CLAIMS

We claim:

1. A pharmaceutical composition for use in the treatment of a disease, condition, or pathologic process characterized by aberrant fibroblast proliferation and extracellular matrix deposition in a tissue of a subject, wherein the pharmaceutical composition comprises a therapeutic amount of a polypeptide of the amino acid sequence YARAAARQARAKALARQLGVAA (SEQ ID NO: 1) or a functional equivalent thereof made from a fusion between a first polypeptide that is a cell penetrating peptide (CPP) selected from the group consisting of a polypeptide of amino acid sequence WLRRIKAWLRRIKA (SEQ ID NO: 12), WLRRIKA (SEQ ID NO: 13), YGRKKRRQRRR (SEQ ID NO: 14), WLRRIKAWLRRI (SEQ ID NO: 15), FAKLAARLYR (SEQ ID NO: 16), KAFAKLAARLYR (SEQ ID NO: 17) and HRRIKAWLKKI (SEQ ID NO: 18), and a second polypeptide that is a therapeutic domain (TD) selected from the group consisting of a polypeptide of amino acid sequence KALARQLAVA (SEQ ID NO: 8), KALARQLGVA (SEQ ID NO: 9), and KALARQLGVAA (SEQ ID NO: 10), and a pharmaceutically acceptable carrier thereof, and wherein the therapeutic amount is effective to reduce the aberrant fibroblast proliferation and extracellular matrix deposition in the tissue of the subject.

2. The pharmaceutical composition according to claim 1, wherein the disease or the condition is acute lung injury (ALI) or acute respiratory distress syndrome (ARDS).

3. The pharmaceutical composition according to claim 1, wherein the disease or the condition is radiation-induced fibrosis.

4. The pharmaceutical composition according to claim 1, wherein the disease or the condition is transplant rejection.

5. The pharmaceutical composition according to claim 1, wherein the tissue is a lung tissue.

6. The pharmaceutical composition according to claim 1, wherein the disease or the condition is an interstitial lung disease.

7. The pharmaceutical composition according to claim 1, wherein the disease or the condition is pulmonary fibrosis.

8. The pharmaceutical composition according to claim 7, wherein the pulmonary fibrosis is idiopathic pulmonary fibrosis.

9. The pharmaceutical composition according to claim 7, wherein the pulmonary fibrosis results from administration of bleomycin.

10. The pharmaceutical composition according to claim 7, wherein the pulmonary fibrosis results from an allergic reaction, inhalation of environmental particulates, smoking, a bacterial infection, a viral infection, mechanical damage to a lung of the subject, lung transplantation rejection, an autoimmune disorder, a genetic disorder, or a combination thereof.

11. The pharmaceutical composition according to claim 1, wherein the disease or the condition is further characterized by an inflammation in the tissue.

12. The pharmaceutical composition according to claim 11, wherein the inflammation is an acute or a chronic inflammation.

13. The pharmaceutical composition according to claim 11, wherein the inflammation is mediated by at least one cytokine selected from the group consisting of Tumor Necrosis Factor-alpha (TNF-α), Interleukin-6 (IL-6), and Interleukin-1β (IL-1β).

14. The pharmaceutical composition according to claim 1, wherein the aberrant fibroblast proliferation and extracellular matrix deposition in the tissue is characterized by an aberrant activity of Mitogen-Activated Protein Kinase-Activated Protein Kinase 2 (MK2) in the tissue compared to the activity of Mitogen-Activated Protein Kinase-Activated Protein Kinase 2 (MK2) in the tissue of a normal healthy control subject.

15. The pharmaceutical composition according to claim 7, wherein the pulmonary fibrosis is characterized by at least one pathology selected from the group consisting of an aberrant deposition of an extracellular matrix protein in a pulmonary interstitium, an aberrant promotion of fibroblast proliferation in the lung, an aberrant induction of myofibroblast differentiation in the lung, and an aberrant promotion of attachment of myofibroblasts to an extracellular matrix compared to a normal healthy control subject.

