Computational modelling of cell migration in confined environments

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Abstract

Cell migration has gained attention over the last years due to its key role in different physiological and pathological process such as embryonic development and tumour growth [1]. Many researchers have developed studies about what stimulate the cells and the critical point in the cell mobility. In this work, we consider cell migration in microchannels, simulating the exact moment when the cell cross to the veins.

Material and methods

Since the tool for elaborating that is the commercial software ABAQUS, a model with an axisymmetric Walker 256 carcinosarcoma cell [2] with Neo-Hookean hyperelastic material and a rigid tube is described. In order to do that, two different parts are considered in the cell, membrane and nucleus, both clearly identify with different properties and features.

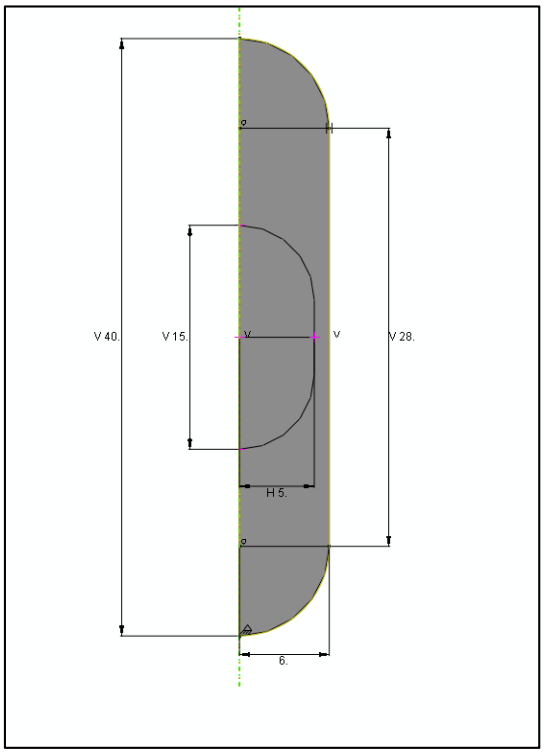

Figure 1: Cell dimensions

Results

As a result of the model presented, we found that not only the fluid drag and friction help to the cellular motion, but internal and biological aspects not developed before like the contraction of myosin [3] and mainly, the protrusion of the actin affect strongly to the cell motility.

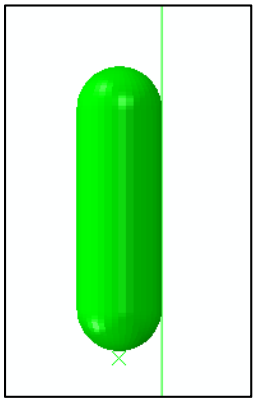

Figure 2: Undeformed cell

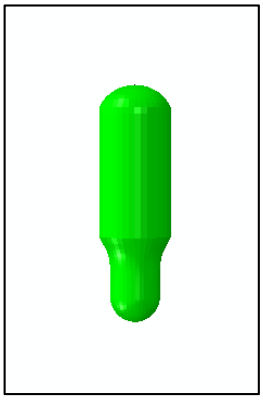

Figure 3: Deformed cell

Conclusions

A mathematical analysis, backed by the numerical simulations of cellular deformation, indicates that polymerization phenomenon and contractility play an important role in enabling cells to modify the external shape and let them moving towards for the migration direction.

References

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