



(43) International Publication Date
15 December 2016 (15.12.2016)

WIPO | PCT

(10) International Publication Number
WO 2016/199112 A1

(51) International Patent Classification:

A61K 38/17 (2006.01) *A61P 35/00* (2006.01)
A61K 38/10 (2006.01)

(21) International Application Number:

PCT/IB2016/053483

(22) International Filing Date:

13 June 2016 (13.06.2016)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

14/738,551 12 June 2015 (12.06.2015) US

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(81) Designated States (unless otherwise indicated, for every

kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,

KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every

kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

Published:

- with international search report (Art. 21(3))
- with sequence listing part of description (Rule 5.2(a))

(54) Title: COMBINATION COMPOSITIONS FOR TREATING DISORDERS REQUIRING REMOVAL OR DESTRUCTION OF UNWANTED CELLULAR PROLIFERATIONS

(57) Abstract: The embodiments include methods of treating conditions requiring removal or destruction of cellular elements, such as benign or malignant tumors using compounds based on small peptides in combination with additional active agent(s). The method includes, but is not limited to, administering the compounds intramuscularly, orally, intravenously, intrathecally, intraprostatically, intratumorally, intranasally, topically, transdermally, etc., either alone or conjugated to a carrier to a mammal in need thereof.



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COMBINATION COMPOSITIONS FOR TREATING DISORDERS REQUIRING REMOVAL OR DESTRUCTION OF UNWANTED CELLULAR PROLIFERATIONS

This application claims priority to U.S. Non-Provisional Patent Application No. 14/738,551, filed June 12, 2015, which is hereby incorporated by reference in its entirety.

BACKGROUND

1. Field of the Embodiments

[0001] The embodiments include compositions and methods of treating conditions requiring removal or destruction of cellular elements, such as benign or malignant tumors in humans, using compositions containing compounds based on small peptides, in combination with at least one additional active agent and a pharmaceutically acceptable carrier. The methods include, but are not limited to, administering the compositions intramuscularly, orally, intravenously, intraperitoneally, intracerebrally (intraparenchymally), intracerebroventricularly, intralesionally, intraocularly, intraarterially, intrathecally, intratumorally, intranasally, topically, transdermally, subcutaneously, or intradermally.

2. Description of Related Art

[0002] The essence of many medical treatments and procedures involves the removal or destruction of harmful or unwanted tissue. Examples of such treatments include the surgical removal of cancerous or pre-cancerous growths, the destruction of metastatic tumors through chemotherapy, and the reduction of glandular (e.g. prostate) hyperplasia. Other examples include the removal of unwanted facial hair, the removal of warts, and the removal of unwanted fatty tissue.

[0003] There is a need for an effective composition that will destroy and hence either facilitate the removal of or inhibit the further growth of harmful

or unwanted cells and tissue but will have mainly local effects and minimal or absent systemic toxicity.

[0004] Some agents known to have this effect are disclosed in U.S. patent application Publication Nos. 2007/0237780 (now abandoned); 2003/0054990 (now US Patent No. 7,172,893); 2003/0096350 (now US Patent No. 6,924,266); 2003/0096756 (now US Patent No. 7,192,929); 2003/0109437 (now US Patent No. 7,241,738); 2003/0166569 (now US Patent No. 7,317,077); and 2005/0032704 (now US Patent No. 7,408,021), the disclosures of each of which are incorporated by reference herein in their entirety.

[0005] Cancer is an abnormality in a cell's internal regulatory mechanisms that results in uncontrolled growth and reproduction of the cell. Normal cells make up tissues, and when these cells lose their ability to behave as a specified, controlled, and coordinated unit, (dedifferentiation), the defect leads to disarray amongst the cell population. When this occurs, a tumor is formed.

[0006] Benign overgrowths of tissue are abnormalities in which it is desirable to remove cells from an organism. Benign tumors are cellular proliferations that do not metastasize throughout the body but do, however, cause disease symptoms. Such tumors can be lethal if they are located in inaccessible areas in organs such as the brain. There are benign tumors of organs including lung, brain, skin, pituitary, thyroid, adrenal cortex and medulla, ovary, uterus, testis, connective tissue, muscle, intestines, ear, nose, throat, tonsils, mouth, liver, gall bladder, pancreas, prostate, heart, and other organs.

[0007] Surgery often is the first step in the treatment of cancer. The objective of surgery varies. Sometimes it is used to remove as much of the evident tumor as possible, or at least to "debulk" it (remove the major bulk(s) of tumor so that there is less that needs to be treated by other

means). Depending on the cancer type and location, surgery may also provide some symptomatic relief to the patient. For instance, if a surgeon can remove a large portion of an expanding brain tumor, the pressure inside the skull will decrease, leading to improvement in the patient's symptoms.

