expanding TILs from a fine needle aspirate (FNA) or a core needle biopsy, which contain low numbers of TILs, and using these expanded TILs in treatment methods.

SUMMARY

[0004] The present disclosure provides improved and/or shortened methods for expanding TILs isolated from a fine needle aspirate or a core biopsy and producing therapeutic populations of TILs.
[0004a] In one aspect, the present disclosure refers to a method for expanding tumor infiltrating lymphocytes (TILs) into a therapeutic population of TILs comprising: (i) performing a first expansion by culturing ~~the~~ a first population of TILs obtained from at least one fine needle aspirate (FNA) or at least one small biopsy from a tumor in a cell culture medium comprising IL-2 to produce a second population of TILs, wherein the cell culture medium is ~~optionally~~ supplemented with OKT-3 at any one of days 1-3, wherein the first expansion is performed for ~~about~~ 3 days to ~~about 10~~ 12 days in order to obtain the second population of TILs, wherein the second population of TILs comprises at least 5×10^7 TILs by ~~about~~ 3 days to ~~about~~ 12 days when the first population of TILs is from a small biopsy; and (ii) performing a second expansion by supplementing the cell culture medium of the second population of TILs with additional IL-2, OKT-3, and antigen presenting cells (APCs), to produce a third population of TILs, wherein the third population of TILs is at least 25-fold greater in number than the second population of TILs, and wherein the second expansion is performed for ~~about~~ 3 days to ~~about~~ 12 days in order to obtain the third population of TILs, wherein the third population of TILs is a therapeutic population of TILs.

[0005] In one example, the present disclosure refers to a method for expanding tumor infiltrating lymphocytes (TILs) into a therapeutic population of TILs comprising:

(i) obtaining a first population of TILs from at least one fine needle aspirate (FNA) or at least one small biopsy from a tumor in a patient;

(ii) performing a first expansion by culturing the first population of TILs in a cell culture medium comprising IL-2 to produce a second population of TILs, wherein the cell culture medium is optionally supplemented with OKT-3 at any one of days 1-3, wherein the first expansion is performed for about 3 days to about 10 days in order to obtain the second population of TILs, wherein the second population of TILs comprises at least 5×10^7 TILs by about 3 days to about 12 days when the first population of TILs is from a small biopsy; and

(iii) performing a second expansion by supplementing the cell culture medium of the second population of TILs with additional IL-2, OKT-3, and antigen presenting cells (APCs), to produce a third population of TILs, wherein the third population of TILs is at least 25-fold greater in number than the second population of TILs, and wherein the second expansion is performed for about 3 days to about 12 days in order to obtain the third population of TILs, wherein the third population of TILs is a therapeutic population of TILs.

[0006] In some examples, the cell culture medium comprising IL-2 in step (ii) further comprises OKT-3 and is not optionally supplemented with OKT-3 at any one of days 1-3, and wherein step (i) is a priming first expansion step and step (ii) is a rapid second expansion.

[0007] The method according to claim 1 or 2, wherein after step (iii), the cells are removed from the cell culture and cryopreserved in a storage medium prior to performing step (iv).

[0008] In some examples, the cells are thawed prior to performing step (iv).

population of TILs, wherein the second population of TILs comprises at least 5×10^7 TILs by about 3 days to about 12 days when the first population of TILs is from a small biopsy;

(iii) performing a second expansion by supplementing the cell culture medium of the second population of TILs with additional IL-2, OKT-3, and antigen presenting cells (APCs), to produce a third population of TILs, wherein the third population of TILs is at least 25-fold greater in number than the second population of TILs, and wherein the second expansion is performed for about 3 days to about 12 days in order to obtain the third population of TILs, wherein the third population of TILs is a therapeutic population of TILs; and

(iv) administering a therapeutically effective dosage of the third population of TILs to the patient.

[0054a] In another aspect, the present disclosure refers to use of a therapeutic population of tumor infiltrating lymphocytes (TILs) in the manufacture of a medicament for treating a subject with cancer, wherein the therapeutic population of TILs is obtained from a method comprising:

(i) performing a first expansion by culturing ~~the~~ a first population of TILs obtained from a fine needle aspirate (FNA) or a small biopsy from a tumor in a cell culture medium comprising IL-2 to produce a second population of TILs, wherein the cell culture medium is supplemented with OKT-3 at any one of days 1-3, wherein the first expansion is performed for ~~about~~ 3 days to ~~about~~ 12 days in order to obtain the second population of TILs, wherein the second population of TILs comprises at least 5×10^7 TILs by ~~about~~ 3 days to ~~about~~ 12 days when the first population of TILs is from a small biopsy; and

(ii) performing a second expansion by supplementing the cell culture medium of the second population of TILs with additional IL-2, OKT-3, and antigen presenting cells (APCs), to produce a third population of TILs, wherein the third population of TILs is at least 25-fold greater in number than the second population of TILs, and wherein the second expansion is performed for ~~about~~ 3 days to ~~about~~ 12 days in order to obtain the third population of TILs, wherein the third population of TILs is a therapeutic population of TILs.

second population of TILs with additional IL-2, OKT-3, and antigen presenting cells (APCs), to produce a third population of TILs, wherein the second expansion is performed for about 3 days to about 12 days to obtain the third population of TILs, wherein the third population of TILs is a therapeutic population of TILs, wherein the second expansion is performed in a closed container providing a second gas-permeable surface area, and wherein the transition from step (c) to step (d) occurs without opening the system;

(e) harvesting the therapeutic population of TILs obtained from step (d), wherein the transition from step (d) to step (e) occurs without opening the system; and

(f) transferring the harvested TIL population from step (e) to an infusion bag, wherein the transfer from step (e) to (f) occurs without opening the system;

(g) optionally cryopreserving the infusion bag comprising the harvested TIL population from step (f) using a cryopreservation process; and

(h) administering a therapeutically effective dosage of the third population of TILs from the infusion bag in step (g) to the patient.

