

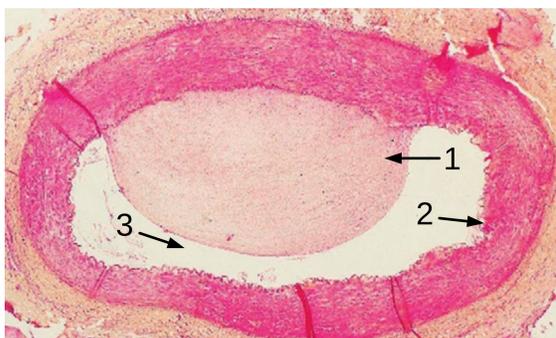
How can we improve the understanding of arterial endofibrosis?

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Context

High level endurance sports may lead to a vascular pathology called endofibrosis. It induces an **arterial wall thickening** and **reduction of the artery lumen caliber**. Cyclists are impacted mostly, but other athletes may be vulnerable like rowers, triathletes, or rugby players [1,2]. Contrary to all other vascular pathologies, endofibrosis affects **young athletes**, from 19 years old [2].

In collaboration with Lyon's Civil Hospices, we develop a numerical modeling of arterial growth under endofibrosis.



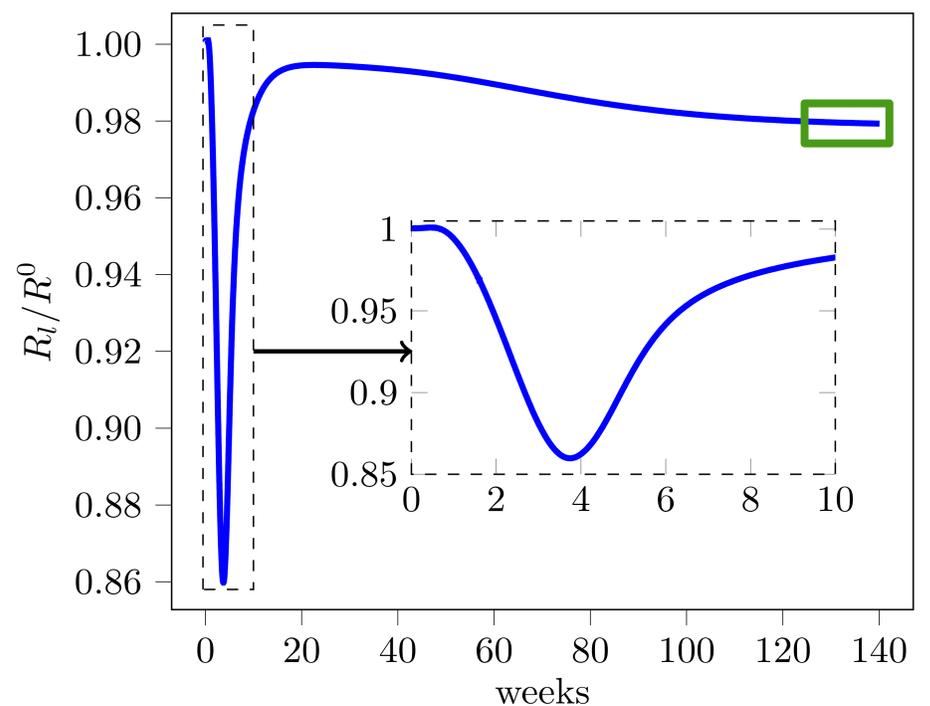
Arterial cut of an endofibrotic lesion [2]:
 (1) **wall thickening**
 (2) normal wall
 (3) **reduced lumen**

Numerical modeling

We propose a phenomenological and multiscale modeling of arterial growth. We loosely couple **hemodynamics** with models of **endofibrotic tissue growth** and **biochemical kinetics**. Blood flow is modeled by Navier-Stokes equations. Based on a previous numerical study [3], we develop a set of ordinary and delay differential equations for biochemical and tissue growth models.

Preliminary results

We experimented our model in a test-case by following the arterial wall dynamic after an **initial damage** as in experimental animal models [4].



Model prediction of **luminal normalized radius narrowing**. The zoom in (- -) shows different phases at short time during the pathology development.

The pathology development is a superposition of **complex biological multiscale processes** which ends by a **steady state regime**. The behavior of our model at short and long timescale is qualitatively consistent with data from the literature [4].

References

- [1] P. Feugier et al. *Endofibrosis of the iliac arteries: an underestimated problem*. Acta chir. Belg, 2004.
- [2] J.M. Chevalier et al. *Pathologie vasculaire du sportif de haut niveau : endofibrose artérielle*. EMC Angéiologie 2012.
- [3] F. Donadoni et al. *Patient-specific, multi-scale modeling of neointimal hyperplasia in vein grafts*. Front. in Phy., 2017.
- [4] A.W. Clowes. *Intimal hyperplasia and graft failure*. Cardiovascular Pathology, 1993.