16. The pharmaceutical composition according to claim 1, wherein the pharmaceutical composition is to be administered intratracheally, parenterally, intravenously, or intraperitoneally.

17. The pharmaceutical composition according to claim 1, wherein the pharmaceutical composition is to be administered intratracheally.

18. The pharmaceutical composition according to claim 1, wherein the pharmaceutical composition further comprises at least one additional therapeutic agent.

19. The pharmaceutical composition according to claim 22, wherein the additional therapeutic agent is selected from the group consisting of a purified bovine Type V collagen, an IL-13 receptor antagonist, a protein tyrosine kinase inhibitor, an endothelial receptor antagonist, a dual endothelin receptor antagonist, a prostacyclin analog, an anti-CTGF monoclonal antibody, an endothelin receptor antagonist (A-selective), AB0024, a lysyl oxidase-like 2 (LOXL2) monoclonal antibody, a c-Jun N-terminal kinase (JNK) inhibitor, pirfenidone, IFN-γ1b, a pan-neutralizing IgG4 human antibody against all three TGF-β isoforms, a TGF-β activation inhibitor, a recombinant human Pentraxin-2 protein (rhPTX-2), a bispecific IL-4/IL-13 antibody, a humanized monoclonal antibody targeting integrin avβ6, N-acetylcysteine, sildenafil, a Tumor Necrosis Factor (TNF) antagonist (etanercept), and a combination thereof.

20. The pharmaceutical composition according to claim 22, wherein the additional therapeutic agent is a glucocorticoid selected from the group consisting of prednisone, budesonide, mometasone furoate, fluticasone propionate, fluticasone furoate, and a combination thereof.

21. The pharmaceutical composition according to claim 22, wherein the additional therapeutic agent is a bronchodilator selected from the group consisting of a leukotriene

modifier, an anticholingertic, bronchodilator, a short-acting β2-agonist, and long-acting β2-agonist, and a combination thereof.

22. The pharmaceutical composition according to claim 22, wherein the additional therapeutic agent is an analgesic agent.

23. The pharmaceutical composition according to claim 22, wherein the additional therapeutic agent is an anti-infective agent.

24. The pharmaceutical composition according to claim 1, wherein the functional equivalent of the polypeptide YARAAARQARAKALARQLGVAA (SEQ ID NO: 1) is of amino acid sequence FAKLAARLYRKALARQLGVAA (SEQ ID NO: 3).

25. The pharmaceutical composition according to claim 1, wherein the functional equivalent of the polypeptide YARAAARQARAKALARQLGVAA (SEQ ID NO: 1) is of amino acid sequence KAFAKLAARLYRKALARQLGVAA (SEQ ID NO: 4).

26. The pharmaceutical composition according to claim 1, wherein the functional equivalent of the polypeptide YARAAARQARAKALARQLGVAA (SEQ ID NO: 1) is of amino acid sequence YARAAARQARAKALARQLAVA (SEQ DI NO: 5).

27. The pharmaceutical composition according to claim 1, wherein the functional equivalent of the polypeptide YARAAARQARAKALARQLGVAA (SEQ ID NO: 1) is of amino acid sequence YARAAARQARAKALARQLGVA (SEQ ID NO: 6).

28. The pharmaceutical composition according to claim 1, wherein the functional equivalent of the polypeptide YARAAARQARAKALARQLGVAA (SEQ ID NO: 1) is of amino acid sequence HRRIKAWLKKIKALARQLGVAA (SEQ ID NO: 7).

