EC CARDIOLOGY
Editorial

Vascular Biology and Biomechanics – Meeting Point

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Adoption of endovascular technology was one of the crucial moments in recent history of vascular surgery and was unavoidable adaptation for survival of vascular community. "*It is not the strongest or the most intelligent but the most adaptable species that survives*" said Charles Darwin. Accumulated knowledge and experience of vascular surgeons grown and become useful for design and testing of upcoming devices with consequent improvement of old and development of new therapies. Can vascular physicians go further for the benefits of their patients? If we purely observe blood vessels as a tubes and blood as a fluid than fluid mechanics should be inevitable tool to fathom in to the vascular pathophysiology however, could it be part of vascular surgeons' research, knowledge and clinical practice?

New vascular books are including biomechanics chapters in their contents [1,2]. Individually, some vascular surgeons are part of the multidisciplinary teams with engineers participating and contributing to new scientific achievements and technological innovations. However, biomechanical hypothesis and scientific papers are frequently based on physical laws and mathematical equations and not on biological processes that medical graduates, including vascular physicians, are more familiar with. Unfamiliar language and lack of direct, obvious, connection between the scientific results and clinical applications is detaching biomechanical scientific papers from the focus of vascular community. We are not reading them since we don't understand them. Are we lost in translation?

Early or late collapse of the thoracic stent graft after treatment of blunt aortic trauma is severe complication endangering patient almost as much as the primary lesion does. In the study of Jonker et al authors found that almost half of the collapsed stent grafts were positioned in the aortic arch with small curvature radius [3].

Protrusion of the stent graft in to the aortic arch was recognized as potential mechanical problem that was analyzed by bioengineers and certain mathematical data are now available that will hopefully contribute to construction and testing of new devices for aortic trauma [4-6]. Until then treating physician familiar with these studies will strive to improve positioning of the stent graft during procedure planning or stent graft deployment or carefully detect stent grafts with so inconvenient position during patients follow up. Ongoing research projects are also related to stent grafts implanted in all aortic segments and pathologies with the common goal of prediction of success or potential catastrophic events after implantation. Such investigations are playing important role in the process of stent graft design and testing up to their assorted interactions inside the vasculature [7]. Tools like computational fluid dynamics are used to estimate loads of blood flow on implanted device while computational solid mechanics assess fixation forces produced by implanted stent graft [8]. Similar analysis demonstrated their role in assessing different open vascular reconstructions [9,10]. No matter to fast development of computational and imaging tools vascular physicians are needed to "translate" these tools in to the clinical practice and eventually better devices and treatment results will appear.

More profound understanding of all mechanisms of vascular pathology might contribute not only to improvement of therapeutic measures but also to more exact prediction of disease progression and ultimate complications. Vascular patients are frequently asymptomatic and accurate risk of disease progression and complication for every individual patient is unknown. Numerous former RCT trials assessing asymptomatic patients in the last two decades left us with simplified threshold criteria that guide us in decision making when treating our asymptomatic patients (55 mm diameter, 75% stenosis, etc) [11,12].

Risk of aneurysm rupture was initially explained by Laplace law, claiming that diameter is the best rupture predictor. Fifteen years ago first computational model of abdominal aortic aneurysm and distribution of mechanical forces was published, following with studies showing the highest level of wall stress ("peak wall stress") having significantly better predicting powers [13,14]. Results of the studies in this filed showed that by respecting the maximum diameter criterion we are unnecessary treating one subgroup of patients while others are expose to higher rupture risk by offering them surveillance [15]. Probably the most controversial treatment decision making in the common clinical practice is related to co-morbid patient with abdominal aortic aneurysm of 55 - 65 mm, unsuitable for endovascular repair and high risk for open repair. Knowing exact rupture risk would facilitate our decision in such a scenario. Still determination of levels of peak wall stress is not part of our clinical practice since it needs higher level of evidence validation, education of clinical specialists and their deeper involvement into biomechanics. Naturally, mechanics is only one side of the story [16]. Term "mechanobiology" confirms that, symbolizing importance of interaction between the cells, extracellular matrix and forces they are exposed to but also symbolize necessity for cooperation between engineers and vascular physicians. By using data from in vivo testing computational simulations are capable to calculate mechanical properties of aortic wall tissue and calculate risks of imbalance between wall stress and wall strength [17]. Future will hopefully bring more improvements [18]. Biomechanics is widely used in other aortic and vascular pathologies like carotid disease [19,20].

New adaptation is in front of us. Once vascular surgeons improve their knowledge and understanding in the field of biomechanics, and engineers adjust scientific language to vascular community a more intensive exchange of idea will build papers with closer clinical importance. Softwares that are assessing the risk of aneurysm rupture, atherosclerotic plaque progression or rupture and stent behavior are on the horizon and it is our responsibility to participate in their creation on the columns of science respecting the needs of the real life clinical practice. Common language, intensive cooperation and clinically based biomechanical research might take us to the point of more accurate risk predictions. Such studies could help vascular surgeons to close the Holy Grail: predicting risk and providing decision making based on the individual level. The fact that one of the ten most cited papers published in the EJVES in the period 2010 - 2014 is exactly from this field confirms its' importance and need [21]. Vascular societies and journals should support publishing educational material and scientific papers contributing to edification of vascular community in biomechanics.

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