

Intravascular plasmonic photothermal therapy for atheroregression below Glagov threshold: Results of NANOM-PCI trial

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Background: Intensive therapy with rosuvastatin 40 mg and ApoA-I Milano reduces the total atheroma volume (TAV) up to 6.38 or 14.1 mm³ respectively. Our previous bench studies PLASMONICS and NANOM First-in-Man trial documented TAV reduction up to unprecedented 79.4 and 60.3 mm³ respectively with high level of safety and feasibility.

Methods: The completed randomized two arm (1:1) study (NANOM-PCI) with parallel assignment (n=62) assessed (NCT01436123) the safety and feasibility of the delivery technique for nanoparticles (NP) using micro-injection catheter (with intravascular intramural injection of allogeneous stem cells carrying NP after MSCT-, IVUS- and OCT-guided mapping of the vessel), and plasmonic photothermal therapy of atherosclerosis combined with stenting (Nano group, n=32) versus stenting with Xience V cage (Stenting group, n=30). The primary outcome was TAV at 12 months.

Results: The mean reduction of TAV at 12 months in Nano group was -84.1 mm³ (95% CI: SD 28.3; min -52.4 mm³, max -99.1 mm³; p<0.05) versus +12.4 mm³ in case of stenting (p<0.05 between groups). 42/62 patients (68%) in Nano group passed the Glagov threshold of a 40% plaque burden with mean plaque burden (PB) 36.2% (95% CI: SD 9.3%, min 30.9%, max 44.5%). The increase of the minimal lumen diameter was 61.2 and 63.3% at 12 month follow up in groups respectively. The serial assessment of VH-IVUS showed a significant decrease at 12 months in the dense calcium area, fibrous and fibro-fatty tissue with fulminant necrosis due to thermolysis in Nano-group, whereas an increase of fibrous and fibro-fatty components in stenting arm. We have documented 2 vs 3 cases of the definite thrombosis and 3 vs 5 cases of target lesion revascularization in groups respectively. The analysis of the event-free survival of the ongoing clinical follow-up shows the significantly lower risk of cardiovascular death in Nano group if compare with conventional stenting (93.4% vs 86.7%; p<0.05).

Conclusions: Plasmonic resonance-mediated therapy using noble-metal NP associated with significant regression of coronary atherosclerosis. Tested delivery approach has acceptable safety and efficacy for atheroregression below a 40% PB.

Biography

Kharlamov was born in Yekaterinburg, Russia, received his M.D. cum laude in 2005 from Ural State Medical Academy (Yekaterinburg, Russia). After finishing his internship in therapeutics and general cardiology in 2008 at the Department of Internal Medicine in Ural Institute of Cardiology (mentor-Prof. Jan Gabinsky, Yekaterinburg, Russia) he started as a physician and translational researcher at the Department of Interventional Cardiology, Acute Care Unit, and founded a Department of Science in the Ural Institute of Cardiology working in the field of novel nanobiotechnologies in cardiology. The main research direction of the group now is a RTD of the new multifunctional nanoparticles for plasmonic photothermal therapy and imaging of coronary arteries. The Biotechnology Lab of the Institute is also involved in the growing of the bioengineered on-artery patch structures for the management of atherogenesis. Since 2007 he is working as a Scientific Assistant to C.E.O. Ural Institute of Cardiology and Chief-Cardiologist of the Ural Federal District (Russia) Prof. Jan Gabinsky in the field of international collaboration and innovative development of bio- and nanotechnologies. He has received his Ph.D. in Russia from Ural State Medical Academy in 2011. Since 2009 he has been working as a research fellow in some institutes in the Netherlands, including supervision of Prof. Patrick W. Serruys (Erasmus MC, Rotterdam, The Netherlands). He is an author of more than 55 articles and some grant proposals (NANOPLASTY, REVOLUTION, NIRVANA, REVERIE, DREAM projects) for the European Commission, European Research Council and FP7/CORDIS, and has received for his research work some national and international awards.

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