29. The pharmaceutical composition according to claim 1, wherein the therapeutic domain (TD) of the functional equivalent of the polypeptide YARAAARQARAKALARQLGVAA (SEQ ID NO: 1) made from the fusion of the first polypeptide that is the cell penetrating peptide (CPP) operatively linked to the second polypeptide that is the therapeutic domain (TD),

~~is a polypeptide whose sequence has a substantial identity to amino acid sequence KALARQLGVAA (SEQ ID NO: 2).~~

~~30. The pharmaceutical composition according to claim 29, wherein the second polypeptide has at least 95 percent sequence identity to amino acid sequence KALARQLGVAA (SEQ ID NO: 2).~~

~~31. The pharmaceutical composition according to claim 29, wherein the second polypeptide is a polypeptide of amino acid sequence KALARQLAVA (SEQ ID NO: 8).~~

~~32. The pharmaceutical composition according to claim 29, wherein the second polypeptide is a polypeptide of amino acid sequence KALARQLGVA (SEQ ID NO: 9).~~

~~33. The pharmaceutical composition according to claim 29, wherein the second polypeptide is a polypeptide of amino acid sequence KALARQLGVAA (SEQ ID NO: 10).~~

~~34. The pharmaceutical composition according to claim 1, wherein the functional equivalent of the polypeptide YARAAARQARAKALARQLGVAA (SEQ ID NO: 1) is a fusion protein comprising a first polypeptide operatively linked to a second polypeptide, wherein the first polypeptide is a cell penetrating peptide functionally equivalent to YARAAARQARA (SEQ ID NO: 11) selected from the group consisting of a polypeptide of amino acid sequence WLRRIKAWLRRIKA (SEQ ID NO: 12), WLRRIKA (SEQ ID NO: 13), YGRKKRRQRRR (SEQ ID NO: 14), WLRRIKAWLRRI (SEQ ID NO: 15), FAKLAARLYR (SEQ ID NO: 16), KAFAKLAARLYR (SEQ ID NO: 17) AND HRRIKAWLKKI (SEQ ID NO: 18), and the second polypeptide is of amino acid sequence KALARQLGVAA (SEQ ID NO: 2).~~

~~35. The pharmaceutical composition according to claim 34, wherein the first polypeptide is a polypeptide of amino acid sequence WLRRIKAWLRRIKA (SEQ ID NO: 12).~~

36. The pharmaceutical composition according to claim 34, wherein the first polypeptide is a polypeptide of amino acid sequence WLRRIKA (SEQ ID NO: 13).

37. The pharmaceutical composition according to claim 34, wherein the first polypeptide is a polypeptide of amino acid sequence YGRKKRRQRRR (SEQ ID NO: 14).

38. The pharmaceutical composition according to claim 34, wherein the first polypeptide is a polypeptide of amino acid sequence WLRRIKAWLRRI (SEQ ID NO: 15).

39. The pharmaceutical composition according to claim 34, wherein the first polypeptide is a polypeptide of amino acid sequence FAKLAARLYR (SEQ ID NO: 16).

40. The pharmaceutical composition according to claim 34, wherein the first polypeptide is a polypeptide of amino acid sequence KAFAKLAARLYR (SEQ ID NO: 17).

41. The pharmaceutical composition according to claim 34, wherein the first polypeptide is a polypeptide of amino acid sequence HRRIKAWLKKI (SEQ ID NO: 18).

42. The pharmaceutical composition according to claim 1, wherein the carrier is selected from the group consisting of a controlled release carrier, a delayed release carrier, a sustained release carrier, and a long-term release carrier.

43. The pharmaceutical composition according to claim 1, wherein the pharmaceutical composition is in a form of a dry powder.

44. The pharmaceutical composition according to claim 43, wherein the dry powder comprises microparticles with Mass Median Aerodynamic Diameter (MMAD) of 1 to 5 microns.

45. The pharmaceutical composition according to claim 1, wherein the therapeutic amount of the pharmaceutical composition is administered via an inhalation device.