[0008] Not all tumors are amenable to surgery. Some may be located in parts of the body that make them impossible to completely remove. Examples of these would be tumors in the brainstem (a part of the brain that controls breathing) or a tumor which has grown in and around a major blood vessel. In these cases, the role of surgery is limited due to the high risk associated with tumor removal.

[0009] In some cases, surgery is not used to debulk tumor tissue because it is simply not necessary. An example is Hodgkin's lymphoma, a cancer of the lymph nodes that responds very well to combinations of chemotherapy and radiation therapy. In Hodgkin's lymphoma, surgery is rarely needed to achieve cure, but almost always used to establish a diagnosis.

[0010] Chemotherapy is another common form of cancer treatment. Essentially, it involves the use of medications (usually given by mouth or injection) which specifically attack rapidly dividing cells (such as those found in a tumor) throughout the body. This makes chemotherapy useful in treating cancers that have already metastasized, as well as tumors that have a high chance of spreading through the blood and lymphatic systems but are not evident beyond the primary tumor. Chemotherapy may also be used to enhance the response of localized tumors to surgery and radiation therapy. This is the case, for example, for some cancers of the head and neck.

[0011] Unfortunately, other cells in the human body that also normally divide rapidly (such as the lining of the stomach and hair) also are affected by chemotherapy. For this reason, many chemotherapy agents induce

undesirable side effects such as nausea, vomiting, anemia, hair loss or other symptoms. These side effects are temporary, and there exist medications that can help alleviate many of these side effects. As our knowledge has continued to grow, researchers have devised newer chemotherapeutic agents that are not only better at killing cancer cells, but that also have fewer side effects for the patient.

[0012] Chemotherapy is administered to patients in a variety of ways. Some include pills and others are administered by an intravenous or other injection. For injectable chemotherapy, a patient goes to the doctor's office or hospital for treatment. Other chemotherapeutic agents require continuous infusion into the bloodstream, 24 hours a day. For these types of chemotherapy, a minor surgical procedure is performed to implant a small pump worn by the patient. The pump then slowly administers the medication. In many cases, a permanent port is placed in a patient's vein to eliminate the requirement of repeated needle sticks.

[0013] Benign tumors and malformations also can be treated by a variety of methods including surgery, radiotherapy, drug therapy, thermal or electric ablation, cryotherapy, and others. Although benign tumors do not metastasize, they can grow large and they can recur. Surgical extirpation of benign tumors has all the difficulties and side effects of surgery in general and oftentimes must be repeatedly performed for some benign tumors, such as for pituitary adenomas, meningiomas of the brain, prostatic hyperplasia, and others.

[0014] The role of androgens in the development of benign prostatic hyperplasia in men is well documented (Wilson, N. Engl. J. Med. 317: 628-629, 1987). In fact, benign prostatic hyperplasia does not develop in the absence of the testes (referred to in Wendel et al., J. Urol. 108: 116-119, 1972).

[0015] Blockade of testicular androgen secretion by surgical or medical (LHRH agonist) castration is known to decrease prostatic size (Auclair et al., *Biochem. Biophys. Res. Commun.* 76: 855-862, 1977; Auclair et al., *Endocrinology* 101: 1890-1893, 1977; Labrie et al., *Int. J. Andrology*, suppl. 2 (V. Hansson, ed.), Scriptor Publisher APR, pp. 303-318, 1978; Labrie et al., *J. Andrology* 1: 209-228, 1980; Tremblay and Belanger, *Contraception* 30: 483-497, 1984; Tremblay et al., *Contraception* 30: 585-598, 1984; Dube et al., *Acta Endocrinol. (Copenh)* 116: 413-417, 1987; Lacoste et al., *Mol. Cell. Endocrinol.* 56: 141-147, 1988; White, *Ann. Surg.* 22: 1-80, 1895; Faure et al., *Fertil. Steril.* 37: 416-424, 1982; Labrie et al., *Endocrine Reviews* 7: 67-74, 1986; Huggins and Stevens, *J. Urol.* 43: 705-714, 1940; Wendel et al., *J. Urol.* 108: 116-119, 1972; Peters and Walsh, *N. Engl. J. Med.* 317: 599-604, 1987; Gabrilove et al., *J. Clin. Endocrinol. Metab.* 64: 1331-1333, 1987).

[0016] Several studies have shown that treatment with an antiandrogen also decreases prostatic size (Neri et al., *Endocrinology*, 82: 311-317, 1968; Neri et al., *Investigative Urology*, 10: 123-130, 1972; Tunn et al., *Acta Endocrinol. (Copenh.)* 91: 373-384, 1979; Seguin et al., *Mol. Cell. Endocrinol.*, 21: 37-41, 1981; Lefebvre et al., *The Prostate* 3: 569-578, 1982; Marchetti and Labrie, *J. Steroid Biochem.*, 29: 691-698, 1988; Lacoste et al., *Mol. Cell. Endocrinol.* 56: 141-147, 1988; Tunn et al., *Invest. Urol.* 18: 289-292, 1980; Scott and Wade, *J. Urol.* 101: 81-85, 1969; Caine et al., *J. Urol.* 114: 564-568, 1975; Stone et al., *J. Urol.* 141: 240A, 1989; Clejan et al., *J. Urol.* 141: 534A, 1989).

