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# COMPUTATIONAL STUDY ON STENT: FROM MATERIAL TO APPLICATION

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**MINI-SYMPOSIUM PROPOSAL**

**Keywords:** *Stent, Computer aided surgical planning, Biodegradable material, Drug-eluting stent, Mechanical simulation, Computational Fluid Dynamics*

## 1 BACKGROUND

Endovascular stents have revolutionized the treatment of vascular diseases and treatment such as stenosis, aneurysm, dissection, deep vein thrombosis, tracheostenosis, valve replacement and inferior vena cava (IVC) filters, etc. Currently, several approaches for improving stent technology have been conducted, such as drug-eluting stent, surface treatment, coating, and design optimization. However, improvement in clinical outcomes still requires detailed evaluation of the performance of stent biomechanics and the effectiveness as well as safety of biomaterials aiming at optimization of endovascular treatment.

Computational modeling offers an efficient framework and indispensable information for analyzing and understanding the parameters that influence the success of stenting and for investigating in silico multiple “What if?” scenarios using finite element analysis (FEA) and computational fluid dynamics (CFD). In 2011, FDA published a report on priority areas to harness regulatory science. In four of the nine priority areas, computational modeling and simulation (CM&S) was identified as one such tool. The power of CM&S to simulate multiple design parameters and in vivo use conditions, to predict relevant outcomes, and to visualize complex processes can revolutionize the way medical devices are investigated and patient data are utilized. For the next stage of surgical planning, chemical/material/biological issue should be included.

This mini-symposium presents the current knowledge on stent materials, stent biomechanics, stent structure, stent fatigue as well as drug release and mechanisms governing biodegradability focusing on the insights from computational modeling approaches.

## 2 MAIN FEATURES OF THE MINI-SYMPOSIUM

- Considering the state-of-the-art studies of endovascular stent via multi-disciplinary, multi-scale and multi-timespan approaches.
- Focusing on the computational modeling of each approach.
- Aiming at the clinical issues of endovascular stent intervention.

## 3 SCOPE OF MINI-SYMPOSIUM

The general scopes of this mini-symposium are the investigation of the several factors associated with stent performance and clinical outcomes, such as the mechanical and chemical properties of the biomaterial, the design of stent structure, the type of coating components and micro-structure, the drug-elution properties, the type of vascular lesion, the competency of the interventional cardiologist, etc. For example, the scopes of mini-symposium are as follows but not limited to:

- Modeling the material properties and fabrication of bare metal stents (BMS), drug eluting

stents (DES) and biodegradable stents (BDS).

- The role of biomaterials, coatings, and drug-delivery systems, to design and develop more comprehensive multi-physics and multi-disciplinary models.
- The optimization of the structure design and placement of stent devices considering the multi-modal loading of combined bending, torsion, and compression under different implantation conditions.
- Modeling the compatibility of stent with regards to ISR and ST, such as biomechanical behavior, flexibility, high radial strength, durability, and corrosion resistance.
- The modeling of corrosion damage and degradation mechanism for bioresorbable polymer and bioresorbable metallic alloys, and the optimization of combination of materials and properties.
- The customization of dosage and elution kinetics for improving the therapeutic effect and eliminating the side effects, and the control of the corrosion rate of the stent coating influencing both biocompatibility and drug release.
- The in-depth investigation of the local hemodynamics environment after stent deployment, the bioresorption and drug-elution mechanisms, causing drug deposition and distribution in the arterial wall.
- The fundamental interactions between the stent, the balloon, and the arterial tissue and the arterial tissue morphology and remodeling around the struts for prediction of stent safety and efficacy, after stent deployment and at follow-up.
- The advanced and novel imaging modalities, such as intracoronary optical coherence tomography (OCT) and magnetic resonance imaging (MRI), for more realistic computational models of stent intervention.
- The CM&S for developing standards, and protocols to evaluate the safety and the efficacy of stent biomedical products.
- Computational algorisms based on medical big-data and artificial intelligence.

## 4 THE SPEAKERS FOR CALL FOR PAPER

Organizers of the mini-symposium will consider the following recommendations when selecting speakers in the mini-symposium:

- Speakers should be selected for their current research contributions to the chosen topic area.
- Speakers from international research groups are encouraged to present their work.
- Speakers who can provide an overview of the topic area, and bring new ideas for continued research and application are also welcomed.

## 5 PROGRAM PROPOSAL

- At least 9 regular talks will be presented, and each talk may be for 15 min.
- One ‘session keynote’ will be organized, and the keynote will be for 25 min.
- At the end of symposium, 30 minutes of round-table discussion will be arranged which is opened for all participants.

## REFERENCES

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