On the coupled active and passive mechanical response of the human artery wall

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ABSTRACT

The human artery wall is a complex biological structure whose mechanical response is composed of a passive response coupled to an active response attributed to the vascular smooth muscle cells (SMCs). Experiments on arterial specimens immediately after extraction from a living body should be performed to characterize this complex response.

In this presentation we describe a series of experimental observations on arteries obtained during coronary bypass graft surgeries complemented by experiments on porcine arteries. Several interesting phenomena were observed, i.e. that the artery is slightly compressible [1], and the active response in several cases is hardly noticed.

We postulate that a *compressible* hyper-elastic constitutive model for the passive response coupled to an active contribution allows a realistic representation of the artery wall's mechanical response [2]. The newly proposed *compressible* hyper-elastic constitutive model for the passive response is based on a variant of the strain-energy-density-function (SEDF) [2] augmented by a volumetric part which is neglected in most studies. The active response is manifested by an additional SEDF that is coupled to the passive response because the SMCs contraction depend on the stretch ratio. This new SEDF is incorporated into a high-order FE code and numerical examples will be provided that highlight the influence of slight compressibility and the SMC activation on the mechanical response of the artery [3].

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