[0017] U.S. Pat. No. 3,423,507 discloses the use of the antiandrogen cyproterone acetate (1 α , 2 β -methylene-6-chloro-17 α -acetoxo-6-dehydropregesterone) for the treatment of benign prostatic hyperplasia. Pure antiandrogens (U.S. Pat. No. 4,329,364) cause an increase in testosterone secretion, which can result in a higher degree of aromatization into estrogens, a situation expected from current knowledge to have

negative effects on prostatic hyperplasia (Jacobi et al., Endocrinology 102: 1748-1755, 1978).

Several studies have shown that treatment with the combination of chemical castration (LHRH agonist) and an antiandrogen cause greater inhibition of prostatic size than either treatment used alone (Seguin et al., Mol. Cell. Endocrinol. 21: 37-41, 1981; Lefebvre et al., The Prostate 3: 569-578, 1982; Marchetti and Labrie, J. Steroid Biochem. 29: 691-698, 1988.

[0018] In the prostate as well as in many other tissues, testosterone is irreversibly converted by 5 α -reductase into the more potent androgen dihydrotestosterone (Bruchovsky and Wilson, J. Biol. Chem. 243: 2012-2021, 1968; Wilson, Handbook of Physiology 5 (section 7), pp. 491-508, 1975). Inhibitors of 5 α -reductase have been found to inhibit prostatic growth (Brooks et al., Endocrinology 109: 830, 1981; Brooks et al., Proc. Soc. Exp. Biol. Med. 169: 67, 1982; Brooks et al., Prostate 3: 35, 1982; Wenderoth et al., Endocrinology 113:569-573, 1983; McConnell et al., J. Urol. 141: 239A, 1989; Stoner, E., Lecture on the role of 5.alpha.-reductase inhibitor in benign prostatic hypertrophy, 84th AUA Annual Meeting, Dallas, May 8, 1989.)

[0019] The inhibitory effect of the 5 α -reductase inhibitor Merck L 652,931 on prostatic and seminal vesicle development in the prepubertal rat was described in Proc. 71st Annual Meeting of Endocr. Soc. abst. #1165, p. 314, 1989. The inhibitory effect of MK-906 on dihydrotestosterone formation in men has been described in men by Gormley et al., in Proc. 71st Annual Meeting of Endocr. Soc., abst. #1225, p. 329, 1989; Imperato-McGinley et al., in Proc. 71st Annual Meeting of Endocr. Soc., abst. #1639, p. 432, 1989; Geller and Franson, in Proc. 71st Annual Meeting of Endocr. Soc., abst. #1640, p. 432, 1989 and Tenover et al., in Proc. 71st Annual Meeting of Endocr. Soc., abst. #583, p. 169, 1989. The activity of the 5 α -reductase inhibitors N,N-diethyl-4-methyl-3-oxo-4-aza-5.alpha.-androstane-17.beta.-

carboxamide (4-MA) and 6-methylene-4-pregnene-3,20-dione (LY 207320) has been described by Toomey et al., Proc. 71st Annual Meeting of Endocr. Soc., abst. #1226, p. 329, 1989.

In addition to the well-known effect of androgens on prostatic growth, there are many studies which show that estrogens play also a role in proliferation of the prostate (Walsh and Wilson, J. Clin. Invest. 57: 1093-1097, 1976; Robinette et al., Invest. Urol. 15: 425-432, 1978; Moore et al., J. Clin. Invest. 63: 351-257, 1979). Moreover, estrogens have been shown to enhance androgen-induced prostatic growth in the dog (Walsh and Wilson, J. Clin. Invest. 57: 1093-1097, 1976; Jacobi et al., Endocrinology 102: 1748-1755, 1978; Tunn et al., Urol. Int. 35: 125-140, 1980). A possible explanation of this enhancing effect of estrogen on androgen-induced prostate growth, is the observation that 17 β -estradiol has been shown to increase androgen binding in the dog prostate (Moore et al., J. Clin. Invest. 63: 351-357, 1979).

