CLAIMS

What is claimed is:

1. Use of an anucleate cell comprising (i) an antigen, (ii) a tolerogenic factor, or (iii) an antigen and a tolerogenic factor in the manufacture of a medicament for suppressing an immune response or inducing tolerance in an individual, wherein the anucleate cell comprising (i) an antigen, (ii) a tolerogenic factor, or (iii) an antigen and a tolerogenic factor is generated by passing a cell suspension comprising an anucleate cell through a constriction, wherein said constriction deforms the cell thereby causing a perturbation of the cell such that (i) an antigen, (ii) a tolerogenic factor, or (iii) an antigen and a tolerogenic factor contacted with the cell enters the anucleate cell,
wherein said constriction size is about 10% to about 99% of the cell diameter and said antigen is processed in a tolerogenic environment, wherein presentation of said antigen in said tolerogenic environment suppresses an immune response to the antigen, and wherein said tolerogenic factor contributes to a tolerogenic environment that suppresses an immune response.

2. Use of an anucleate cell comprising (i) an antigen, (ii) a tolerogenic factor, or (iii) an antigen and a tolerogenic factor in the manufacture of a medicament for inducing antigen-specific tolerance in an individual, wherein the anucleate cell comprising (i) an antigen, (ii) a tolerogenic factor, or (iii) an antigen and a tolerogenic factor is generated by passing a cell suspension comprising an anucleate cell through a constriction, wherein said constriction deforms the cell thereby causing a perturbation of the cell such that (i) an antigen, (ii) a tolerogenic factor, or (iii) an antigen and a tolerogenic factor enters the anucleate cell, wherein said constriction size is about 10% to about 99% of the cell diameter and said antigen is processed in a tolerogenic environment, wherein presentation of said antigen in said tolerogenic environment induces tolerance to the antigen, and wherein said tolerogenic factor contributes to a tolerogenic environment that suppresses an immune response.

3. A method for delivering an (i) antigen, (ii) a tolerogenic factor, or (iii) or an antigen and a tolerogenic factor into an anucleate cell, the method comprising passing a cell suspension comprising the anucleate cell through a constriction, wherein said constriction deforms the

anucleate cell, thereby causing a perturbation of the cell such that (i) an antigen, (ii) a tolerogenic factor, or (iii) or an antigen and a tolerogenic factor enters the cell, wherein said cell suspension is contacted with (i) the antigen, (ii) the tolerogenic factor, or (iii) the antigen and the tolerogenic factor, wherein said constriction size is about 10% to about 99% of the cell diameter.

4. The method of claim 3, wherein processing and presentation of said antigen in a tolerogenic environment suppresses an immune response to the antigen and/or induces tolerance to the antigen.

5. The method of claim 3 or 4, wherein processing and presentation of said antigen in a tolerogenic environment induces tolerance to the antigen.

6. The use or method of any one of claims 1-5, wherein at least one additional antigen is introduced into the cell.

7. The use or method of any one of claims 1-6, wherein at least one additional tolerogenic factor is introduced into the cell.

8. The use or method of any one of claims 1, 2, and 4-7, wherein the tolerogenic environment is located in the spleen, liver, or lymph nodes.

9. The use or method of any one of claims 1-8, wherein the constriction is
    a) contained within a microfluidic channel, or
    b) a pore or contained within a pore.

10. The use or method of claim 9, wherein the microfluidic channel or the pore comprises a constriction width of about 0.25 pm to about 4 μm.

11. The use or method of any one of claims 1-10, wherein the cell suspension:
    a) is whole blood;
    b) comprises a mixed cell population; or
    c) comprises a purified cell population.

12. The use or method of any one of claims 1-11, wherein the anucleate cell is a red blood cell, an erythrocyte, a reticulocyte, or a platelet.

13. The use or method of any one of claims 1-12, wherein the antigen is:

a) located in a cell lysate;

b) a foreign antigen;

c) a self-antigen;

d) an allograft transplantation antigen;

e) a protein or polypeptide;

f) a lysate;

g) a lipid antigen;

h) a carbohydrate antigen;

i) associated with a virus; or

j) a modified antigen.

14. The use or method of claim 13, wherein the modified antigen comprises

a) an antigen fused with a polypeptide;

b) an antigen fused with a therapeutic agent;

c) an antigen fused with a targeting peptide;

d) an antigen fused with a lipid;

e) an antigen fused with a carbohydrate.

15. The use or method of any one of claims 1-14, wherein the tolerogenic factor comprises a polypeptide.

16. The use or method of claim 15, wherein the polypeptide is:

a) IL-4, lL-10, IL- 13, IL-35, IFNα, or TGFβ;

b) is a therapeutic polypeptide or a fragment thereof; or

c) is conjugated to a carbohydrate.

17. The use or method of any one of claim 1-16, wherein the half-life of the anucleate cell is decreased.

18. The use or method of any one of claims 1, 2 and 4-17, wherein the suppressed immune response or the tolerance comprises:

a) a decreased production and/or secretion of one or more inflammatory cytokines;

b) increased production and/or secretion of one or more anti-inflammatory cytokines;

c) a decreased T cell response;

d) uncostimulated activation of a T cell;

e) an enhanced Treg response;

f) a decreased B cell response;

g) decreased cytokine production;

h) a decreased autoimmune response;

i) a decreased allergic response;

j) a decreased immune response against a transplanted tissue;

k) a decreased pathogenic immune response to a virus;

l) decreased immune response against a therapeutic agent or vehicle; or

m) decreased immune response against a therapeutic vehicle.

19. The use or method of claim 18, wherein:

a) the one or more inflammatory cytokines are selected from the group consisting of interleukin-l (IL-1), IL-12, and IL-18, tumor necrosis factor (TNF), interferon gamma (IFN-gamma), and granulocyte-macrophage colony stimulating factor (GM-CSF);

b) the one or more anti-inflammatory cytokines are selected from the group consisting of IL-4, IL-10, IL-13, IL-35, IFN-a, and transforming growth factor-beta (TGBb);

c) the decreased T cell response comprises decreased T cell activation, decreased T cell survival, decreased T cell proliferation, decreased T cell functionality, and/or a change in T cell phenotype;

d) the decreased B cell response comprises decreased antibody production.

20. The use or method of any one of claims 1-19, wherein the method is repeated at least 1, 2, 3, 4, 5, or 6 times.