REDV density gradient on hyaluronic acid-coated PCL film and its influence on selective adhesion and directional migration of endothelial cells

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Selective adhesion and directional migration of endothelial cells (ECs) over smooth muscle cells (SMCs) plays a significant role in the fast endothelialization of blood-contacting implants, in particular for the anti-restenosis of vascular stents. In this study, a uniform cell-resistant layer of methacrylate functionalized hyaluronic acid (HA) was firstly immobilized on the surface of a poly(ε-caprolactone) (PCL) film via polydopamine coupling. Then a density gradient of thiol functionalized Arg-Glu-Asp-Val (REDV) peptide was immobilized onto the HA layer via the thiol-ene click chemistry and a continuous injection method.

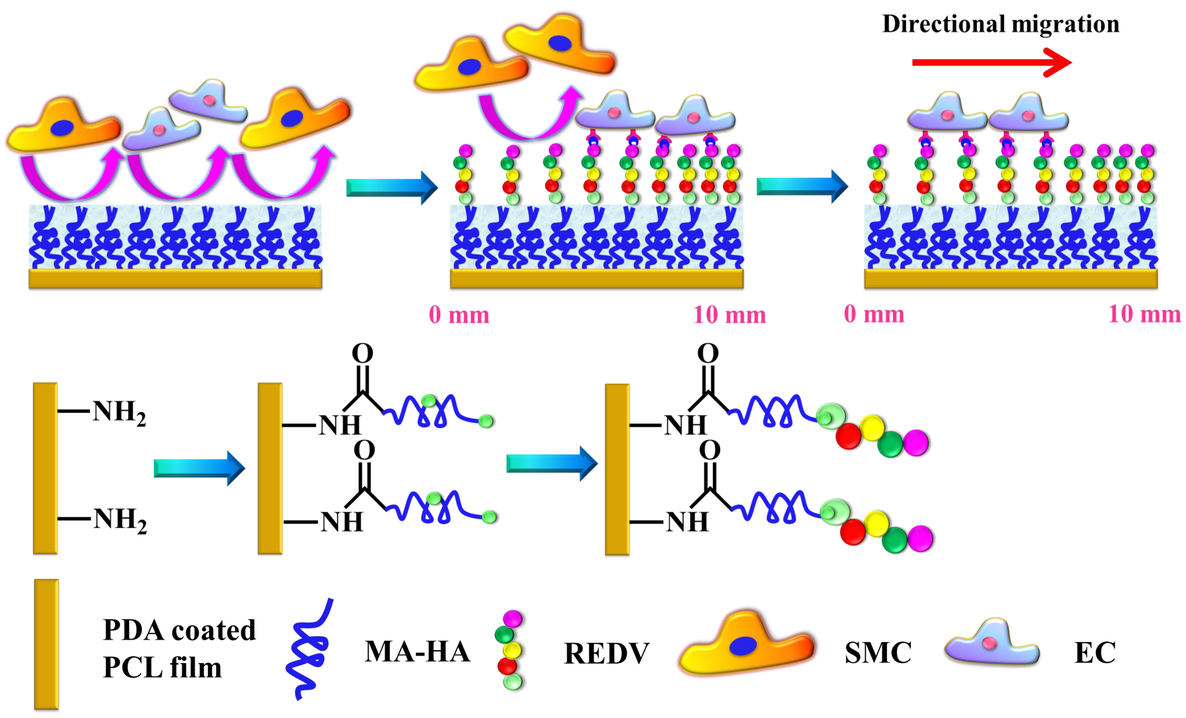

Figure 1. Schematic illustration to show the structure of the ECs selective peptide (REDV) density gradient on a uniform methacrylate anhydride modified hyaluronic acid (MA-HA) layer, which is constructed on the top of polydopamine coated poly(ε-caprolactone) (PCL) films and its influence on the selective adhesion and migration of ECs and SMCs. REDV peptides were grafted onto cell-resistant MA-HA layer through thiol-ene reaction.