[00130a] In another aspect, the present disclosure refers to use of a therapeutic population of tumor infiltrating lymphocytes (TILs) in the manufacture of a medicament for treating a subject with cancer, wherein the therapeutic population of TILs is obtained from a method comprising:
(a) performing, within a closed system, a first expansion by culturing a first population of TILs obtained from a fine needle aspirate (FNA) or a small biopsy from a tumor in a cell culture medium comprising IL-2 to produce a second population of TILs, wherein the cell culture medium is supplemented with OKT-3 at any one of days 1-3, wherein the first expansion is performed for ~~about~~ 3 days to ~~about~~ 12 days in order to obtain the second population of TILs, wherein the second population of TILs comprises at least 5×10^7 TILs by ~~about~~ 3 days to ~~about~~ 12 days when the first population of TILs is from a small biopsy, wherein the first expansion is performed in a closed container providing a first gas-permeable surface area, ~~wherein the first expansion is performed for about 3-14 days to obtain the second population of TILs,~~ wherein the second population of TILs is at least 25-fold greater in number than the first population of TILs; (b) performing, without opening the system, a second expansion by supplementing the cell culture medium of the second population of TILs with additional IL-2, OKT-3, and antigen presenting cells (APCs), to produce a third population of TILs, wherein the second expansion is performed for ~~about~~ 3 days to ~~about~~ 12 days to obtain the third population of TILs, wherein the third population of TILs is a therapeutic population of TILs, wherein the second expansion is performed in a closed container providing a second gas-permeable surface area; (c) harvesting, without opening the system, the therapeutic population of TILs obtained from step (b); and (d) transferring, without opening the system, the harvested TIL population from step (c) to an infusion bag; and (e) optionally cryopreserving the infusion bag comprising the harvested TIL population from step (d) using a cryopreservation process.

[00151] In some examples, the high-dose IL-2 regimen comprises 600,000 or 720,000 IU/kg administered as a 15-minute bolus intravenous infusion every eight hours until tolerance.

[00152] In some examples, the third population of TILs comprises an increased subpopulation of effector T cells and/or central memory T cells relative to the second population of TILs, wherein the effector T cells and/or central memory T cells in the therapeutic population of TILs exhibit one or more characteristics selected from the group consisting of expressing CD27+, expressing CD28+, longer telomeres, increased CD57 expression, and decreased CD56 expression relative to effector T cells, and/or central memory T cells obtained from the second population of cells.

[00153] In some examples, the effector T cells and/or central memory T cells in the therapeutic population of TILs exhibit increased CD57 expression and decreased CD56 expression relative to effector T cells and/or central memory T cells obtained from the second population of cells.

[00153a] In another aspect, the present disclosure refers to a method for expanding tumor infiltrating lymphocytes (TILs) into a therapeutic population of TILs comprising:

(a) performing a priming first expansion by culturing the first population of TILs obtained from a fine needle aspirate (FNA) a small biopsy, or a core biopsy from a tumor in a cell culture medium comprising IL-2, OKT-3, and antigen presenting cells (APCs) to produce a second population of TILs, wherein the priming first expansion is performed for a first period of about 1 to 14 days in a container comprising a first gas-permeable surface area to obtain the second population of TILs, wherein the second population of TILs is greater in number than the first population of TILs;

(b) performing a rapid second expansion by supplementing the cell culture medium of the second population of TILs with additional IL-2, OKT-3, and APCs, to produce a third population of TILs, wherein the rapid second expansion is performed for a second period of about 1 to about 14 days to obtain the third population of TILs, wherein the third population of TILs is a therapeutic population of TILs; and

(c) harvesting the therapeutic population of TILs from step (b).

[00153b] In another aspect, the present disclosure refers to a method for expanding tumor infiltrating lymphocytes (TILs) into a therapeutic population of TILs comprising: (a) performing, within a closed system, a first expansion by culturing ~~the~~ a first population of TILs obtained from a fine needle aspirate (FNA) or a small biopsy from a tumor in a cell culture medium comprising IL-2 to produce a second population of TILs, wherein the cell culture medium is supplemented with OKT-3 at any one of days 1-3, wherein the first expansion is performed for 3 days to 12 days in order to obtain the second population of TILs, wherein the second population of TILs comprises at least 5×10^7 TILs by 3 days to 12 days when the first population of TILs is from a small biopsy, wherein the first expansion is performed in a closed container providing a first gas-permeable surface area, wherein the second population of TILs is at least 25-fold greater in number than the first population of TILs; (b) performing, without opening the system, a second expansion by supplementing the cell culture medium of the second population of TILs with additional IL-2, OKT-3, and antigen presenting cells (APCs), to produce a third population of TILs, wherein the second expansion is performed for 3 days to 12 days to obtain the third population of TILs, wherein the third population of TILs is a therapeutic population of TILs, wherein the second expansion is performed in a closed container providing a second gas-permeable surface area; (c) harvesting, without opening the system, the therapeutic population of TILs obtained from step (b); and (d) transferring, without opening the system, the harvested TIL population from step (c) to an infusion bag.

[00153c] In another aspect, the present disclosure refers to a method for expanding tumor infiltrating lymphocytes (TILs) into a therapeutic population of TILs comprising: (a) performing a priming first expansion by culturing the first population of TILs obtained from a fine needle aspirate (FNA) a small biopsy, or a core biopsy from a tumor in a cell culture medium comprising IL-2, OKT-3, and antigen presenting cells (APCs) to produce a second population of TILs, wherein the priming first expansion is performed for a first period of 1 to 14 days in a container comprising a first gas-permeable surface area to obtain the second population of TILs, wherein the second population of TILs is greater in number than the first population of TILs; (b) performing a rapid second expansion by supplementing the cell culture medium of the second population of TILs with additional IL-2, OKT-3, and APCs, to produce a third population of TILs, wherein the rapid second expansion is performed for a second period of 1 to 14 days to obtain the third population of TILs, wherein the third population of TILs is a therapeutic population of TILs; and (c) harvesting the therapeutic population of TILs from step (b).

[00154] In another aspect, the present disclosure refers to a method for expanding tumor infiltrating lymphocytes (TILs) into a therapeutic population of TILs comprising:

(a) obtaining a first population of TILs from a fine needle aspirate (FNA), a small biopsy, a core biopsy, or a small biopsy from a tumor in a patient;

(b) performing a priming first expansion by culturing the first population of TILs in a cell culture medium comprising IL-2, OKT-3, and antigen presenting cells (APCs) to produce a second population of TILs, wherein the priming first expansion is performed for a first period of about 1 to 14 days in a container comprising a first gas-permeable surface area to obtain the second population of TILs, wherein the second population of TILs is greater in number than the first population of TILs;

(c) performing a rapid second expansion by supplementing the cell culture medium of the second population of TILs with additional IL-2, OKT-3, and APCs, to produce a third population of TILs, wherein the rapid second expansion is performed for a second period of about 1 to about 14 days to obtain the third population of TILs, wherein the third population of TILs is a therapeutic population of TILs; and

(d) harvesting the therapeutic population of TILs from step (c).