[0020] The antiestrogen Tamoxifen has been shown to improve steroid-induced benign prostatic hyperplasia in the dog (Funke et al., Acta Endocrinol. 100: 462-472, 1982). Administration of the antiestrogen Tamoxifen in association with the steroidal antiandrogen cyproterone acetate in patients suffering from benign prostatic hyperplasia showed beneficial effects on the symptoms of the disease (Di Silverio et al., in Ipertrafia Prostatica Benigna (F. Di Silverio, F. Neumann and M. Tannenbaum, eds), Excerpta Medica, pp. 117-125, 1986). In U.S. Pat. No. 4,310,523, it is proposed that a combination of an antiandrogen and an antiestrogen is effective for the prophylaxis and/or therapy of benign prostatic hyperplasia. Tamoxifen, however, has intrinsic estrogenic activity which limits its effectiveness.

[0021] Estrogen formation resulting from aromatization of androgens, occurs at several sites. In the male, aromatization of androgens has been

demonstrated in the testis, adipose and muscle tissue, skin, liver, brain and prostate (Schweikert et al., J. Clin. Endocrinol. Metab. 40: 413-417, 1975; Folker and James, J. Steroid Biochem. 49: 687-690, 1983; Longcope et al., J. Clin. Endocrinol. Metab. 46: 146-152, 1978; Lacoste and Labrie, unpublished data; Stone et al., The Prostate 9: 311-318, 1986; Stone et al., Urol. Res. 15: 165-167, 1987). There is evidence for an increased production of estrogens in the prostatic tissue of benign prostatic hyperplasia patients (Stone et al., The Prostate 9: 311-318, 1986). Such data indicate that the local formation of estrogens may play a crucial role in stimulating prostatic growth in excess of the action predicted by circulating estrogens.

[0022] U.S. Pat No. 4,472,382 discloses treatment of BPH with an antiandrogen and certain peptides which act as LH-RH agonists. U.S. Pat No. 4,596,797 discloses aromatase inhibitors as a method of prophylaxis and/or treatment of prostatic hyperplasia. U.S. Pat. No. 4,760,053 describes a treatment of certain cancers which combines an LHRH agonist with an antiandrogen and/or an antiestrogen and/or at least one inhibitor of sex steroid biosynthesis. U.S. Pat. No. 4,775,660 discloses a method of treating breast cancer with a combination therapy which may include surgical or chemical prevention of ovarian secretions and administering an antiandrogen and an antiestrogen.

[0023] U.S. Pat. No. 4,659,695 discloses a method of treatment of prostate cancer in susceptible male animals including humans whose testicular hormonal secretions are blocked by surgical or chemical means, e.g. by use of an LHRH agonist, which comprises administering an antiandrogen, e.g. flutamide, in association with at least one inhibitor of sex steroid biosynthesis, e.g. aminoglutethimide and/or ketoconazole. The disclosures of each of the above-mentioned patents (US 4,472,382, 4,596,797, 4,760,053, 4,775,660, and 4,659,695) are incorporated by reference herein in their entireties.

[0024] BPH is caused by increased activity of both androgens and estrogens. Because of such a dual etiology of BPH, proposed hormonal therapies have been less than satisfactory and have all been unpredictable while, frequently, causing unacceptable side-effects. Moreover, the prior art treatment seldomly resulted in a decrease in prostatic volume above about 20 to 30% with inconsistent effects on the symptomatology (Scott and Wade, J. Urol. 101: 81-85, 1969; Caine et al., J. Urol. 114: 564-568, 1975; Peters and Walsh, New Engl. J. Med. 317: 599-604, 1987; Gabrilove et al., J. Clin. Endocrinol. Metab. 64: 1331-1333, 1987; Stone et al., J. Urol. 141: 240A, 1989; Clejan et al., J. Urol. 141: 534A, 1989; Stoner, E., Lecture on the role of 5 α -reductase inhibitor in benign prostatic hypertrophy, 84th AUA Annual Meeting, Dallas, May 8, 1989.

[0025] The elucidation of the mechanism summarized above has resulted in the recent development of effective agents to control, and in many cases reverse, the advance of BPH. In the forefront of these agents is Merck & Co., Inc.'s product PROSCAR® (finasteride). The effect of this compound is to inhibit the enzyme testosterone 5 α reductase, which converts testosterone into 5 α -dihydrotestosterone, resulting in a reduced rate of prostatic enlargement, and often reduction in prostatic mass.

[0026] The development of such agents as PROSCAR® bodes well for the long-term control of BPH. However, as may be appreciated from the lengthy development of the syndrome, its reversal also is not immediate. In the interim, those males suffering with BPH continue to suffer, and may in fact lose hope that the agents are working sufficiently rapidly.