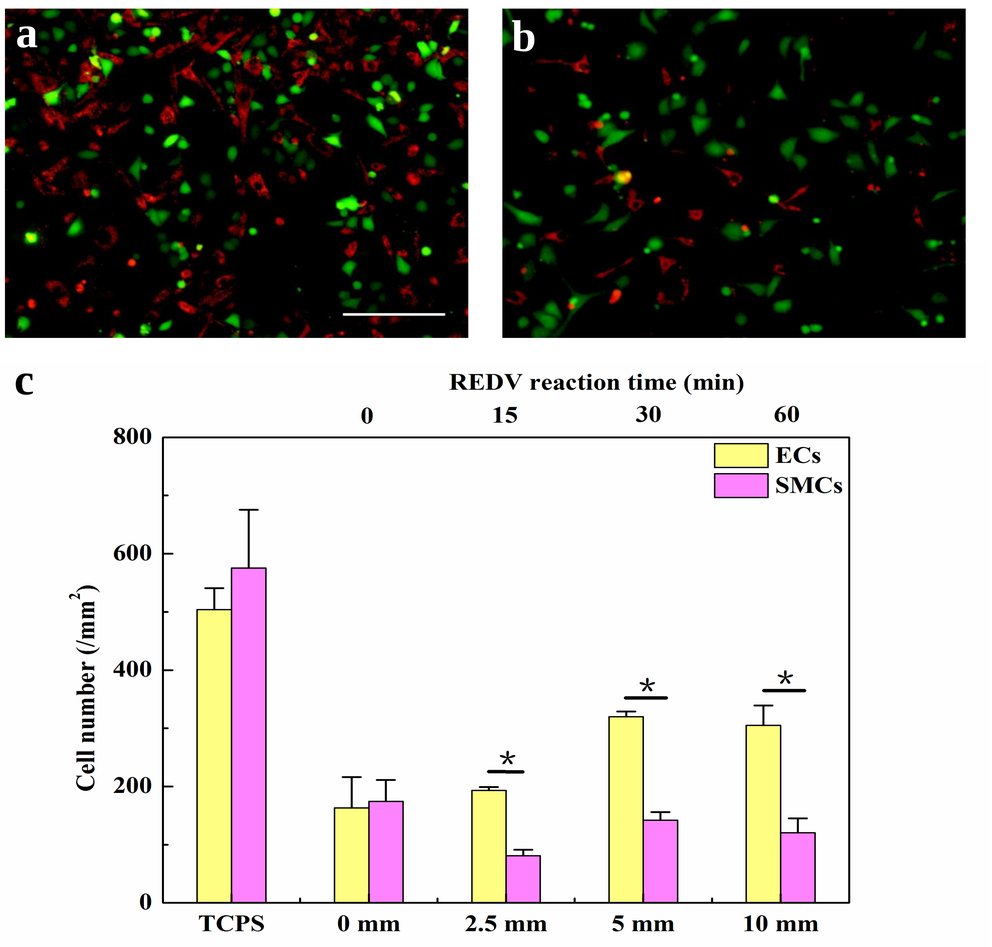

Figure 2. Representative fluorescent images of ECs (green) and SMCs (red) on (a) TCPS, and (b) REDV density gradient surface at 5 mm position. Scale bar is 100 μm. (c) Numbers of ECs and SMCs being cultured for 8 h on TCPS and different positions of REDV density gradient.