[00155] In some examples, the first period is about 6 to 12 days.

WHAT IS CLAIMED IS:

1. A method for expanding tumor infiltrating lymphocytes (TILs) into a therapeutic population of TILs comprising:

(i) performing a first expansion by culturing ~~the~~ a first population of TILs obtained from at least one fine needle aspirate (FNA) or at least one small biopsy from a tumor in a cell culture medium comprising IL-2 to produce a second population of TILs, wherein the cell culture medium is ~~optionally~~ supplemented with OKT-3 at any one of days 1-3, wherein the first expansion is performed for ~~about~~ 3 days to ~~about 10~~ 12 days in order to obtain the second population of TILs, wherein the second population of TILs comprises at least 5×10^7 TILs by ~~about~~ 3 days to ~~about~~ 12 days when the first population of TILs is from a small biopsy; and

(ii) performing a second expansion by supplementing the cell culture medium of the second population of TILs with additional IL-2, OKT-3, and antigen presenting cells (APCs), to produce a third population of TILs, wherein the third population of TILs is at least 25-fold greater in number than the second population of TILs, and wherein the second expansion is performed for ~~about~~ 3 days to ~~about~~ 12 days in order to obtain the third population of TILs, wherein the third population of TILs is a therapeutic population of TILs.

~~2. The method according to claim 1, wherein the cell culture medium comprising IL-2 in step (i) further comprises OKT-3 and is not optionally supplemented with OKT-3 at any one of days 1-3, and wherein step (i) is a priming first expansion step and step (ii) is a rapid second expansion.~~

~~3~~2. The method according to claim 1 ~~or 2~~, wherein after step (ii), the cells are removed from the cell culture and cryopreserved in a storage medium.

~~4~~3. The method according to claim ~~3~~2, wherein the cells are thawed after cryopreservation.

~~5~~4. The method of according to any of the preceding claims, wherein steps (i) and (ii) are performed within a period of ~~about~~ 17 days to ~~about~~ 24 days.

~~6~~5. The method according to any of the preceding claims, wherein steps (i) and (ii) are performed within a period of ~~about~~ 18 days to ~~about~~ 22 days.

~~7~~6. The method according to any of the preceding claims, wherein steps (i) and (ii) are performed within a period of ~~about~~ 20 days to ~~about~~ 22 days.

~~8~~7. The method according to any of the preceding claims, wherein steps (i) and (ii) are performed within ~~about~~ 22 days.

~~9~~8. The method according to ~~claim 1~~any one of claims 1-7, wherein the cell culture medium of step (i) further comprises APCs.

~~9~~10. The method according to any one of claims 1-~~claim 1~~8, wherein the APCs are peripheral blood mononuclear cells (PBMCs).

10~~11~~. The method according to claim ~~10~~9, wherein the PBMCs are added to the cell culture on any of days 3 through 12 in step (i) and/or any of days 11 through 14 in step (ii).

~~12~~11. The method according to any one of claims ~~2~~ 1 to ~~11~~10, wherein the third population of TILs comprises an increased subpopulation of effector T cells and/or central memory T cells relative to the second population of TILs, wherein the effector T cells and/or central memory T cells in the third population of TILs exhibit one or more characteristics selected from the group consisting of expression of CD27, expression of CD28, longer telomeres, increased CD57 expression, and decreased CD56 expression, relative to effector T cells and/or central memory T cells in the second population of cells.

~~13~~12. The method according to claim ~~12~~11, wherein the effector T cells and/or central memory T cells exhibit increased CD57 expression and decreased CD56 expression.

~~14~~13. The method according to any of the preceding claims, wherein the APCs are artificial APCs (aAPCs) or autologous APCs.

~~15~~14. The method according to any of the preceding claims, wherein the therapeutic population of TILs are to be infused into a patient.

~~16~~15. The method according to any one of claims 1-14~~claim 1~~, wherein the first expansion in step ~~(ii)~~ (i) is performed by further supplementing the cell culture medium of the second population of TILs with OKT-3, IL-15, OX40 agonistic antibody and/or 4-1BB agonistic antibody.

~~17~~16. The method according to any one of claims 1-15~~claim 1~~, wherein the second expansion in step ~~(iii)~~(ii) is performed by further supplementing the cell culture medium of the second population of TILs with IL-15, OX40 agonistic antibody and/or 4-1BB agonistic antibody.

~~18~~17. The method according to any one of claims 1-16~~claim 1~~, wherein the FNA in step (i) comprises at least 400,000 TILs.

~~19~~18. The method according to any one of claims 1-16~~claim 1~~, wherein the small biopsy is obtained from a tumor selected from the group consisting of pancreatic, melanoma, breast, and ovarian.

~~20~~19. The method according to any one of claims 1-18~~claim 1~~, wherein the FNA is obtained from a tumor selected from the group consisting of lung, melanoma, head and neck, cervical, ovarian, pancreatic, glioblastoma, colorectal, and sarcoma.

~~21~~20. The method according to claim ~~20~~19, wherein the lung tumor is a non-small cell lung carcinoma (NSCLC), and optionally wherein the patient has previously undergone surgical treatment.

~~22~~21. The method according to any one of claims 1-20~~claim 1~~, wherein the TILs in step (i) are obtained from a FNA.

~~23~~22. The method according to claim 21, wherein the FNA is obtained using a 25-18 gauge needle.

~~24~~23. The method according to any one of claims 1-22~~claim 1~~, wherein the TILs in step (i) are obtained from a small biopsy.

~~25~~24. The method according to claim ~~1~~23, wherein the small biopsy is obtained using a 16-11 gauge needle.

~~26~~25. The method according to any one of claims 1-24~~claim 1~~, wherein step ~~(iii)~~ (ii) is repeated one to four times in order to obtain sufficient TILs in the therapeutic population of TILs for a therapeutically effective dosage of the TILs.

~~27~~26. The method according to claim ~~26~~25, where the number of TILs sufficient for a therapeutically effective dosage is from ~~about~~ 2.3×10^{10} to ~~about~~ 13.7×10^{10}.

27, The method according to any one of claims 1-26, wherein the first expansion is performed for 3 days to 10 days.

