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Ri.MED RESEARCH SEMINARS 2026

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ENGINEERING IMMUNITY FOR TISSUE REGENERATION
From Bench to Clinic and Back



Anthal Smits, PhD
Associate Professor, Lead of ImmunoRegeneration Group,
Dept. of Biomedical Engineering, Institute for Complex Molecular Systems,
Eindhoven University of Technology (NL).

Host: Antonio D'Amore, PhD

THURSDAY
DEC 03rd
H 9.30 AM
AULA PAGLIARO
ISMETT
Via Ernesto Tricomi, 5
Palermo

Abstract

The host immune response to a medical device can be harmful, leading to fibrotic encapsulation and implant failure. Yet this same response is the body's natural kick-starter for tissue regeneration after injury. Our aim is to develop implants that promote regeneration in situ by steering the host immune response toward pro-regenerative pathways. Using this approach, we have developed resorbable synthetic heart valve and blood vessel replacements. After implantation, these materials trigger an inflammatory response that supports new tissue formation as the implants gradually resorb.

This seminar will trace our journey from preclinical studies to ongoing clinical trials of regenerative pulmonary valves, arteriovenous conduits, and endovascular stents. I will discuss how successes and failures have revealed key challenges to robust clinical application. Our current research investigates the spatio-temporal patterns of inflammation during in situ regeneration and how these patterns may vary among patients. In particular, we study the mechanobiology of macrophages and foreign body giant cells, as well as their interactions with tissue-producing cells and the transient inflammatory niche created by the implant. This knowledge could inform the design of next-generation implants with more predictable and tuneable inflammatory and regenerative responses.

Biosketch

Anthal Smits is Associate Professor of ImmunoRegeneration in the Department of Biomedical Engineering and the Institute for Complex Molecular Systems (ICMS) at Eindhoven University of Technology, The Netherlands. He leads the ImmunoRegeneration Group, which studies how the immune system can be steered to enable in situ tissue regeneration using resorbable biomaterials. The group focuses particularly on macrophages and foreign body giant cells, aiming to understand and control inflammation to promote functional tissue repair.

To achieve this, the group combines advanced human *in vitro* and *in silico* models of inflammation with *in vivo* studies to enable rational implant design. While the primary clinical applications are cardiovascular therapies, including heart valves and blood vessels, the research is curiosity-driven and broadly applicable. Dr. Smits' work contributed to the world's first clinical trials of regenerative heart valves for paediatric patients.

The group's research spans tissue engineering, immunology and mechanobiology. In 2021, Dr. Smits received an ERC Starting Grant for the MACxercise project on macrophage mechanobiology. He is a faculty member in major Dutch research programs, including Materials-Driven Regeneration and DRIVE-RM, which investigate patient variability in biomaterial-driven regeneration. Since 2022, he is an elected board member of the Netherlands Society for Biomaterials and Tissue Engineering.