

WHAT IS CLAIMED IS:

1. An *ex vivo* method to maintain, reduce a decrease in or expand capillary
vessel lumen diameter in a re-endothelialized extracellular matrix of a
5 mammalian organ, tissue or portion thereof with an intact vascular bed,
comprising:
 providing a decellularized extracellular matrix of a mammalian organ,
tissue or portion thereof with an intact vascular bed and a population of
endothelial cells or stem or progenitor cells capable of differentiation into
10 endothelial cells; and
 introducing an amount of the cells and a first aqueous solution
comprising an amount of biocompatible microparticles to the decellularized
extracellular matrix, wherein the amount of the cells is effective to re-
endothelialize the vasculature of the decellularized extracellular matrix and
15 wherein the amount of the microparticles when circulated through the
vasculature maintains, reduces a decrease or expands capillary vessel lumen
diameter in the vasculature during or after re-endothelialization relative to a
corresponding re-endothelialized decellularized extracellular matrix that lacks
the microparticles.
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2. The method of claim 1 wherein the microparticles maintain flow through
the capillary beds.
3. The method of claim 1 or 2 wherein the microparticles are biodegradable.
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4. The method of claim 1 or 2 wherein the microparticles are not
biodegradable.
5. The method of any one of claims 1 to 4 wherein the microparticles are
30 spherical or elliptical or are deformable.
6. The method of any one of claims 1 to 5 wherein the microparticles are
formed of polymers.

7. The method of any one of claims 1 to 5 wherein the microparticles comprise alginate, polysaccharide, collagen, dextran, hyaluronic acid, glass, ceramic, metal, poly-lactic acid (PLA), poly-glutamic acid (PGA) or copolymers of PLA and PGA (PLA/PGA) or are magnetic.
- 5 8. The method of any one of claims 1 to 5 wherein the microparticles are modified to include carboxylates, esters, amines, aldehydes, alcohols, or halides.
9. The method of any one of claims 1 to 5 wherein the microparticles are formed of protein and non-protein polymers.
- 10 10. The method of any one of claims 1 to 9 wherein the average diameter of the microparticles is from about 0.5 μm to about 20 μm .
11. The method of any one of claims 1 to 10 wherein the microparticles comprise a hydrophilic surface.
12. The method of any one of claims 1 to 11 wherein the microparticles
15 comprise a surface modification that binds a ligand.
13. The method of claim 1 or 5 wherein the microparticles comprise a hydrogel.
14. The method of any one of claims 1 to 13 wherein the solution is added after re-endothelialization.
- 20 15. The method of any one of claims 1 to 14 further comprising introducing a second aqueous solution comprising biocompatible microparticles having an average diameter that is at least 10% greater than the microparticles in the first solution and optionally further comprising introducing a third aqueous solution comprising biocompatible microparticles having an average diameter that is at
25 least 10% greater than the microparticles in the second solution.
16. The method of any one of claims 1 to 15 wherein the first solution comprises about 300, to about 500,000 microparticles per μL .

17. The method of any one of claims 1 to 15 further comprising washing the vasculature with a solution that lacks the microparticles.
18. The method of claim 17 wherein the solution that lacks the nanoparticles or microparticles comprises an agent that degrades the microparticles.
- 5 19. The method of claim 17 wherein the solution that lacks the nanoparticles or microparticles is applied concurrent with an external factor that degrades or removes the microparticles including temperature, pH, ultrasound, light or electrical energy.
- 10 20. The method of any one of claims 1 to 6, 8, 10 to 12, or 14 to 19 wherein the microparticles comprise polystyrene or polysaccharide.
21. The method of claim 20 wherein the microparticles have an average diameter of about 5 to about 20 microns.
22. The method of any one of claims 1 to 21 wherein the organ is a heart, a pancreas, a bone, a liver, a kidney, or a lung.
- 15 23. The method of any one of claims 1 to 22 wherein the cells are obtained from iPS cells.
24. The method of any one of claims 1 to 23 wherein the population comprises primary cells, human embryonic stem cells, or a plurality of different cell types.
- 20 25. The method of any one of claims 1 to 24 wherein the cells and the perfusion decellularized organ or tissue are allogeneic or xenogenic.