~~28. A method for expanding tumor infiltrating lymphocytes (TILs) into a therapeutic population of TILs comprising:~~
~~(i) performing a first expansion by culturing a first population of TILs from a fine needle aspirate (FNA) or a small biopsy from a tumor in a patient in a cell culture medium comprising IL-2 to obtain a second population of TILs, wherein the cell culture medium is supplemented with OKT-3 at any one of days 1-3, wherein the first expansion is performed for about 3 days to about 12 days in order to obtain the second population of TILs, wherein the second population of TILs comprises at least 5×10^{7} TILs by about 3 days to about 12 days when the first population of TILs is from a small biopsy; and~~
~~(ii) performing a second expansion by supplementing the cell culture medium of the second population of TILs with additional IL-2, OKT-3, and antigen presenting cells (APCs) to obtain a third population of TILs, wherein the third population of TILs is at least 25-fold greater in number than the second population of TILs, and wherein the second expansion is performed for about 3 days to about 12 days in order to obtain the third population of TILs, wherein the third population of TILs is a therapeutic population of TILs.~~

~~29. The method according to claim 28, wherein the cell culture medium comprising IL-2 in step (ii) further comprises OKT-3 and is not optionally supplemented with OKT-3 at any one of days 1-3, and wherein step (i) is a priming first expansion step and step (ii) is a rapid second expansion step.~~

30. The method according to claims 28 or 29, wherein the cells from the cell culture medium in step (ii) are removed and cryopreserved in a storage medium.

31. The method according to claim 29, wherein the cells are thawed.

32. The method according to any of claims 28 to 30, wherein the APCs are artificial APCs (aAPCs) or autologous APCs.

33. The method according to any of claims 28 to 31, wherein the therapeutic population of TILs are to be infused into a patient.

34. The method according to claim 28, wherein the first expansion in step (i) is performed by further supplementing the cell culture medium of the second population of TILs with OKT-3, IL-15, OX40 agonistic antibody and/or 4-1BB agonistic antibody.

35. The method according to claim 28, wherein the second expansion in step (ii) is performed by further supplementing the cell culture medium of the second population of TILs with IL-15, OX40 agonistic antibody and/or 4-1BB agonistic antibody.

36. The method according to claim 28, performed by further supplementing the cell culture medium of the third population of TILs with IL-15, OX40 agonistic antibody and/or 4-1BB agonistic antibody.

37. The method according to claim 28, wherein the FNA in step (i) comprises at least 400,000 TILs.

38. The method according to claim 28, wherein the small biopsy is obtained from a tumor selected from the group consisting of pancreatic, melanoma, breast, and ovarian.

39. The method according to claim 28, wherein the FNA is obtained from a tumor selected from the group consisting of lung, melanoma, head and neck, cervical, ovarian, pancreatic, glioblastoma, colorectal, and sarcoma.

40. The method according to claim 39, wherein the lung tumor is a non-small cell lung carcinoma (NSCLC), and optionally wherein the patient has previously undergone surgical treatment.

41. The method according to claim 28, wherein the TILs in step (i) are obtained from a FNA.

42. The method according to claim 28, wherein the FNA is obtained using a 25-18 gauge needle.

43. The method according to claim 28, wherein the TILs in step (i) are obtained from a small biopsy.

44. The method according to claim 28, wherein the small biopsy is obtained using a 16-11 gauge needle.

45. The method according to claim 28, wherein step (ii) is repeated one to four times in order to obtain sufficient TILs in the therapeutic population of TILs for a therapeutically effective dosage of the TILs.

46. The method according to claim 44, where the number of TILs sufficient for a therapeutically effective dosage is from about 2.3×10^{10} to about 13.7×10^{10}.

47. The method according to any of claims 28 to 46, wherein the third population of TILs comprises an increased subpopulation of effector T cells and/or central memory T cells relative to the second population of TILs, wherein the effector T cells and/or central memory T cells exhibit one or more characteristics selected from the group consisting of expression of CD27, expression of CD28, longer telomeres, increased CD57 expression, and decreased CD56 expression, relative to effector T cells and/or central memory T cells in the third population of cells.

48. The method according to claim 47, wherein the effector T cells and/or central memory T cells exhibit increased CD57 expression and decreased CD56 expression.

~~49~~28. Use of a therapeutic population of tumor infiltrating lymphocytes (TILs) in the manufacture of a medicament for treating a subject with cancer, wherein the therapeutic population of TILs is obtained from a method comprising:

(i) performing a first expansion by culturing ~~the~~ a first population of TILs obtained from a fine needle aspirate (FNA) or a small biopsy from a tumor in a cell culture medium comprising IL-2 to produce a second population of TILs, wherein the cell culture medium is supplemented with OKT-3 at any one of days 1-3, wherein the first expansion is performed for ~~about~~ 3 days to ~~about~~ 12 days in order to obtain the second population of TILs, wherein the second population of TILs comprises at least 5×10^7 TILs by ~~about~~ 3 days to ~~about~~ 12 days when the first population of TILs is from a small biopsy; and

(ii) performing a second expansion by supplementing the cell culture medium of the second population of TILs with additional IL-2, OKT-3, and antigen presenting cells (APCs), to produce a third population of TILs, wherein the third population of TILs is at least 25-fold greater in number than the second population of TILs, and wherein the second expansion is performed for ~~about~~ 3 days to ~~about~~ 12 days in order to obtain the third population of TILs, wherein the third population of TILs is a therapeutic population of TILs.

~~50. The use according to claim 49, wherein the cell culture medium comprising IL-2 in step (ii) (i) further comprises OKT-3 and is not optionally supplemented with OKT-3 at any one of days 1-3, and wherein step (i) is a priming first expansion step and step (ii) is a rapid second expansion step.~~

~~51~~29. The use according to claim ~~49~~28, wherein after step (ii) the cells are removed from the cell culture medium and cryopreserved in a storage medium prior to administration of a therapeutically effective dosage of the third population of TILs to the patient.

~~52~~30. The use according to claim ~~49~~29, wherein the cells are thawed prior to administration of a therapeutically effective dosage of the third population of TILs to the patient.

~~53~~31. The use according to ~~claim 49~~any one of claims 28-30, wherein step (ii) is repeated one to four times in order to obtain sufficient TILs in the therapeutic population of TILs for a therapeutically effective dosage of the TILs.

~~54~~32. The use according to any one of claims ~~49~~ 28 to ~~53~~31, wherein the APCs are artificial APCs (aAPCs) or autologous APCs.

