[0004] Procedures involving cryoneurolysis that selectively target peripheral nerves without damaging the surrounding tissue and provide sustained treatment of pain would be highly desirable.

SUMMARY

[0005] In one aspect, there is provided use of a biocompatible ice slurry in the manufacture of a medicament for providing reversible inhibition of one or more peripheral nerves to a subject in need thereof, wherein the biocompatible slurry is to be provided to the peripheral nerves for a duration sufficient to inhibit the peripheral nerves in the subject, wherein said inhibition is reversible. The disclosure also provides a method of providing reversible inhibition of peripheral nerves to a subject in need thereof. The use or method comprises providing a biocompatible ice slurry to the peripheral nerves for a duration sufficient to inhibit the peripheral nerves in the subject, wherein the inhibition is reversible. In some embodiments, the inhibition is reversed after about 5 months or less. The peripheral nerves targeted for inhibition can be subcutaneous nerves; somatic nerves, including sensory nerves, motor nerves, cranial nerves or spinal nerves; and autonomic nerves, including sympathetic, parasympathetic or enteric nerves. In some embodiments, the biocompatible ice slurry is provided along the perineural sheath of a peripheral nerve.

[0006] In one embodiment, the biocompatible ice slurry comprises ice particles and a lactated Ringer's solution or a lactated electrolyte solution.

[0007] In another embodiment, the biocompatible ice slurry further comprises hetastarch or dextrose.

[0008] In yet another embodiment, the biocompatible ice slurry further comprises about 0.1% to about 20% glucose.

[0009] In yet another embodiment, the biocompatible ice slurry further comprises about 0.1% to about 20% glycerol.

[0010] In yet another embodiment, the biocompatible ice slurry further comprises about 0.1% to about 6% hetastarch.

[0011] In yet another embodiment, the biocompatible ice slurry comprises ice particles and saline.

[0012] In yet another embodiment, the biocompatible ice slurry further comprises about 0.1% to about 20% glycerol.

[0013] In yet another embodiment, the biocompatible ice slurry further comprises about 0.1 % to about 20% dextrose.

[0014] In yet another embodiment, the biocompatible ice slurry further comprises about 0.1% to about 5% ethanol.

[0015] In yet another embodiment, the biocompatible ice slurry further comprises about 0.1% to about 10% poly vinyl alcohol.

[0016] In yet another embodiment, the biocompatible ice slurry further comprises at least one ion, sugar, polysaccharide, lipid, oil, lysolecithin, amino acid, caffeine, surfactant, anti-metabolite or combinations thereof. The at least one ion includes, but is not limited to, calcium, potassium,

CLAIMS

1. Use of a biocompatible ice slurry in the manufacture of a medicament for providing reversible inhibition of one or more peripheral nerves to a subject in need thereof, wherein the biocompatible slurry is to be provided to the peripheral nerves for a duration sufficient to inhibit the peripheral nerves in the subject, wherein said inhibition is reversible.

2. The use of claim 1, wherein the biocompatible ice slurry comprises ice particles and a lactated Ringer's solution, electrolyte solution or a lactated electrolyte solution.

3. The use of claim 2, wherein the biocompatible ice slurry further comprises hetastarch or dextrose.

4. The use of claim 2, wherein the biocompatible ice slurry further comprises about 0.1% to about 20% glucose.

5. The use of claim 2, wherein the biocompatible ice slurry further comprises about 0.1% to about 20% glycerol.

6. The use of claim 2, wherein the biocompatible ice slurry further comprises about 0.1% to about 6% hetastarch.

7. The use of claim 1, wherein the biocompatible ice slurry comprises ice particles and saline.

8. The use of claim 7, wherein the biocompatible ice slurry further comprises about 0.1% to about 20% glycerol.

9. The use of claim 7, wherein the biocompatible ice slurry further comprises about 0.1 % to about 20% dextrose.

10. The use of claim 7, wherein the biocompatible ice slurry further comprises about 0.1% to about 5% ethanol.

11. The use of claim 7, wherein the biocompatible ice slurry further comprises about 0.1% to about 10% poly vinyl alcohol.

12. The use of claim 7, wherein the biocompatible ice slurry further comprises at least one sugar, ion, polysaccharide, lipid, oil, lysolecithin, amino acid, caffeine, surfactant, antimetabolite, detergent or a combination thereof.

13. The use of claim 12, wherein the at least one sugar is glucose, mannitol, hetastarch, sucrose, sorbitol or a combination thereof.

14. The use of claim 12, wherein the at least one ion is calcium, potassium, hydrogen, chloride, magnesium, sodium, lactate, phosphate, zinc, sulfur, nitrate, ammonium, carbonate, hydroxide, iron, barium, salts thereof or a combination thereof.

15. The use of claim 12, wherein the at least one oil is canola oil, coconut oil, corn oil, cottonseed oil, flaxseed oil, olive oil, palm oil, peanut oil, safflower oil, soybean oil, sunflower oil or a combination thereof.

