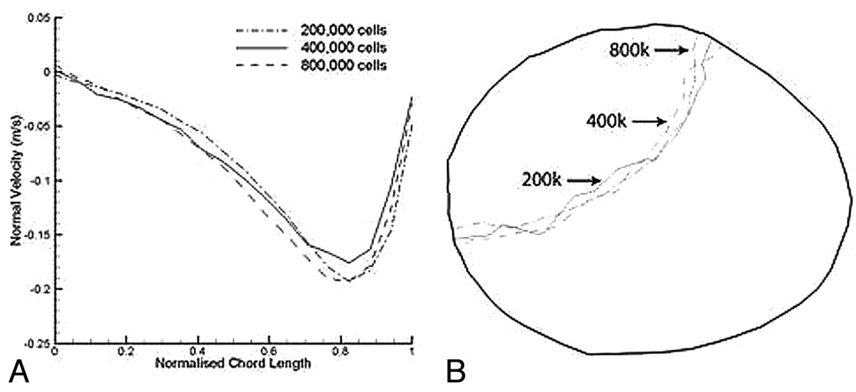
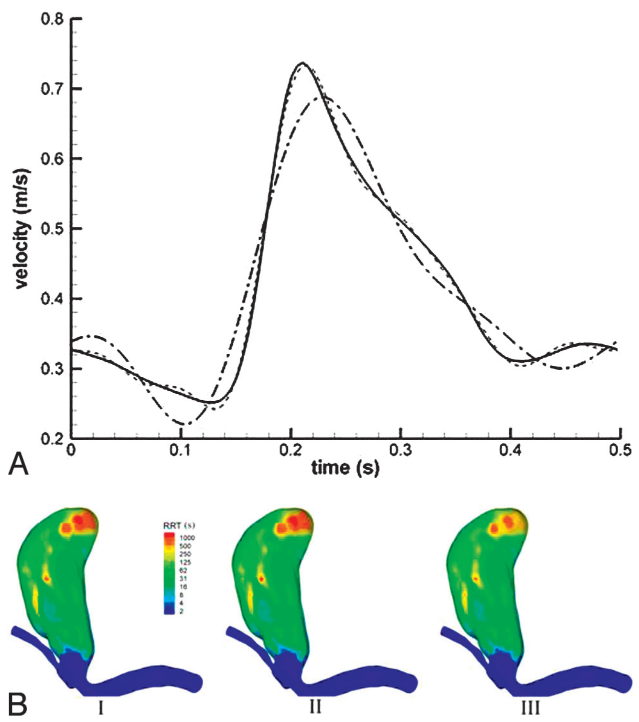
On-line Supplemental Materials

Grid Independence

We assessed the degree to which spatial and temporal discretization specifics affect the numeric solution. The mesh size (number of computational cells) and computational setup were chosen in light of the study of cerebral aneurysms performed by Chatziprodromou et al,[1] which used the same solver as in this article. Temporal discretization was set to 100 time steps per heartbeat. The mesh size is a key determinant of how accurately spatial nonlinearities are captured by the solver. Meshes of 200 k, 400 k, and 800 k cells were examined for the exercise simulation for all aneurysms. In the context of aneurysms, a relevant determinant of intra-aneurysmal flow is the division of the inflow/outflow zones at the



On-line Fig 1. Grid-independence study. *A*, Influence of mesh resolution on the computation of the inflow/outflow region-separating line (zero normal-velocity contour line) on a plane across the neck of aneurysm 1 at peak systole. *B*, Influence of mesh resolution on the computation of normal-velocity profiles along a chord across the neck of aneurysm 1 at peak systole.



On-line Fig 2. *A*, Inlet velocity profiles for Fourier analysis, exercise condition. Solid black line indicates 10 coefficients in the Fourier series; dashed gray line, 6 coefficients; dot-dashed black line, 3 coefficients. *B*, RRT. *I*, Ten Fourier coefficients. *II*, Six Fourier coefficients. III, Three Fourier coefficients.

neck of the aneurysm. As illustrated in on-line Fig 1, there was not a large discrepancy between results on varying computational meshes for aneurysm 1. These measures were examined for the other aneurysms with similar results (data not shown). This stability indicates that the results presented herein and, more important, the trends identified, though of measurable differences, were not significantly affected by the mesh size.

Boundary-Condition Independence

In vivo, there are inherent cycle-to-cycle variations of the velocity profile entering the aneurysm. With this in mind, we decided to investigate whether alterations to the number of coefficients used for the inlet-velocity Fourier series had a significant effect on the flow within the aneurysm. Changing the Fourier coefficients leaves the average flow rate and time period unaffected but changes the accuracy of the approximation with respect to the experimentally observed waveform (on-line Fig 2*A*). RRT was a metric that was particularly sensitive to the change from rest to exercise; however, as can be seen in on-line Fig 2*B*, the change with varying Fourier coefficients is negligible.

Reference

1. Chatziprodromou I, Butty VD, Makhijani VB, et al. **Pulsatile blood flow in anatomically accurate vessels with multiple aneurysms: a medical intervention planning application of computational hemodynamics.** *Flow, Turbulence and Combustion.* 2003;71:333–46