~~55~~33. The use according to any one of claims ~~49~~28-32, wherein the first expansion in step (i) is performed by further supplementing the cell culture medium of the second population of TILs with OKT-3, IL-15, OX40 agonistic antibody and/or 4-1BB agonistic antibody.

~~56~~34. The use according to any one of claims ~~49~~28-33, wherein the second expansion in step (ii) is performed by further supplementing the cell culture medium of the second population of TILs with IL-15, OX40 agonistic antibody and/or 4-1BB agonistic antibody.

~~57~~35. The use according to any one of claims ~~49~~28-34, wherein the FNA in step (i) comprises at least 400,000 TILs.

~~58~~36. The use according to any one of claims ~~49~~28-35, wherein the FNA is obtained from a tumor selected from the group consisting of lung, melanoma, head and neck, cervical, ovarian, pancreatic, glioblastoma, colorectal, and sarcoma.

~~59~~37. The use according to claim ~~58~~36, wherein the lung tumor is a non-small cell lung carcinoma (NSCLC), and optionally wherein the subject has previously undergone surgical treatment.

~~60~~38. The use according to any one of claims ~~49~~28-37, wherein the TILs in step (i) are obtained from a FNA.

~~61~~39. The use according to claim ~~49~~38, wherein the FNA is obtained using a 25-18 gauge needle.

~~62~~40. The use according to any one of claims ~~49~~28-39, wherein the TILs in step (i) are obtained from a small biopsy.

~~63~~41. The use according to claim ~~49~~40, wherein the small biopsy is obtained using a 16-11 gauge needle.

~~64~~42. The use according to any one of claims ~~49~~28-41, wherein step (ii) is repeated one to four times in order to obtain sufficient TILs in the therapeutic population of TILs for a therapeutically effective dosage of the TILs.

~~65~~43. The use according to claim ~~64~~42, where the number of TILs sufficient for a therapeutically effective dosage is from ~~about~~ 2.3×10^{10} to ~~about~~ 13.7×10^{10}.

~~66~~44. The use according to any of claims ~~49~~ 28 to ~~65~~43, wherein the third population of TILs comprises an increased subpopulation of effector T cells and/or central memory T cells relative to the second population of TILs, wherein the effector T cells and/or central memory T cells exhibit one or more characteristics selected from the group consisting of expression of CD27, expression of CD28, longer telomeres, increased CD57 expression, and decreased CD56 expression, relative to effector T cells and/or central memory T cells in the third population of cells.

~~67~~45. The use according to claim ~~66~~44, wherein the effector T cells and/or central memory T cells exhibit increased CD57 expression and decreased CD56 expression.

~~68~~46. The use according to any of claims ~~49~~ 28 to ~~67~~45, wherein the cancer is selected from the group consisting of melanoma, cervical cancer, head and neck cancer, glioblastoma, ovarian cancer, sarcoma, pancreatic cancer, bladder cancer, breast cancer, triple negative breast cancer, and non-small cell lung carcinoma.

~~69. Use of a therapeutic population of tumor infiltrating lymphocytes (TILs) in the manufacture of a medicament for treating a subject with cancer, wherein the therapeutic population of TILs is obtained from a method comprising:~~
~~(i) performing a first expansion by culturing a first population of TILs from a fine needle aspirate (FNA) or a small biopsy from a tumor in a patient in a cell culture medium comprising IL-2 to obtain a second population of TILs, wherein the cell culture medium is supplemented with OKT-3 at any one of days 1-3, wherein the first expansion is performed for about 3 days to about 12 days in order to obtain the second population of TILs, wherein the second population of TILs comprises at least 5×10^{7} TILs by about 3 days to about 12 days when the first population of TILs is from a small biopsy; and~~

(ii) performing a second expansion by supplementing the cell culture medium of the second population of TILs with additional IL-2, OKT-3, and antigen presenting cells (APCs) to obtain a third population of TILs, wherein the third population of TILs is at least 25-fold greater in number than the second population of TILs, and wherein the second expansion is performed for about 3 days to about 12 days in order to obtain the third population of TILs, wherein the third population of TILs is a therapeutic population of TILs.

70. The use according to claim 69, wherein the cell culture medium comprising IL-2 in step (ii) further comprises OKT-3 and is not optionally supplemented with OKT-3 at any one of days 1-3, and wherein step (i) is a priming first expansion step and step (ii) is a rapid second expansion step.

71. The use according to claim 69 to 70, wherein the cells from the cell culture medium in step (ii) are removed and cryopreserved in a storage medium prior to administration of a therapeutically effective dosage of the therapeutic population of TILs to the patient.

72. The use according to claim 71, wherein the cells are thawed prior to administration of a therapeutically effective dosage of the therapeutic population of TILs to the patient.

73. The use according to any of claims 69 to 72, wherein the APCs are artificial APCs (aAPCs) or autologous APCs.

74. The use according to any of claims 69 to 73, wherein the APCs are peripheral blood mononuclear cells (PBMCs).

75. The use according to any of claims 68 to 74, wherein the therapeutic population of TILs are to be infused into a patient.

76. The use according to claim 69, wherein the first expansion in step (i) is performed by further supplementing the cell culture medium of the second population of TILs with OKT-3, IL-15, OX40 agonistic antibody and/or 4-1BB agonistic antibody.

~~77. The use according to claim 69, wherein the second expansion in step (ii) is performed by further supplementing the cell culture medium of the second population of TILs with IL-15, OX40 agonistic antibody and/or 4-1BB agonistic antibody.~~

~~78. The use according to claim 69, wherein the FNA in step (i) comprises at least 400,000 TILs.~~

~~79. The use according to claim 69, wherein the small biopsy is obtained from a tumor selected from the group consisting of pancreatic, melanoma, breast, and ovarian.~~

~~80. The use according to claim 69, wherein the FNA is obtained from a tumor selected from the group consisting of lung, melanoma, head and neck, cervical, ovarian, pancreatic, glioblastoma, colorectal, and sarcoma.~~

~~81. The use according to claim 80, wherein the lung tumor is a non-small cell lung carcinoma (NSCLC), and optionally wherein the subject has previously undergone surgical treatment.~~

~~82. The use according to claim 69, wherein the TILs in step (i) are obtained from a FNA.~~

~~83. The use according to claim 69, wherein the FNA is obtained using a 25-18 gauge needle.~~

~~84. The use according to claim 69, wherein the TILs in step (i) are obtained from a small biopsy.~~