16. The use of claim 12, wherein the surfactant is a detergent.

17. The use of claim 12, wherein the detergent is at least one of deoxycholate, sodium tetradecyl sulphate, polidocanol, deoxycholate, sodium tetradecyl sulphate, polidocanol, polysorbate 20 (polyoxyethylen (20) sorbitan monolaurate), polysorbate 40 (polyoxyethylene (20) sorbitan monopalmitate), polysorbate 60 (polyoxyethylene (20) sorbitan monostearate), polysorbate 80 (polyoxyethylene (20) sorbitan monooleate), sorbitan ester, poloxamater or a combination thereof.

18. The use of claim 1, wherein the biocompatible ice slurry comprises a peritoneal dialysis solution.

19. The use of claim 1, wherein the biocompatible ice slurry is provided along the perineural sheath of a peripheral nerve.

20. The use of claim 1, where in the peripheral nerves are subcutaneous nerves.

21. The use of claim 1, where in the peripheral nerves are autonomic nerves.

22. The use of claim 21, where in the autonomic nerves are sympathetic nerves, parasympathetic nerves or enteric nerves.

23. The use of claim 21, where in the peripheral nerves are somatic nerves.

24. The use of claim 1, wherein the somatic nerves are sensory nerves, motor nerves, cranial nerves, or spinal nerves.

25. The use of claim 1, wherein the biocompatible ice slurry cools the nerves to between about 5°C and about -40°C.

26. The use of claim 1, wherein the biocompatible ice slurry has a first equilibration temperature of between about 4°C and about -30°C.

27. The use of claim 1, wherein the biocompatible ice slurry has a second equilibration temperature of between about 2°C and about -30°C.

28. The use of claim 2, wherein the ice particles are spherical or round with a diameter of about 1 mm to about 0.01 mm.

29. The use of claim 1, wherein the biocompatible ice slurry further comprises an agent selected from the group consisting of a vasoconstricting agent, corticosteroid, a nonsteroidal antiinflammatory drug (NSAID), anesthetic, glucocorticoid, a lipoxygenase inhibitor, and combinations thereof.

30. The use of claim 29, wherein the vasoconstricting agent is epinephrine or norepinephrine.

31. The use of claim 29, wherein the anesthetic is selected from the group consisting of lidocaine, bupivacaine, prilocaine, tetracaine, procaine, mepivicaine, etidocaine, QX-314 and combinations thereof.

32. The use of claim 1, wherein the biocompatible ice slurry is to be injected.

33. The use of claim 32, wherein the biocompatible ice slurry is to be provided to the peripheral nerves of the subject by injection into or around the nerve or nerves selected from the group consisting of the cutaneous nerve, trigeminal nerve, ilioinguinal nerve, intercostal nerve, interscalene nerve, intercostal nerve, supraclavicular nerve, infraclavicular nerve, axillary nerve, paravertebral nerve, transverse abdominis nerve, genitofemoral nerve, lumbar plexus nerve, femoral nerve, pudental nerve, celiac plexus nerve, and sciatic nerve.

34. The use of claim 1, wherein the biocompatible ice slurry is to be provided to the peripheral nerves of the subject by tumescent pumping of the slurry.

35. The use of claim 1, wherein pressure is to be administered to reduce blood flow at the site of injection.

36. The use of claim 1, further comprising monitoring the biocompatible ice slurry by ultrasound or imaging.

37. The use of claim 1, wherein the inhibition is reversed after about 5 months or less.

38. The use of claim 1, wherein the subject in need thereof suffers from a disorder selected from the group consisting of neuropathic pain, diabetic neuropathy pain, trigeminal neuralgia, post-herpetic neuralgia, phantom limb pain, cancer related itch or pain, burn itch or pain, lichen sclerosus, scalp itch, nostalgia parastethica, atopic dermatitis, eczema, psoriasis, lichen planus, vulvar itch, vulvodynia, lichen simplex chornicus, prurigo nodularis, itch mediated by sensory nerves, peripheral neuropathy, peripheral nerve damage, post-thoracotomy pain, incisional pain, chest pain, coccydynia, lower back pain, superficial scars, neuromas, acute post-operation pain, lumbar facet joint syndrome, cutaneous pain disorder, and urinary incontinence.

39. The use of claim 38, wherein the cutaneous pain disorder is selected from the group consisting of reflex sympathetic dystrophy (RSD), phantom limb pain, neuroma, post herpetic neuralgia, tension headache, occipital neuralgia and vulvodynia.

40. The use of claim 1, wherein the subject in need thereof suffers from a motor disorder selected from the group consisting of hemifacial spasm, bladder spasm and laryngospasm.

41. The use of claim 1, wherein the subject in need thereof suffers from hyperhidrosis disorder.

42. The use of claim 1, wherein the tissue comprising the peripheral nerves is externally cooled prior to providing, during or after providing, the biocompatible ice slurry.