[0027] In response to this problem, one solution is to identify pharmaceutically active compounds which complement slower-acting therapeutics by providing acute relief. Agents that induce relaxation of the lower urinary tract tissue, by binding to alpha 1 adrenergic receptors, thus reducing the increased adrenergic tone due to the disease, would be good

candidates for this activity. Thus, one such agent is alfuzosin, which is reported in EP 0 204597 to induce urination in cases of prostatic hyperplasia. Likewise, in WO 92/00073, the selective ability of the R(+) enantiomer of terazosin to bind to adrenergic receptors of the α_1 subtype was reported. In addition, in WO 92/16213, combinations of α -reductase inhibitory compounds and α_1 -adrenergic receptor blockers (terazosin, doxazosin, prazosin, bunazosin, indoramin, alfuzosin) were disclosed. However, no information as to the α_{1d} , α_{1b} , or α_{1a} subtype specificity of these compounds was provided as this data and its relevancy to the treatment of BPH was not known. Current therapy for BPH uses existing non-selective α_1 antagonists such as prazosin (Minipress, Pfizer), Terazosin (Hytrin, Abbott) or doxazosin mesylate (Cardura, Pfizer). These non-selective antagonists suffer from side effects related to antagonism of the α_{1d} and α_{1b} receptors in the peripheral vasculature, e.g., hypotension and syncope.

[0028] The cloning of the human α_{1a} adrenergic receptor (ATCC CRL 11140) and the use of a screening assay utilizing the cloned human α_{1a} receptor enables identification of compounds which specifically interact with the human α_{1a} adrenergic receptor. [PCT International Application Publication Nos. WO94/08040, published Apr. 14, 1994 and WO94/10989, published May 26, 1994]

[0029] WO 96/14846, published May 23, 1996, discloses a broad genus of dihydropyrimidine compounds and proposes their use as selective antagonists for human α_{1a} receptors. Compounds were assayed using cloned human α adrenergic receptors, and certain of the compounds so assayed were disclosed to be selective α_{1a} antagonists.

[0030] Other conditions involving unwanted cellular elements exist where selective cellular removal is desirable. For example, heart disease and strokes commonly are caused by atherosclerosis, which is a proliferative

lesion of fibrofatty and modified smooth muscle elements that distort the blood vessel wall, narrow the lumen, constrict blood flow, predispose to focal blood clots, and ultimately lead to blockage and infarction. There are various treatments for atherosclerosis such as bypass grafts; artificial grafts; angioplasty with recanalization, curettage, radiation, laser, or other removal; pharmacotherapy to inhibit atherosclerosis through lipid reduction; anti-clotting therapies; and general measures of diet, exercise, and lifestyle. A method for removing atherosclerotic lesions without the risk and side effects of surgical procedures is needed.

[0031] Other examples of unwanted cellular elements where selective cellular removal is desirable include viral induced growths, such as warts. Another example is hypertrophic inflammatory masses found in inflammatory conditions, and hypertrophic scars or keloids. Still other examples are found in cosmetic contexts such as the removal of unwanted hair, e.g., facial hair, or for shrinkage of unwanted tissue areas for cosmetic purposes, such as in the facial Dermis and connective tissues or in the dermas and connective tissue of the extremities.

[0032] Other examples of unwanted cellular elements where selective cellular removal or the inhibition of cellular proliferation is desirable include stenosis and restenosis of any artery, valve or canal in the circulatory system including, but not limited to, valves (e.g., aortic stenosis which involves narrowing of the aortic valve orifice), coronary arteries (e.g., coronary ostial sclerosis which involves narrowing of the mouths of the coronary arteries), carotid arteries, and renal arteries. Other examples include the inhibition or removal of unwanted cellular growth or accumulation causing the partial or complete occlusion of medical devices such as stents placed or implanted within a blood vessel for treating stenoses, strictures or aneurysms therein or within the urinary tract and in bile ducts.

[0033] Still other examples will be obvious to those of ordinary skill in the art. In all or most of these examples there is a need for treatments that can remove or destroy the unwanted cellular elements without the risks and side effects of conventional therapies or remove the unwanted cellular elements with more precision.

[0034] Throughout this description, including the foregoing description of related art, any and all publicly available documents described herein, including any and all U.S. patent published patent applications, are specifically incorporated by reference herein in their entirety. The foregoing description of related art is not intended in any way as an admission that any of the documents described therein, including pending U.S. patent applications, are prior art to the present disclosure. Moreover, the description herein of any disadvantages associated with the described products, methods, and/or apparatus, is not intended to limit the embodiments. Indeed, aspects of the embodiments may include certain features of the described products, methods, and/or apparatus without suffering from their described disadvantages.

SUMMARY OF THE EMBODIMENTS

[0035] There remains a need in the art for new, less toxic treatments for treating unwanted cellular elements. The embodiments satisfy these needs.

[0036] This disclosure is premised in part on the discovery that certain NTP peptides, including a specific peptide described by the amino acid sequence Ile-Asp-Gln-Gln-Val-Leu-Ser-Arg-Ile-Lys-Leu-Glu-Ile-Lys-Arg-Cys-Leu, are capable of treating and/or killing unwanted cellular proliferations in mammals when combined with at least one additional active agent capable of treating symptoms of, reducing, blocking, inhibiting treating and/or killing unwanted cellular proliferations in mammals. These unwanted cellular proliferations include, *inter alia*, benign and malignant

tumors, glandular (e.g. prostate) hyperplasia, unwanted facial hair, warts, and unwanted fatty tissue.