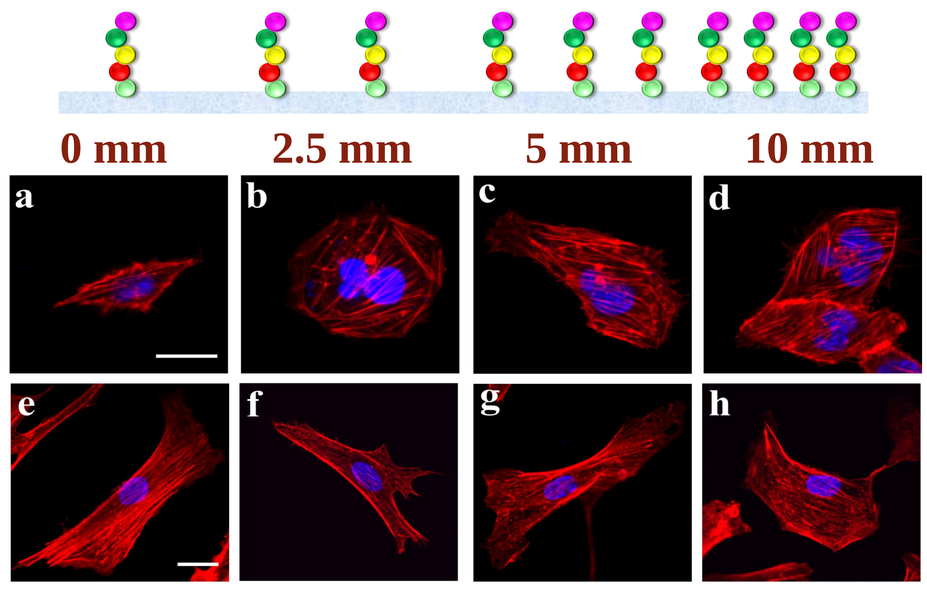

Figure 3. CLSM images of ECs (a-d) and SMCs (e-h) on REDV density gradient at (a,e) 0, (b,f) 2.5, (c,g) 5 and (d,h) 10 mm positions.

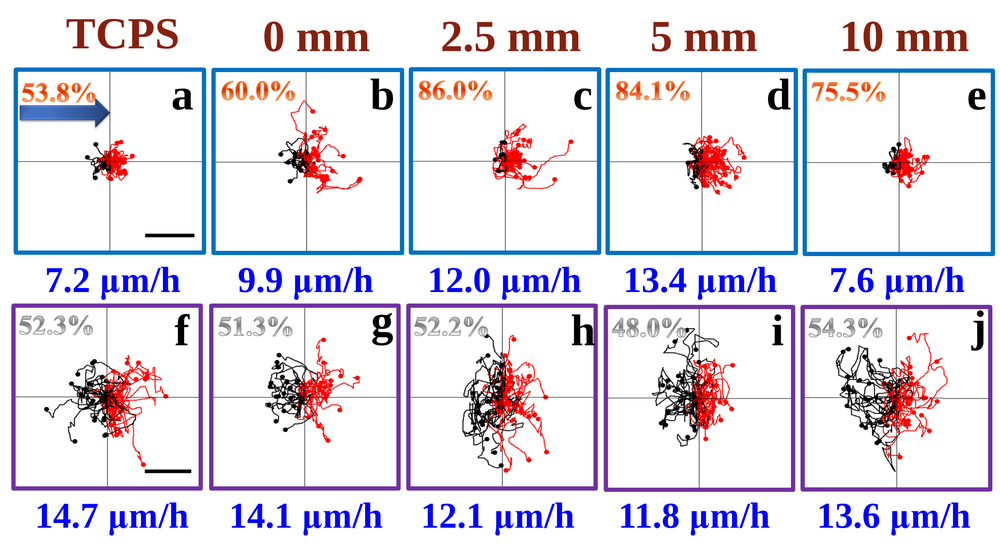

Figure 4. Migration trajectories and rates of ECs (a-e) and SMCs (f-j) on TCPS (a, f), 0 mm (b, g), 2.5 mm (c, h), 5 mm (d, i) and 10 mm (e, j) on REDV density gradient.

Conclusion

The gradient surface selectively enhanced the ECs adhesion, preferential orientation and directional migration. The migration rate of ECs was enhanced to 2-folds compared to that on TCPS. The gradient significantly weakened the adhesion of SMCs to 25% of that on TCPS, but had no obvious impact on the migration rate and directionality of adherent SMCs. The success of the gradient on PCL membrane relies on the appropriate interplay between the cell-resistant HA layer and the cell-specific ligands, enabling the selective guidance of adhesion and migration of ECs.

Acknowledgement

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Reference

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[2] Ren T, Yu S, Mao Z, Gao C. Biomaterials. 2015;56:58-67.