46. The pharmaceutical composition according to claim 45, wherein the inhalation device is a nebulizer.

47. The pharmaceutical composition according to claim 45, wherein the inhalation device is a metered-dose inhaler (MDI).

48. The pharmaceutical composition according to claim 45, wherein the inhalation device is a dry powder inhaler (DPI).

~~49. The pharmaceutical composition according to claim 45, wherein the inhalation device is a dry powder nebulizer.~~

CLAIMS

We claim:

~~50~~1. Use of a pharmaceutical composition formulated for intratracheal, parenteral, intravenous, or intraperitoneal delivery, in the manufacture of a medicament for treating a disease, condition, or pathologic process characterized by aberrant fibroblast proliferation and extracellular matrix deposition in a tissue of a subject, wherein the pharmaceutical composition comprises a therapeutic amount of a polypeptide of the amino acid sequence YARAAARQARAKALARQLGVAA (SEQ ID NO: 1) or a functional equivalent thereof made from a fusion between a first polypeptide that is a cell penetrating peptide (CPP) selected from the group consisting of a polypeptide of amino acid sequence WLRRIKAWLRRIKA (SEQ ID NO: 12), WLRRIKA (SEQ ID NO: 13), YGRKKRRQRRR (SEQ ID NO: 14), WLRRIKAWLRRI (SEQ ID NO: 15), FAKLAARLYR (SEQ ID NO: 16), KAFAKLAARLYR (SEQ ID NO: 17) and HRRIKAWLKKI (SEQ ID NO: 18), and a second polypeptide that is a therapeutic domain (TD) selected from the group consisting of a polypeptide of amino acid sequence KALARQLAVA (SEQ ID NO: 8), KALARQLGVA (SEQ ID NO: 9), and KALARQLGVAA (SEQ ID NO: 10), and a pharmaceutically acceptable carrier thereof, wherein the carrier is selected from the group consisting of a controlled release carrier, a delayed release carrier, a sustained release carrier, and a long-term release carrier and wherein the therapeutic amount is effective to reduce the aberrant fibroblast proliferation and extracellular matrix deposition in the tissue of the subject.

~~51~~2. The use according to claim ~~50~~ 1, wherein the disease or the condition is acute lung injury (ALI) or acute respiratory distress syndrome (ARDS).

~~52~~3. The use according to claim ~~50~~1, wherein the disease or the condition is radiation-induced fibrosis.

~~53~~4. The use according to claim ~~50~~1, wherein the disease or the condition is transplant rejection.

~~54~~5. The use according to claim ~~50~~1, wherein the tissue is a lung tissue.

~~55~~6. The use according to claim ~~50~~1, wherein the disease or the condition is an interstitial lung disease.

~~56~~7. The use according to claim ~~50~~1, wherein the disease or the condition is pulmonary fibrosis.

~~57~~8. The use according to claim ~~56~~7, wherein the pulmonary fibrosis is idiopathic pulmonary fibrosis.

~~58~~9. The use according to claim ~~56~~7, wherein the pulmonary fibrosis is caused by administration of bleomycin.

~~59~~10. The use according to claim ~~56~~7, wherein the pulmonary fibrosis results from an allergic reaction, inhalation of environmental particulates, smoking, a bacterial infection, a

viral infection, mechanical damage to a lung of the subject, lung transplantation rejection, an autoimmune disorder, a genetic disorder, or a combination thereof.

~~60~~11. The use according to claim ~~50~~1, wherein the disease or the condition is further characterized by an inflammation in the tissue.

~~61~~12. The use according to claim ~~60~~11, wherein the inflammation is an acute or a chronic inflammation.

~~62~~13. The use according to claim ~~60~~11, wherein the inflammation is mediated by at least one cytokine selected from the group consisting of Tumor Necrosis Factor-alpha (TNF-α), Interleukin-6 (IL-6), and Interleukin-1β (IL-1β).

~~63~~14. The use according to claim ~~50~~1, wherein the aberrant fibroblast proliferation and extracellular matrix deposition in the tissue is characterized by an aberrant activity of Mitogen-Activated Protein Kinase-Activated Protein Kinase 2 (MK2) in the tissue compared to the activity of Mitogen-Activated Protein Kinase-Activated Protein Kinase 2 (MK2) in the tissue of a normal healthy control subject.

~~64~~15. The use according to claim ~~56~~7, wherein the pulmonary fibrosis is characterized by at least one pathology selected from the group consisting of an aberrant deposition of an extracellular matrix protein in a pulmonary interstitium, an aberrant promotion of fibroblast proliferation in the lung, an aberrant induction of myofibroblast differentiation in the lung, and an aberrant promotion of attachment of myofibroblasts to an extracellular matrix compared to a normal healthy control subject.

