## SUMMARY OF THE INVENTION

[0006] In one aspect, the present invention refers to the use of low-anticoagulant heparinoid in manufacture of a medicament for treating or preventing radiation damage in a subject exposed to whole-body radiation. In another aspect, the present invention refers to the use of low-anticoagulant heparinoid in manufacture of a medicament for extending the life of a subject exposed to whole-body radiation. In ~~a first aspect~~one example, methods of treating or preventing radiation damage in a subject exposed to whole-body radiation are presented, comprising administering to a subject exposed to whole-body radiation a therapeutically or prophylactically effective amount of a low-anticoagulant heparinoid. In ~~a second aspect~~another example, methods are presented for extending the life of a subject exposed to whole-body radiation, comprising administering to a subject exposed to whole-body radiation a therapeutically or prophylactically effective amount of a low-anticoagulant heparinoid.

[0007] In certain ~~embodiments~~examples, the low-anticoagulant heparinoid ~~of the invention~~disclosed herein has an average molecular weight of about 8kDa to about 15kDa. The low-anticoagulant heparinoid may be desulfated or substantially desulfated at the 2-O position or the 3-O position. In certain example~~embodiment~~s, the low-anticoagulant heparinoid is desulfated or substantially desulfated at both the 2-O position and the 3-O position. In particular example~~embodiment~~s, the low-anticoagulant heparinoid is ODSH, which is described in greater detail herein below.

[0008] The low-anticoagulant heparinoid may be administered parenterally. In particular example~~embodiment~~s, the low-anticoagulant heparinoid is administered intravenously and/or subcutaneously.

[0009] The low-anticoagulant heparinoid may be administered prior to, and/or during, and/or following exposure to whole-body radiation. In certain example~~embodiment~~s, the subject is administered the low-anticoagulant heparinoid following exposure to whole-body radiation, such as within 60 hours after exposure to whole-body radiation. The subject may be administered the low-anticoagulant heparinoid immediately following, or about 2 hours or more after exposure to whole-body radiation.

[0010] In certain examplecembodiments, a subject is administered the low-anticoagulant heparinoid prior to exposure to whole-body radiation.

[0011] The methods described herein may be used for subjects exposed to whole-body radiation at a dose of about 0.1 Gy/min or greater, such as about 0.5 Gy/min or greater. In certain examplecembodiments, the subject has received a whole-body absorbed dose of radiation about 2 Gy or

greater, such as about 6 Gy or greater or even about 8 Gy or greater. The whole-body radiation of a subject may occur over a time period of about 2 hours or less, such as about 1 hour or less.

[0012] The low-anticoagulant heparinoid may be administered in one or more doses, such as in one dose, two doses or three doses or more. In particular exampleembodiments, the one or more doses are administered after the subject is exposed to whole-body radiation. The one or more doses may be independently selected from about 1 mg/kg to about 40 mg/kg. In particular exampleembodiments, the one or more doses are independently selected from about 10 mg/kg to about 30 mg/kg.

[0013] In certain exampleembodiments, the subject exposed to whole-body radiation has acute radiation syndrome (ARS). The subject exposed to whole-body radiation may display symptoms of hematopoietic, gastrointestinal and/or cerebrovascular syndromes. In certain exampleembodiments, the symptoms include one or more of anemia, infection, bleeding, nausea, vomiting, diarrhea, severe dehydration, sepsis, and petechiae.

[0014] The methods described herein may further comprise administering one or more additional treatments to the subject. In particular, the additional treatment may be selected from one or more of a blood transfusion, antibiotics and a bone marrow transplant.

## BRIEF DESCRIPTION OF THE FIGURES

**[0015]** FIG. 1 provides a graph illustrating the survival of CD2F1 mice after total body irradiation: control group with no post-irradiation treatment (○); 0.1 mL PBS administered subcutaneously at 4 h post-irradiation (□); 0.1 mL PBS administered subcutaneously at 24, 36, and 48 h post-irradiation (△); 0.1 mL 25 mg/kg ODSH administered subcutaneously at 4, 16, and 28 h post-irradiation (■); and 0.1 mL 25 mg/kg ODSH administered subcutaneously at 24, 36, and 48 h post-irradiation (▲).

## DETAILED DESCRIPTION OF THE INVENTION

### *Definitions*

[0016] The phrase "radiation damage" as used herein refers to the health effects which present after exposure to high amounts of ionizing radiation. Examples of radiation damage include, but are not limited to, cell injury, tissue damage, organ dysfunction, acute radiation syndrome, and

We claim:

1. A method of treating or preventing radiation damage in a subject exposed to whole-body radiation, comprising administering to a subject exposed to whole-body radiation a therapeutically or prophylactically effective amount of a low-anticoagulant heparinoid.

2. A method of extending the life of a subject exposed to whole-body radiation, comprising administering to a subject exposed to whole-body radiation a therapeutically or prophylactically effective amount of a low-anticoagulant heparinoid.