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1. An *ex vivo* method to maintain, reduce a decrease in or expand capillary vessel lumen diameter in a re-endothelialized extracellular matrix of a mammalian organ, tissue or portion thereof with an intact vascular bed, comprising:
 - providing a decellularized extracellular matrix of a mammalian organ, tissue or portion thereof with an intact vascular bed and a population of endothelial cells or stem or progenitor cells capable of differentiation into endothelial cells; and
 - introducing an amount of the cells and a first aqueous solution comprising an amount of biocompatible microparticles to the decellularized extracellular matrix, wherein the amount of the cells is effective to re-endothelialize the vasculature of the decellularized extracellular matrix and wherein the amount of the microparticles when circulated through the vasculature maintains, reduces a decrease or expands capillary vessel lumen diameter in the vasculature during or after re-endothelialization relative to a corresponding re-endothelialized decellularized extracellular matrix that lacks the microparticles.
2. The method of claim 1 wherein the microparticles maintain flow through the capillary beds.
3. The method of claim 1 or 2 wherein the microparticles are biodegradable.
4. The method of claim 1 or 2 wherein the microparticles are not biodegradable.
5. The method of any one of claims 1 to 3 wherein the microparticles are spherical or elliptical or are deformable.
6. The method of any one of claims 1 to 3 wherein the microparticles are formed of polymers.

7. The method of any one of claims 1 to 3 or 5 to 6 wherein the microparticles comprise alginate, polysaccharide, collagen, dextran, hyaluronic acid, poly-lactic acid (PLA), poly-glutamic acid (PGA) or co-polymers of PLA and PGA (PLA/PGA).
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8. The method of any one of claims 1 to 5 wherein the microparticles are modified to include carboxylates, esters, amines, aldehydes, alcohols, or halides.
9. The method of any one of claims 1 to 5 wherein the microparticles are formed of protein and non-protein polymers.
- 10 10. The method of any one of claims 1 to 9 wherein the average diameter of the microparticles is from about 0.5 μm to about 20 μm .
11. The method of any one of claims 1 to 10 wherein the microparticles comprise a hydrophilic surface.
12. The method of any one of claims 1 to 11 wherein the microparticles
- 15 12. The method of any one of claims 1 to 11 wherein the microparticles comprise a surface modification that binds a ligand.
13. The method of claim 1 or 5 wherein the microparticles comprise a hydrogel.
14. The method of any one of claims 1 to 13 wherein the solution is added after re-endothelialization.
- 20 15. The method of any one of claims 1 to 14 further comprising introducing a second aqueous solution comprising biocompatible microparticles having an average diameter that is at least 10% greater than the microparticles in the first solution and optionally further comprising introducing a third aqueous solution comprising biocompatible microparticles having an average diameter that is at
- 25 15. The method of any one of claims 1 to 14 further comprising introducing a second aqueous solution comprising biocompatible microparticles having an average diameter that is at least 10% greater than the microparticles in the second solution.
16. The method of any one of claims 1 to 15 wherein the first solution comprises about 300, to about 500,000 microparticles per μL .

17. The method of any one of claims 1 to 15 further comprising washing the vasculature with a solution that lacks the microparticles.
18. The method of claim 17 wherein the solution that lacks the microparticles comprises an agent that degrades the microparticles.
- 5 19. The method of claim 17 wherein the solution that lacks the microparticles is applied concurrent with an external factor that degrades or removes the microparticles including temperature, pH, ultrasound, light or electrical energy.
20. The method of any one of claims 1 to 6, 8, 10 to 12, or 14 to 19 wherein the microparticles comprise polystyrene or polysaccharide.
- 10 21. The method of claim 20 wherein the microparticles have an average diameter of about 5 to about 20 microns.
22. The method of any one of claims 1 to 21 wherein the organ is a heart, a pancreas, a bone, a liver, a kidney, or a lung.
- 15 23. The method of any one of claims 1 to 22 wherein the cells are obtained from iPS cells.
24. The method of any one of claims 1 to 23 wherein the population comprises primary cells, human embryonic stem cells, or a plurality of different cell types.
- 20 25. The method of any one of claims 1 to 24 wherein the cells and the decellularized organ or tissue are allogeneic or xenogenic.
- 25 26. The method of claim 4 wherein the microparticles are spherical or elliptical or are deformable.
27. The method of any one of claims 4 or 26 wherein the microparticles comprise glass, ceramic, metal, or are magnetic.