~~65. The use according to claim 50, wherein the pharmaceutical composition is to be administered intratracheally, parenterally, intravenously, or intraperitoneally.~~

~~66~~16. The use according to claim ~~50~~1, wherein the pharmaceutical composition is to be administered intratracheally.

~~67~~17. The use according to claim ~~50~~1, wherein the pharmaceutical composition further comprises at least one additional therapeutic agent.

~~68~~18. The use according to claim ~~67~~17, wherein the additional therapeutic agent is selected from the group consisting of a purified bovine Type V collagen, an IL-13 receptor antagonist, a protein tyrosine kinase inhibitor, an endothelial receptor antagonist, a dual endothelin receptor antagonist, a prostacyclin analog, an anti-CTGF monoclonal antibody, an endothelin receptor antagonist (A-selective), AB0024, a lysyl oxidase-like 2 (LOXL2) monoclonal antibody, a c-Jun N-terminal kinase (JNK) inhibitor, pirfenidone, IFN-γ1b, a pan-neutralizing IgG4 human antibody against all three TGF-β isoforms, a TGF-β activation inhibitor, a recombinant human Pentraxin-2 protein (rhPTX-2), a bispecific IL-4/IL-13 antibody, a humanized monoclonal antibody targeting integrin avβ6, N-acetylcysteine, sildenafil, a Tumor Necrosis Factor (TNF) antagonist (etanercept), and a combination thereof.

~~69~~19. The use according to claim ~~67~~17, wherein the additional therapeutic agent is a glucocorticoid selected from the group consisting of prednisone, budesonide, mometasone furoate, fluticasone propionate, fluticasone furoate, and a combination thereof.

~~70~~20. The use according to claim ~~67~~17, wherein the additional therapeutic agent is a bronchodilator selected from the group consisting of a leukotriene modifier, an anticholingertic bronchodilator, a short-acting β2-agonist, and long-acting β2-agonist, and a combination thereof.

~~71~~21. The use according to claim ~~67~~17, wherein the additional therapeutic agent is an analgesic agent.

~~72~~22. The use according to claim ~~67~~17, wherein the additional therapeutic agent is an anti-infective agent.

~~73~~23. The use according to claim ~~50~~1, wherein the functional equivalent of the polypeptide YARAAARQARAKALARQLGVAA (SEQ ID NO: 1) is of amino acid sequence FAKLAARLYRKALARQLGVAA (SEQ ID NO: 3).

~~74~~24. The use according to claim ~~50~~1, wherein the functional equivalent of the polypeptide YARAAARQARAKALARQLGVAA (SEQ ID NO: 1) is of amino acid sequence KAFAKLAARLYRKALARQLGVAA (SEQ ID NO: 4).

~~75~~25. The use according to claim ~~50~~1, wherein the functional equivalent of the polypeptide YARAAARQARAKALARQLGVAA (SEQ ID NO: 1) is of amino acid sequence YARAAARQARAKALARQLAVA (SEQ ID NO: 5).

~~76~~26. The use according to claim ~~50~~1, wherein the functional equivalent of the polypeptide YARAAARQARAKALARQLGVAA (SEQ ID NO: 1) is of amino acid sequence YARAAARQARAKALARQLGVA (SEQ ID NO: 6).

~~77~~27. The use according to claim ~~50~~1, wherein the functional equivalent of the polypeptide YARAAARQARAKALARQLGVAA (SEQ ID NO: 1) is of amino acid sequence HRRIKAWLKKIKALARQLGVAA (SEQ ID NO: 7).

~~78~~28. The use according to claim ~~50~~1, wherein the therapeutic domain (TD) of the functional equivalent of the polypeptide YARAAARQARAKALARQLGVAA (SEQ ID NO: 1) made from the fusion of the first polypeptide that is the cell penetrating peptide (CPP) operatively linked to the second polypeptide that is the therapeutic domain (TD), is a polypeptide whose sequence has a substantial identity to amino acid sequence KALARQLGVAA (SEQ ID NO: 2).