~~85. The use according to claim 69, wherein the small biopsy is obtained using a 16-11 gauge needle.~~

~~86. The use according to claim 69, wherein step (ii) is repeated one to four times in order to obtain sufficient TILs in the therapeutic population of TILs for a therapeutically effective dosage of the TILs.~~

~~87. The use according to claim 86, where the number of TILs sufficient for a therapeutically effective dosage is from about 2.3×10^{10} to about 13.7×10^{10}.~~

~~88. The use according to any of claims 69 to 87, wherein the third population of TILs comprises an increased subpopulation of effector T cells and/or central memory T cells relative to the second population of TILs, wherein the effector T cells and/or central memory T cells exhibit one or more characteristics selected from the group consisting of expression of CD27, expression of CD28, longer telomeres, increased CD57 expression, and decreased CD56 expression, relative to effector T cells and/or central memory T cells in the third population of cells.~~

~~89. The use according to claim 88, wherein the effector T cells and/or central memory T cells exhibit increased CD57 expression and decreased CD56 expression.~~

~~90~~47. A method for expanding tumor infiltrating lymphocytes (TILs) into a therapeutic population of TILs comprising:

(a) performing, within a closed system, a first expansion by culturing ~~the~~ a first population of TILs obtained from a fine needle aspirate (FNA) or a small biopsy from a tumor in a cell culture medium comprising IL-2 to produce a second population of TILs, wherein the cell culture medium is supplemented with OKT-3 at any one of days 1-3, wherein the first expansion is performed for ~~about~~ 3 days to ~~about~~ 12 days in order to obtain the second population of TILs, wherein the second population of TILs comprises at least 5×10^7 TILs by ~~about~~ 3 days to ~~about~~ 12 days when the first population of TILs is from a small biopsy, wherein the first expansion is performed in a closed container providing a first gas-permeable surface area, ~~wherein the first expansion is performed for about 3 days to about 12 days to obtain the second population of TILs,~~ wherein the second population of TILs is at least 25-fold greater in number than the first population of TILs;

(b) performing, without opening the system, a second expansion by supplementing the cell culture medium of the second population of TILs with additional IL-2, OKT-3, and antigen presenting cells (APCs), to produce a third population of TILs, wherein the second expansion is performed for ~~about~~ 3 days to ~~about~~ 12 days to obtain the third population of TILs, wherein the third population of TILs is a therapeutic population of TILs, wherein the second expansion is performed in a closed container providing a second gas-permeable surface area;

(c) harvesting, without opening the system, the therapeutic population of TILs obtained from step (b); and

(d) transferring, without opening the system, the harvested TIL population from step (c) to an infusion bag.

~~91. The method according to claim 90, wherein the cell culture medium comprising IL-2 in step (a) further comprises OKT-3 and is not optionally supplemented with OKT-3 at any one of days 1-3, and wherein step (a) is a priming first expansion step and step (b) is a rapid second expansion step.~~

~~92~~48. The method according to ~~claims 90 to 91~~claim 47, further comprising the step of cryopreserving the infusion bag comprising the harvested TIL population in step (d) using a cryopreservation process.

~~93~~49. The method according to claim ~~92~~48, wherein the cryopreservation process is performed using a 1:1 ratio (v/v) of harvested TIL population to CS10 media.

~~94~~50. The method according to any one of claims ~~90~~47-49, wherein the cell culture medium of step (a) further comprises APCs.

~~95~~51. The method according to any one of claims ~~90~~ 47 to ~~94~~50, wherein the APCs are peripheral blood mononuclear cells (PBMCs).

~~96~~52. The method of claim ~~95~~51, wherein the PBMCs are irradiated and allogeneic.

~~97~~53. The method according to claim ~~96~~52, wherein the PBMCs are added to the cell culture on any of days 3 through 12 in step (a) and/or any of days 3 through 12 in step (b).

~~98~~54. The method according to any one of claims ~~90~~ 47 to ~~95~~51, wherein the antigen-presenting cells are artificial antigen-presenting cells (aAPCs) or autologous APCs.

~~99~~55. The method according to any of claims ~~90~~ 47 to ~~98~~54, wherein the therapeutic population of TILs are to be infused into a patient.

~~100~~56. The method according to any one of claims ~~90~~47-55, wherein the first expansion in step (a) is performed by further supplementing the cell culture medium of the second population of TILs with ~~OKT 3,~~ IL-15, OX40 agonistic antibody and/or 4-1BB agonistic antibody.

~~101~~57. The method according to any one of claims ~~90~~47-56, wherein the second expansion in step (b) is performed by further supplementing the cell culture medium of the second population of TILs with IL-15, OX40 agonistic antibody and/or 4-1BB agonistic antibody.

~~102~~58. The method according to any one of claims ~~90~~47-57, wherein the FNA comprises at least 400,000 TILs.

~~103~~59. The method according to any one of claims 47~~90~~-58, wherein the small biopsy is obtained from a tumor selected from the group consisting of pancreatic, melanoma, breast and ovarian.

~~104~~60. The method according to any one of claim 47~~90~~-59, wherein the FNA is obtained from a tumor selected from the group consisting of lung, melanoma, head and neck, cervical, ovarian, pancreatic, glioblastoma, colorectal, and sarcoma.

~~105~~61. The method according to claim ~~104~~60, wherein the lung tumor is a non-small cell lung carcinoma (NSCLC), and optionally wherein the subject has previously undergone surgical treatment.

~~106~~62. The method according to any one of claims ~~90~~47-61, wherein the TILs in step (a) are obtained from a FNA.

~~107~~63. The method according to claim ~~90~~62, wherein the FNA is obtained using a 25-18 gauge needle.

~~108~~64. The method according to any one of claims ~~90~~47-61, wherein the TILs in step (a) are obtained from a small biopsy.

~~109~~65. The method according to claim ~~90~~64, wherein the small biopsy is obtained using a 16-11 gauge needle.

~~110~~66. The method according to any one of claims ~~90~~47-65, wherein the harvesting is performing using a membrane-based cell processing system.

~~111~~67. The method according to any one of claims ~~90~~47-66, wherein the cell culture medium is provided in a container selected from the group consisting of a gas-permeable container and a cellbag.

~~112~~68. The method according to any one of claims ~~90~~47-67, wherein the infusion bag is a hypothermic biopreservation-containing infusion bag.

~~113~~69. The method according to any one of claims ~~90~~47-68, wherein steps (a) through (d) are performed within a period of ~~about~~ 17 days to ~~about~~ 24 days.

