CLAIMS

1. A PEGylated liposomal drug formulation for use in the treatment of a disease in a patient, comprising:

echinomycin,

a peglyated phospholipid,

a neutral phosphoglyceride, and

a sterol, and

wherein the composition comprises a plurality of PEGylated liposomes encapsulating the echinomycin, and

wherein the liposomes are suspended in a pharmaceutically acceptable carrier.

2. The formulation of Claim 1, wherein the PEGylated phospholipid is a distearoylphosphatidylethanolamine-polyethylene glycol (DSPE-PEG), a dimyristoyl phosphatidylethanolamine-polyethylene glycol (DMPE-PEG), a dipalmitoylglycerosuccinate polyethylene glycol (DPGS-PEG), a cholesteryl-polyethylene glycol, or a ceramide-based pegylated lipid.

3. The formulation of Claim 1 or 2, wherein the neutral phosphoglyceride is selected from the group consisting of phosphatidylcholine, phosphatidylserine, phosphatidylethanolamine, phosphatidylglycerol and phosphatidylinositol.

4. The formulation of any one of Claims 1 to 3, wherein the molar ratio of the PEGylated phospholipid to total lipids in the formulation is from 3 to 6%,

wherein the molar ratio of the neutral phosphoglyceride to total lipids in the formulation is between 45 to 65%, and

wherein the molar ratio of the sterol to total lipids in the formulation is 30 to 50%.

5. The formulation of any one of Claims 1 to 4, wherein the PEGylated phospholipid is a distearoylphosphatidylethanolamine-polyethylene glycol (DSPE-PEG), the neutral phosphoglyceride is a phosphatidylcholine, and the sterol is cholesterol.

6. The formulation of Claim 5, comprising DSPE-PEG-2000, hydrogenated soybean phosphatidylcholine (HSPC), and cholesterol.

7. The formulation of Claim 6, wherein the molar ratio DSPE-PEG-2000, HSPC, and cholesterol to total lipids is 5.3%, 56.3%, and 38.4%, respectively.

8. The formulation of any one of Claims 1 to 7, wherein the mass ratio of echinomycin to total lipids is between 2 to 10%.

9. The formulation of any one of Claims 1 to 7, wherein the mass ratio of echinomycin to total lipids is 5%.

10. The formulation of any one of Claims 1 to 9, wherein at least 90% of the liposomes in the formulation have a diameter between 80 to 120 nm.

11. The formulation of any one of Claims 1 to 10, wherein the average polydispersity index of the liposomes is <0.1 and the liposomes and are sufficiently stable to achieve a shelf-life of at least 12 months at 4°C.

12. The formulation of any one of Claims 1 to 11, wherein the liposomes are formulated as a lyophilized powder.

13. Use of the formulation of Claim 1 in the manufacture of a medicament for the treatment of a disease in a patient,

wherein the liposomal formulation comprises echinomycin or an echinomycin analogue in an amount sufficient to treat a proliferative disorder, autoimmune disease, or graft-versus-host disease in which the disease is characterized by overexpression of HIF-1α or HIF-2α.

14. The use of Claim 13, wherein the disease is a proliferative disorder.

15. The use of Claim 14, wherein the proliferative disorder is leukemia.

16. The use of Claim 14, wherein the proliferative disorder is breast cancer.

17. The use of Claim 13, wherein the disease is an autoimmune disease.

18. The use of Claim 13, wherein the disease is graft-versus-host disease.

19. The method for making the pharmaceutical composition of Claim 1, comprising:

forming a mixture comprising the echinomycin and lipid components, including the peglyated phospholipid, the neutral phospholipid and the sterol in a polar solvent;

drying the mixture so as to remove the polar solvent, thereby forming a dried lipid film;

solubilizing the dried lipid film in a buffer to form a lipid suspension;

extruding the lipid suspension through a polycarbonate filter to achieve a desired size range of liposomes; and

sterilizing the liposomes by filtration.