~~79~~29. The use according to claim ~~78~~28, wherein the second polypeptide is a polypeptide of amino acid sequence KALARQLAVA (SEQ ID NO: 8).

~~80~~30. The use according to claim ~~78~~28, wherein the second polypeptide is a polypeptide of amino acid sequence KALARQLGVA (SEQ ID NO: 9).

~~81~~31. The use according to claim ~~78~~28, wherein the second polypeptide is a polypeptide of amino acid sequence KALARQLGVAA (SEQ ID NO: 10).

~~82~~32. The use according to claim ~~50~~1, wherein the functional equivalent of the polypeptide YARAAARQARAKALARQLGVAA (SEQ ID NO: 1) is a fusion protein comprising a first polypeptide operatively linked to a second polypeptide, wherein the first polypeptide is a cell penetrating peptide functionally equivalent to YARAAARQARA (SEQ ID NO: 11) selected from the group consisting of a polypeptide of amino acid sequence WLRRIKAWLRRIKA (SEQ ID NO: 12), WLRRIKA (SEQ ID NO: 13), YGRKKRRQRRR (SEQ ID NO: 14), WLRRIKAWLRRI (SEQ ID NO: 15), FAKLAARLYR (SEQ ID NO: 16), KAFAKLAARLYR (SEQ ID NO: 17) AND HRRIKAWLKKI (SEQ ID NO: 18), and the second polypeptide is of amino acid sequence KALARQLGVAA (SEQ ID NO: 2).

~~83~~33. The use according to claim ~~82~~32, wherein the first polypeptide is a polypeptide of amino acid sequence WLRRIKAWLRRIKA (SEQ ID NO: 12).

~~84~~34. The use according to claim ~~82~~32, wherein the first polypeptide is a polypeptide of amino acid sequence WLRRIKA (SEQ ID NO: 13).

~~85~~35. The use according to claim ~~82~~32, wherein the first polypeptide is a polypeptide of amino acid sequence YGRKKRRQRRR (SEQ ID NO: 14).

~~86~~36. The use according to claim ~~82~~32, wherein the first polypeptide is a polypeptide of amino acid sequence WLRRIKAWLRRI (SEQ ID NO: 15).

~~87~~37. The use according to claim ~~82~~32, wherein the first polypeptide is a polypeptide of amino acid sequence FAKLAARLYR (SEQ ID NO: 16).

~~88~~38. The use according to claim ~~82~~32, wherein the first polypeptide is a polypeptide of amino acid sequence KAFAKLAARLYR (SEQ ID NO: 17).

~~89~~39. The use according to claim ~~82~~32, wherein the first polypeptide is a polypeptide of amino acid sequence HRRIKAWLKKI (SEQ ID NO: 18).

~~90. The use according to claim 50, wherein the carrier is selected from the group consisting of a controlled release carrier, a delayed release carrier, a sustained release carrier, and a long-term release carrier.~~

~~91~~40. The use according to claim ~~50~~1, wherein the pharmaceutical composition is in a form of a dry powder.

~~92~~41. The use according to claim ~~91~~40, wherein the dry powder comprises microparticles with Mass Median Aerodynamic Diameter (MMAD) of 1 to 5 microns.

~~93~~42. The use according to claim ~~50~~40, wherein the therapeutic amount of the pharmaceutical composition is administered via an inhalation device.

~~94~~43. The use according to claim ~~93~~42, wherein the inhalation device is a nebulizer.

~~95~~44. The use according to claim ~~93~~42, wherein the inhalation device is a metered-dose inhaler (MDI).

~~96~~45. The use according to claim ~~93~~42, wherein the inhalation device is a dry powder inhaler (DPI).

~~97~~46. The use according to claim ~~93~~42, wherein the inhalation device is a dry powder nebulizer.