3. The method of claim 1 or 2, wherein the low-anticoagulant heparinoid has an average molecular weight of about 8 kDa to about 15 kDa.

4. The method of claim 1 or 2, wherein the low-anticoagulant heparinoid is desulfated or substantially desulfated at the 2-O position or the 3-O position.

5. The method of claim 1 or 2, wherein the low-anticoagulant heparinoid is desulfated or substantially desulfated at the 2-O and 3-O positions.

6. The method of claim 1 or 2, wherein the low-anticoagulant heparinoid is administered parenterally.

7. The method of claim 6, wherein the low-anticoagulant heparinoid is administered intravenously or subcutaneously.

8. The method of claim 1 or 2, wherein the subject is administered the low-anticoagulant heparinoid following exposure to whole-body radiation.

9. The method of claim 8, wherein the subject is administered the low-anticoagulant heparinoid within about 60 hours after exposure to whole-body radiation.

10. The method of claim 8, wherein the subject is administered the low-anticoagulant heparinoid about 2 hours or more after exposure to whole-body radiation.

11. The method of claim 1 or 2, wherein the subject is administered the low-anticoagulant heparinoid prior to exposure to whole-body radiation.

12. The method of claim 1 or 2, wherein the subject is exposed to whole-body radiation at a dose rate of about 0.1 Gy/min or greater.

13. The method of claim 12, wherein the subject is exposed to whole-body radiation at a dose rate of about 0.5 Gy/min or greater.

14. The method of claim 1 or 2, wherein the subject has a whole-body absorbed dose of radiation of about 2 Gy or greater.

15. The method of claim 14, wherein the subject has a whole-body absorbed dose of radiation of about 6 Gy or greater.

16. The method of claim 15, wherein the subject has a whole-body absorbed dose of radiation of about 8 Gy or greater.

17. The method of claim 12, wherein the irradiation of the subject occurs over a time period of about 2 hours or less.

18. The method of claim 17, wherein the irradiation of the subject occurs over a time period of about 1 hour or less.

19. The method of claim 1 or 2, wherein the low-anticoagulant heparinoid is administered in one or more doses.

20. The method of claim 19, wherein the one or more doses are independently selected from about 1 mg/kg to about 40 mg/kg.

21. The method of claim 20, wherein the one or more doses are independently selected from about 10 mg/kg to about 30 mg/kg.

22. The method of claim 1 or 2, wherein the subject exposed to whole-body radiation has acute radiation syndrome.

23. The method of claim 1 or 2, wherein the subject exposed to whole-body radiation displays symptoms of hematopoietic, gastrointestinal and/or cerebrovascular syndromes.

24. The method of claim 23, wherein symptoms include one or more of anemia, infection, bleeding, nausea, vomiting, diarrhea, severe dehydration, sepsis, and petechiae.

25. The method of claim 1 or 2, further comprising administering one or more additional treatments.

26. The method of claim 25, wherein the one or more additional treatments are selected from a blood transfusion, antibiotics and a bone marrow transplant.

27. The method of claim 4, wherein the low-anticoagulant heparinoid is substantially desulfated at the 2-O position.

28. The method of claim 27, wherein the substantially 2-O desulfated heparinoid is at least 85% desulfated at the 2-O position.

29. The method of claim 28, wherein the substantially 2-O desulfated heparinoid is at least 90% desulfated at the 2-O position.

30. The method of claim 29, wherein the substantially 2-O desulfated heparinoid is at least 95% desulfated at the 2-O position.

31. The method of claim 4, wherein the low-anticoagulant heparinoid is substantially desulfated at the 3-O position.

32. The method of claim 31, wherein the substantially 3-O desulfated heparinoid is at least 85% desulfated at the 3-O position.

33. The method of claim 32, wherein the substantially 3-O desulfated heparinoid is at least 90% desulfated at the 3-O position.

34. The method of claim 33, wherein the substantially 3-O desulfated heparinoid is at least 95% desulfated at the 3-O position.

35. The method of claim 5, wherein the substantially 2-O and 3-O desulfated heparinoid is at least 85% desulfated at the 2-O and 3-O positions.

36. The method of claim 35, wherein the substantially 2-O and 3-O desulfated heparinoid is at least 90% desulfated at the 2-O and 3-O positions.

37. The method of claim 36, wherein the substantially 2-O and 3-O desulfated heparinoid is at least 95% desulfated at the 2-O and 3-O positions.

**We claim:**

**1.** Use of low-anticoagulant heparinoid in manufacture of a medicament for treating or preventing radiation damage in a subject exposed to whole-body radiation.

**2.** Use of low-anticoagulant heparinoid in manufacture of a medicament for extending the life of a subject exposed to whole-body radiation.

**3.** The use of claim 1 or 2, wherein unit dosage form of the medicament comprises 1 mg to 1 g of the low-anticoagulant heparinoid.