~~114~~70. The method according to any one of claims ~~90~~47-68, wherein steps (a) through (d) are performed within a period of ~~about~~ 18 days to ~~about~~ 22 days.

~~115~~71. The method according to any one of claims ~~90~~47-68, wherein steps (a) through (d) are performed within a period of ~~about~~ 20 days to ~~about~~ 22 days.

~~116~~72. The method according to any one of claims ~~90~~47-68, wherein steps (a) through (d) are performed in 22 days or less.

~~117~~73. The method according to any one of claims ~~90~~47-68, wherein steps (a) through (d) and cryopreservation are performed in 22 days or less.

~~118~~74. The method according to any one of claims ~~90~~ 47 to ~~117~~73, wherein the therapeutic population of TILs harvested comprises sufficient TILs for a therapeutically effective dosage of the TILs.

~~119~~75. The method according to claim ~~118~~74, wherein the number of TILs sufficient for a therapeutically effective dosage is from ~~about~~ 2.3×10^{10} to ~~about~~ 13.7×10^{10}.

~~120~~76. The method according to any one of claims ~~90~~ 47 to ~~119~~75, wherein steps (a) through (c) are performed in a single container, wherein performing steps (a) through (c) in a single container results in an increase in TIL yield per resected tumor as compared to performing steps (a) through (c) in more than one container.

~~121~~77. The method according to any one of claims ~~90~~ 47 to ~~120~~76, wherein the antigen-presenting cells are added to the TILs during the second expansion without opening the system.

~~122~~78. The method according to any one of claims ~~90~~ 47 to ~~121~~77, wherein the third population of TILs comprises an increased subpopulation of effector T cells and/or central memory T cells relative to the second population of TILs, wherein the effector T cells and/or central memory T cells in the therapeutic population of TILs exhibit one or more characteristics selected from the group consisting of expressing CD27+, expressing CD28+, longer telomeres, increased CD57 expression, and decreased CD56 expression relative to effector T cells, and/or central memory T cells obtained from the second population of cells.

~~123~~79. The method according to any one of claims ~~90~~ 47 to ~~122~~78, wherein the effector T cells and/or central memory T cells obtained from the third population of TILs exhibit increased CD57 expression and decreased CD56 expression relative to effector T cells and/or central memory T cells obtained from the second population of cells.

~~124~~80. The method according to any one of claims ~~90~~ 47 to ~~123~~79, wherein the risk of microbial contamination is reduced as compared to an open system.

~~125~~81. The method according to any one of claims ~~90~~ 47 to 80~~124~~, wherein the TILs are to be infused into a patient.

~~126~~82. Use of a therapeutic population of tumor infiltrating lymphocytes (TILs) in the manufacture of a medicament for treating a subject with cancer, wherein the therapeutic population of TILs is obtained from a method comprising:
(a) performing, within a closed system, a first expansion by culturing a first population of TILs obtained from a fine needle aspirate (FNA) or a small biopsy from a tumor in a cell

culture medium comprising IL-2 to produce a second population of TILs, wherein the cell culture medium is supplemented with OKT-3 at any one of days 1-3, wherein the first expansion is performed for ~~about~~ 3 days to ~~about~~ 12 days in order to obtain the second population of TILs, wherein the second population of TILs comprises at least 5×10^7 TILs by ~~about~~ 3 days to ~~about~~ 12 days when the first population of TILs is from a small biopsy, wherein the first expansion is performed in a closed container providing a first gas-permeable surface area, ~~wherein the first expansion is performed for about 3-14 days to obtain the second population of TILs,~~ wherein the second population of TILs is at least 25-fold greater in number than the first population of TILs;

(b) performing, without opening the system, a second expansion by supplementing the cell culture medium of the second population of TILs with additional IL-2, OKT-3, and antigen presenting cells (APCs), to produce a third population of TILs, wherein the second expansion is performed for ~~about~~ 3 days to ~~about~~ 12 days to obtain the third population of TILs, wherein the third population of TILs is a therapeutic population of TILs, wherein the second expansion is performed in a closed container providing a second gas-permeable surface area;

(c) harvesting, without opening the system, the therapeutic population of TILs obtained from step (b); and

(d) transferring, without opening the system, the harvested TIL population from step (c) to an infusion bag; and

(e) optionally cryopreserving the infusion bag comprising the harvested TIL population from step (d) using a cryopreservation process.

~~127~~83. The use according to claim ~~126~~82, wherein the therapeutic population of TILs harvested comprises sufficient TILs for administration of a therapeutically effective dosage of the TILs.

~~128. The use according to claims 126 or 127, wherein the cell culture medium comprising IL-2 in step (a) further comprises OKT-3 and is not optionally supplemented with OKT-3 at any one of days 1-3, and wherein step (a) is a priming first expansion step and step (b) is a rapid second expansion step.~~

~~129~~84. The use according to ~~any one of claims 126 to 128~~claim 82 or 83, wherein the APCs are artificial APCs (aAPCs) or autologous APCs.

~~130~~85. The use according to any of claims ~~126~~ 82 to ~~129~~84, wherein the therapeutic population of TILs are to be infused into a patient.

~~131~~86. The use according to any of claims 82 to 85~~claim 126~~84, wherein the first expansion is performed by further supplementing the cell culture medium of the second population of TILs with OKT-3, IL-15, OX40 agonistic antibody and/or 4-1BB agonistic antibody.

~~132~~87. The use according to any of claims 82 to 86~~claim 126~~, wherein the second expansion in step (~~d~~b) is performed by further supplementing the cell culture medium of the second population of TILs with ~~OKT-3,~~ IL-15, OX40 agonistic antibody and/or 4-1BB agonistic antibody.

~~133~~88. The use according to any of claims 82 to 87~~claim 126~~, wherein the FNA in step (a) comprises at least 400,000 TILs.

~~134~~89. The use according to any of claims 82 to 88~~claim 126~~, wherein the small biopsy is obtained from a tumor selected from the group consisting of pancreatic, melanoma, breast and ovarian.

~~135~~90. The use according to any of claims 82 to 89~~claim 126~~, wherein the FNA is obtained from a tumor selected from the group consisting of lung, melanoma, head and neck, cervical, ovarian, pancreatic, glioblastoma, colorectal, and sarcoma.

~~136~~91. The use according to claim ~~135~~90, wherein the lung tumor is a non-small cell lung carcinoma (NSCLC), and optionally wherein the subject has previously undergone surgical treatment.