[0037] This disclosure also is premised in part on the discovery that certain NTP peptides, including a specific peptide described by the amino acid sequence Ile-Asp-Gln-Gln-Val-Leu-Ser-Arg-Ile-Lys-Leu-Glu-Ile-Lys-Arg-Cys-Leu, either alone or in combination with an additional active agent capable of treating symptoms of, reducing, blocking, inhibiting treating and/or killing unwanted cellular proliferations in mammals, provide an unexpected improvement in patients who subsequently undergo surgical treatment

[0038] Some embodiments are directed to compositions and methods of treating unwanted cellular proliferations (benign and malignant tumors, glandular (e.g. prostate) hyperplasia, unwanted facial hair, warts, and unwanted fatty tissue) comprising administering to a mammal in need thereof a therapeutically effective amount of a composition comprising an NTP peptide, in combination with at least one additional active agent capable of treating and/or killing unwanted cellular proliferations in mammals.

[0039] The compositions can be administered intramuscularly, orally, intravenously, intraperitoneally, intracerebrally (intraparenchymally), intracerebroventricularly, intratumorally, intralesionally, intradermally, intrathecally, intranasally, intraocularly, intraarterially, topically, transdermally, via an aerosol, infusion, bolus injection, implantation device, sustained release system etc.. Alternatively, the NTP peptides can be expressed in vivo by administering a gene that expresses the NTP peptides, by administering a vaccine that induces such production or by introducing cells, bacteria or viruses that express the peptide in vivo, because of genetic modification or otherwise. In this alternative embodiment, and in the embodiments discussed previously, the additional

active agent can be administered together or separately from the NTP peptide or the agent that expresses the NTP peptide in vivo.

[0040] Some embodiments include methods of treating unwanted cellular proliferations (benign and malignant tumors, glandular (e.g. prostate) hyperplasia, unwanted facial hair, warts, and unwanted fatty tissue) comprising administering to a mammal in need thereof a therapeutically effective amount of a composition comprising an NTP peptide, in combination with at least one additional active agent capable of treating and/or killing unwanted cellular proliferations in mammals, followed by surgical treatment of the unwanted cellular proliferations.

[0041] Both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the embodiments as claimed. Other objects, advantages, and features will be readily apparent to those skilled in the art from the following detailed description of the embodiments.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0042] Before the present proteins, nucleotide sequences, peptides, compositions, active agents, etc., and methods are described, it is understood that this invention is not limited to the particular methodology, protocols, cell lines, vectors, and reagents described, as these may vary. It also is to be understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to limit the scope of the present embodiments which will be limited only by the appended claims.

[0043] Terms and phrases used herein are defined as set forth below unless otherwise specified. Throughout this description, the singular forms "a," "an," and "the" include plural reference unless the context clearly dictates otherwise. Thus, for example, a reference to "a host cell" includes a plurality of such host cells, and a reference to "an antibody" is a reference

to one or more antibodies and equivalents thereof known to those skilled in the art, and so forth.

[0044] Amino acids and amino acid residues described herein may be referred to according to the accepted one or three-letter code provided in the table below.

Table 1

Three-Letter Amino Acid	One-Letter Symbol	Symbol
Alanine	A	Ala
Arginine	R	Arg
Asparagine	N	Asn
Aspartic acid	D	Asp
Cysteine	C	Cys
Glutamine	Q	Gln
Glutamic acid	E	Glu
Glycine	G	Gly
Histidine	H	His
Isoleucine	I	Ile
Leucine	L	Leu
Lysine	K	Lys
Methionine	M	Met
Phenylalanine	F	Phe
Proline	P	Pro
Serine	S	Ser
Threonine	T	Thr
Tryptophan	W	Trp
Tyrosine	Y	Tyr
Valine	V	Val

[0045] The expression “NTP peptide” refers to peptides comprising amino acid sequences corresponding to at least a part of the amino acid sequence of Neural Thread Proteins or to fragments of Neural Thread Proteins and includes homologues, derivatives, variants, fusion proteins, and peptide mimetics of such peptides unless the context indicates otherwise. The expression “NTP peptide” also refers to a peptide or other composition of matter claimed in one or more of the following U.S. patent application Publication Nos. 2007/0237780 (now abandoned); 2003/0054990 (now US

Patent No. 7,172,893); 2003/0096350 (now US Patent No. 6,924,266); 2003/0096756 (now US Patent No. 7,192,929); 2003/0109437 (now US Patent No. 7,241,738); 2003/0166569 (now US Patent No. 7,317,077); and 2005/0032704 (now US Patent No. 7,408,021). The disclosures of each of these applications are incorporated by reference herein in their entirety. Specific peptides are listed below.

