear stress regions. Fluorescent, polystyrene particles of 500 nm diameter are used as flow tracers. A polyethylene glycol coating makes the tracers bio-inert. The shear stress pattern is compared to gene expression patterns.

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Study of diabetes mellitus under the administration of quantitative diet using joslin's principle for various body frames – a mathematical model

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Mathematical analysis is presented to asses type II diabetes mellitus under what conditions the blood sugar concentration may rise above the normal concentration of 90–100 mg per 100 ml of blood (hyperglycemia) and in the unabsorbed glucose appears in the urine(glycosuria). With the administration of quantitative diet for three types of body frames the physiological state of blood viscosity is being calculated using mathematical model. Men aged 25 years, women aged 25 years and the juvenile cases aged $\frac{1}{2}$ year to 20 years have been studied for patho-etiology of cardiovascular diseases. Mathematical model presents to to ascertain the relationship between blood glucose regulation and the administration of quantitative diet under various body frames. From the analytical calculations the comparisons are made between blood glucose of normal subjects to a large carbohydrate meal, hypoglycemic and hyperglycemic, normal blood glucose and dehydration due to increased deposition in the arterial walls (leads to arteriosclerosis). Numerical results using PFC model give the calorie based palatable diet for small [1713–2087] calories, medium [1626–2293] calories and for large [1681–2624] calories body