**4.** The use of claim 1 or 2, wherein the low-anticoagulant heparinoid has an average molecular weight of about 8 kDa to about 15 kDa.

**5.** The use of claim 1 or 2, wherein the low-anticoagulant heparinoid is desulfated or substantially desulfated at the 2-O position or the 3-O position.

**6.** The use of claim 1 or 2, wherein the low-anticoagulant heparinoid is desulfated or substantially desulfated at the 2-O and 3-O positions.

**7.** The use of claim 1 or 2, wherein the low-anticoagulant heparinoid is to be administered parenterally.

**8.** The use of claim 7, wherein the low-anticoagulant heparinoid is to be administered intravenously or subcutaneously.

**9.** The use of claim 1 or 2, wherein the subject is to be administered the low-anticoagulant heparinoid following exposure to whole-body radiation.

**10.** The use of claim 9, wherein the subject is to be administered the low-anticoagulant heparinoid within about 60 hours after exposure to whole-body radiation.

**11.** The use of claim 9, wherein the subject is to be administered the low-anticoagulant heparinoid about 2 hours or more after exposure to whole-body radiation.

**12.** The use of claim 1 or 2, wherein the subject is to be administered the low-anticoagulant heparinoid prior to exposure to whole-body radiation.

**13.** The use of claim 1 or 2, wherein the subject is exposed to whole-body radiation at a dose rate of about 0.1 Gy/min or greater.

**14.** The use of claim 13, wherein the subject is exposed to whole-body radiation at a dose rate of about 0.5 Gy/min or greater.

**15.** The use of claim 1 or 2, wherein the subject has a whole-body absorbed dose of radiation of about 2 Gy or greater.

**16.** The use of claim 15, wherein the subject has a whole-body absorbed dose of radiation of about 6 Gy or greater.

**17.** The use of claim 16, wherein the subject has a whole-body absorbed dose of radiation of about 8 Gy or greater.

**18.** The use of claim 13, wherein the irradiation of the subject occurs over a time period of about 2 hours or less.

**19.** The use of claim 18, wherein the irradiation of the subject occurs over a time period of about 1 hour or less.

**20.** The use of claim 1 or 2, wherein a therapeutically or prophylactically effective amount of a low-anticoagulant heparinoid is to be administered to a subject exposed to whole-body radiation.

**21.** The use of claim 1 or 2, wherein the low-anticoagulant heparinoid is to be administered in one or more doses.

**22.** The use of claim 21, wherein the one or more doses are independently selected from about 1 mg/kg to about 40 mg/kg.

**23.** The use of claim 22, wherein the one or more doses are independently selected from about 10 mg/kg to about 30 mg/kg.

**24.** The use of claim 1 or 2, wherein the subject exposed to whole-body radiation has acute radiation syndrome.

**25.** The use of claim 1 or 2, wherein the subject exposed to whole-body radiation displays symptoms of hematopoietic, gastrointestinal and/or cerebrovascular syndromes.

**26.** The use of claim 25, wherein symptoms include one or more of anemia, infection, bleeding, nausea, vomiting, diarrhea, severe dehydration, sepsis, and petechiae.

**27.** The use of claim 1 or 2, further comprising one or more additional treatments.

**28.** The use of claim 27, wherein the one or more additional treatments are selected from a blood transfusion, antibiotics which are to be administered and a bone marrow transplant.

**29.** The use of claim 5, wherein the low-anticoagulant heparinoid is substantially desulfated at the 2-O position.

**30.** The use of claim 29, wherein the substantially 2-O desulfated heparinoid is at least 85% desulfated at the 2-O position.

**31.** The use of claim 30, wherein the substantially 2-O desulfated heparinoid is at least 90% desulfated at the 2-O position.

**32.** The use of claim 31, wherein the substantially 2-O desulfated heparinoid is at least 95% desulfated at the 2-O position.

**33.** The use of claim 4, wherein the low-anticoagulant heparinoid is substantially desulfated at the 3-O position.

**34.** The use of claim 33, wherein the substantially 3-O desulfated heparinoid is at least 85% desulfated at the 3-O position.

**35.** The use of claim 34, wherein the substantially 3-O desulfated heparinoid is at least 90% desulfated at the 3-O position.

**36.** The use of claim 35, wherein the substantially 3-O desulfated heparinoid is at least 95% desulfated at the 3-O position.

**37.** The use of claim 5, wherein the substantially 2-O and 3-O desulfated heparinoid is at least 85% desulfated at the 2-O and 3-O positions.

**38.** The use of claim 37, wherein the substantially 2-O and 3-O desulfated heparinoid is at least 90% desulfated at the 2-O and 3-O positions.

**39.** The use of claim 38, wherein the substantially 2-O and 3-O desulfated heparinoid is at least 95% desulfated at the 2-O and 3-O positions.