- 1) SEQ ID NO. 1: MEFSLLLPRLECNGA or Met-Glu-Phe-Ser-Leu-Leu-Leu-Pro-Arg-Leu-Glu-Cys-Asn-Gly-Ala
- 2) SEQ ID NO. 2: GAISAHRLRLPGSS or Gly-Ala-Ile-Ser-Ala-His-Arg-Asn-Leu-Arg-Leu-Pro- Gly-Ser-Ser
- 3) SEQ ID NO. 3: DSPASASPVAGITGMCT or Asp-Ser-Pro-Ala-Ser-Ala-Ser-Pro-Val-Ala-Gly-Ile-Thr-Gly-Met-Cys-Thr
- 4) SEQ ID NO.4: MCTHARLILYFFLVEM or Met-Cys-Thr-His-Ala-Arg-Leu-Ile-Leu-Tyr-Phe-Phe-Leu-Val-Glu-Met
- 5) SEQ ID NO.5: YFFLVEMEFLH or Tyr-Phe-Phe-Leu-Val-Glu-Met-Glu-Phe-Leu-His
- 6) SEQ ID NO.6: VGQAGLELPTS or Val-Gly-Gln-Ala-Gly-Leu-Glu-Leu-Pro-Thr-Ser
- 7) SEQ ID NO.7: DDPSVSASQSARYRTGH or Asp-Asp-Pro-Ser-Val-Ser-Ala-Ser-Gln-Ser-Ala-Arg-Tyr-Arg-Thr-Gly-His
- 8) SEQ ID NO.8: TGHHARLCLANFCG or Thr-Gly-His-His-Ala-Arg-Leu-Cys-Leu-Ala-Asn-Phe-Cys-Gly
- 9) SEQ ID NO.9: ANFCGRNRVSLMCPSWS or Ala-Asn-Phe-Cys-Gly-Arg-Asn-Arg-Val-Ser-Leu-Met-Cys-Pro-Ser-Trp-Ser
- 10) SEQ ID NO.10: PELKQSTCLSLPKWDYRR or Pro-Glu-Leu-Lys-Gln-Ser-Thr-Cys-Leu-Ser-Leu-Pro-Lys-Cys-Trp-Asp-Tyr-Arg-Arg
- 11) SEQ ID NO.11: LKQSTCLSLPKWDYRR or Leu-Lys-Gln-Ser-Thr-Cys-Leu-Ser-Leu-Pro-Lys-Cys-Trp-Asp-Tyr-Arg-Arg

- 12) SEQ ID NO.12: STCLSLPKWDYRR or Ser-Thr-Cys-Leu-Ser-Leu-Pro-Lys-Cys-Trp-Asp-Tyr-Arg-Arg
- 13) SEQ ID NO.13: LSLPKWDYRR or Leu-Ser-Leu-Pro-Lys-Cys-Trp-Asp-Tyr-Arg-Arg
- 14) SEQ ID NO.14: KCWDYRRRAAVPGL or Lys-Cys-Trp-Asp-Tyr-Arg-Arg-Ala-Ala-Val-Pro-Gly-Leu
- 15) SEQ ID NO. 15: KCWDYRRRAAVPGLFILFFL or Lys-Cys-Trp-Asp-Tyr-Arg-Arg-Ala-Ala-Val-Pro-Gly-Leu-Phe-Ile-Leu-Phe-Phe-Leu
- 16) SEQ ID NO.16: KCWDYRRRAAVPGLFILFFLRHRCPP or Lys-Cys-Trp-Asp-Tyr-Arg-Arg-Ala-Ala-Val-Pro-Gly-Leu-Phe-Ile-Leu-Phe-Phe-Leu-Arg-His-Arg-Cys-Pro
- 17) SEQ ID NO.17:
KCWDYRRRAAVPGLFILFFLRHRCPTLTQDEVQWCDHSS or
Lys-Cys-Trp-Asp-Tyr-Arg-Arg-Ala-Ala-Val-Pro-Gly-Leu-Phe-Ile-Leu-Phe-Phe-Leu-Arg-His-Arg-Cys-Pro-Thr-Leu-Thr-Gln-Asp-Glu-Val-Gln-Trp-Cys-Asp-His-Ser-Ser
- 18) SEQ ID NO.18: WDYRR or Trp-Asp-Tyr-Arg-Arg
- 19) SEQ ID NO.19: FILFFLRHRCPTL or Phe-Ile-Leu-Phe-Phe-Leu-Arg-His-Arg-Cys-Pro-Thr-Leu
- 20) SEQ ID NO.20: FILFFLRHRCPTLTQDEVQWCDHSS or Phe-Ile-Leu-Phe-Phe-Leu-Arg-His-Arg-Cys-Pro-Thr-Leu-Thr-Gln-Asp-Glu-Val-Gln-Trp-Cys-Asp-His-Ser-Ser
- 21) SEQ ID NO.21: HRCPTLTQDEVQWCDHSSLQPSTPEIKHP or His-Arg-Cys-Pro-Thr-Leu-Thr-Gln-Asp-Glu-Val-Gln-Trp-Cys-Asp-His-Ser-Ser-Leu-Gln-Pro-Ser-Thr-Pro-Glu-Ile-Lys-His-Pro
- 22) SEQ ID NO.22: PASASQVAGTKDMH or Pro-Ala-Ser-Ala-Ser-Gln-Val-Ala-Gly-Thr-Lys-Asp-Met-His
- 23) SEQ ID NO.23: DMHHYTWLIFIFIFNFLR or Asp-Met-His-His-Tyr-Thr-Trp-Leu-Ile-Phe-Ile-Phe-Ile-Phe-Asn-Phe-Leu-Arg