~~137~~92. The use according to any of claims 82 to 91~~claim 126~~, wherein the TILs in step (i) are obtained from a FNA.

~~138~~93. The use according to claim ~~137~~92, wherein the FNA is obtained using a 25-18 gauge needle.

~~139~~94. The use according to any of claims 82 to 93~~claim 126~~, wherein the TILs in step (i) are obtained from a small biopsy.

~~140~~95. The use according to claim ~~139~~94, wherein the small biopsy is obtained using a 16-11 gauge needle.

~~141~~96. The use according to any of claims 82 to 95~~claim 126~~, wherein the number of TILs sufficient for administration of a therapeutically effective dosage is from ~~about~~ 2.3×10^{10} to ~~about~~ 13.7×10^{10}.

~~142~~97. The method according to any of claims 82 to 96~~claim 126~~, wherein the cell culture medium of step (a) further comprises APCs.

~~143~~98. The use according to claim ~~126~~97, wherein the antigen presenting cells (APCs) are PBMCs.

~~144~~99. The use according to claim ~~142~~ 97 or ~~143~~98, wherein the PBMCs are added to the cell culture on any of days 3 through 12 in step (a) and/or any of days 3 through 12 in step (b).

~~145~~100. The use according to any of claims ~~126~~ 82 to ~~144~~99, wherein prior to administration of a therapeutically effective dosage of TIL cells, a non-myeloablative lymphodepletion regimen has been administered to the patient.

~~146~~101. The use according to claim ~~145~~100, where the non-myeloablative lymphodepletion regimen comprises the steps of administration of cyclophosphamide at a dose of 60 mg/m2/day for two days followed by administration of fludarabine at a dose of 25 mg/m2/day for five days.

~~147~~102. The use according to any of claims ~~126~~ 82 to 101~~146~~, wherein a high-dose IL-2 regimen is to be further administered to the patient, starting on the day after administration of the TIL cells to the patient.

~~148~~103. The use according to claim ~~147~~102, wherein the high-dose IL-2 regimen comprises 600,000 or 720,000 IU/kg to be administered as a 15-minute bolus intravenous infusion every eight hours until tolerance.

~~149~~104. The use according to any of the claims ~~126~~ 82 to ~~148~~103, wherein the third population of TILs comprises an increased subpopulation of effector T cells and/or central memory T cells relative to the second population of TILs, wherein the effector T cells and/or central memory T cells in the therapeutic population of TILs exhibit one or more characteristics selected from the group consisting of expressing CD27+, expressing CD28+, longer telomeres, increased CD57 expression, and decreased CD56 expression relative to effector T cells, and/or central memory T cells obtained from the second population of cells.

~~150~~105. The use according to any of claims ~~126~~ 82 to ~~149~~104, wherein the effector T cells and/or central memory T cells in the therapeutic population of TILs exhibit increased CD57 expression and decreased CD56 expression relative to effector T cells and/or central memory T cells obtained from the second population of cells.

~~151~~106. A method for expanding tumor infiltrating lymphocytes (TILs) into a therapeutic population of TILs comprising:

(a) performing a priming first expansion by culturing the first population of TILs obtained from a fine needle aspirate (FNA) a small biopsy, or a core biopsy from a tumor in a cell culture medium comprising IL-2, OKT-3, and antigen presenting cells (APCs) to produce a second population of TILs, wherein the priming first expansion is performed for a first period of ~~about~~ 1 to 14 days in a container comprising a first gas-permeable surface area to obtain the second population of TILs, wherein the second population of TILs is greater in number than the first population of TILs;

(b) performing a rapid second expansion by supplementing the cell culture medium of the second population of TILs with additional IL-2, OKT-3, and APCs, to produce a third population of TILs, wherein the rapid second expansion is performed for a second period of ~~about~~ 1 to ~~about~~ 14 days to obtain the third population of TILs, wherein the third population of TILs is a therapeutic population of TILs; and

(c) harvesting the therapeutic population of TILs from step (b).

~~152~~107. The method according to claim ~~151~~106, wherein the first expansion is ~~about~~ 6 to 12 days.

~~153~~108. The method according to claims ~~151~~ 106 or ~~152~~107, wherein the second expansion is ~~about~~ 6 to 12 days.

~~154.~~109 The method according to claim ~~151~~106, wherein the first expansion is selected from the group consisting of 5 days, 6 days, 7 days, 8 days, 9 days, 10 days, 11 days, or 12 days.

~~155~~110. The method according to claims ~~151~~ 106 or ~~152~~107, wherein the second expansion is selected from the group consisting of 5 days, 6 days, 7 days, 8 days, 9 days, 10 days, 11 days, or 12 days.

~~156~~111. The method of any of claims ~~151~~ 106 to ~~155~~110, wherein the APCs are peripheral blood mononuclear cells (PBMCs).

~~157~~112. The method of claim ~~156~~111, wherein the ratio of APCs used in Step (a) to the APCs used in Step (b) is ~~about~~ 1.1:1, 1.2:1, 1.3:1, 1.4:1, 1.5:1, 1.6:1, 1.7:1, 1.8:1, 1.9:1, 2:1, 2.1:1, 2.2:1, 2.3:1, 2.4:1, 2.5:1, 2.6:1, 2.7:1, 2.8:1, 2.9:1, 3:1, 3.1:1, 3.2:1, 3.3:1, 3.4:1, 3.5:1, 3.6:1, 3.7:1, 3.8:1, 3.9:1, 4:1, 4.1:1, 4.2:1, 4.3:1, 4.4:1, 4.5:1, 4.6:1, 4.7:1, 4.8:1, 4.9:1, or 5:1, or preferably ~~about~~ 1 to 2.

~~158~~113. The method of claim ~~157~~112, wherein the first population of TILs is obtained from a core biopsy.

~~159.~~114. The method of claim ~~158~~113, wherein the core biopsy is obtained from a tumor selected from the group consisting of a melanoma tumor, an ovarian cancer tumor, a cervical cancer tumor, a non-small-cell lung cancer (NSCLC) tumor, a lung cancer tumor, a bladder cancer tumor, a breast cancer tumor, a tumor from a cancer caused by human papilloma virus, a head and neck cancer (including head and neck squamous cell carcinoma (HNSCC)) tumor, a glioblastoma tumor, a gastrointestinal cancer tumor, and a renal cancer tumor.