- 24) SEQ ID NO.24: HYTWLIFIFIFNFLRQSLN or His-Tyr-Thr-Trp-Leu-Ile-Phe-Ile-Phe-Ile-Phe-Asn-Phe-Leu-Arg-Gln-Ser-Leu-Asn
- 25) SEQ ID NO.25:
SVTQAGVQWRNLGSLQPLPPGFKLFSCPSLLSSWDYRRPPRLANF or Ser-Val-Thr-Gln-Ala-Gly-Val-Gln-Trp-Arg-Asn-Leu-Gly-Ser-Leu-Gln-Pro-Leu-Pro-Pro-Gly-Phe-Lys-Leu-Phe-Ser-Cys-Pro-Ser-Leu-Leu-Ser-Ser-Trp-Asp-Tyr-Arg-Arg-Pro-Pro-Arg-Leu-Ala-Asn-Phe
- 26) SEQ ID NO.26: PGFKLFSCPSLLSSWDYRR or Pro-Gly-Phe-Lys-Leu-Phe-Ser-Cys-Pro-Ser-Leu-Leu-Ser-Ser-Trp-Asp-Tyr-Arg-Arg
- 27) SEQ ID NO.27: FKLFSCPSLLSSWDYRRPPRLANF or Phe-Lys-Leu-Phe-Ser-Cys-Pro-Ser-Leu-Leu-Ser-Ser-Trp-Asp-Tyr-Arg-Arg-Pro-Pro-Arg-Leu-Ala-Asn-Phe
- 28) SEQ ID NO.28: FSCPSLLSSWDYRR or Phe-Ser-Cys-Pro-Ser-Leu-Leu-Ser-Ser-Trp-Asp-Tyr-Arg-Arg
- 29) SEQ ID NO.29: SLLSSWDYRR or Ser-Leu-Leu-Ser-Ser-Trp-Asp-Tyr-Arg-Arg
- 30) SEQ ID NO.30: SSWDY or Ser-Ser-Trp-Asp-Tyr
- 31) SEQ ID NO.31: SSWDYRR or Ser-Ser-Trp-Asp-Tyr-Arg-Arg
- 32) SEQ ID NO.32: SSWDYRRPPRLANFFVFLVEMGFTM or Ser-Ser-Trp-Asp-Tyr-Arg-Arg-Pro-Pro-Arg-Leu-Ala-Asn-Phe-Phe-Val-Phe-Leu-Val-Glu-Met-Gly-Phe-Thr-Met
- 33) SEQ ID NO.33: FVFLVEMGFTM or Phe-Val-Phe-Leu-Val-Glu-Met-Gly-Phe-Thr-Met
- 34) SEQ ID NO.34: MGFTMFARLILISGPCDLPASAS or Met-Gly-Phe-Thr-Met-Phe-Ala-Arg-Leu-Ile-Leu-Ile-Ser-Gly-Pro-Cys-Asp-Leu-Pro-Ala-Ser-Ala-Ser
- 35) SEQ ID NO.35: ISGPC or Ile-Ser-Gly-Pro-Cys

- 36) SEQ ID NO.36: DLPASASQSAGITGVSH or Asp-Leu-Pro-Ala-Ser-Ala-Ser-Gln-Ser-Ala-Gly-Ile-Thr-Gly-Val-Ser-His
- 37) SEQ ID NO.37: GVSHHARLIFNFCLFEM or Gly-Val-Ser-His-His-Ala-Arg-Leu-Ile-Phe-Asn-Phe-Cys-Leu-Phe-Glu-Met
- 38) SEQ ID NO.38: NFCLFEMESH or Asn-Phe-Cys-Leu-Phe-Glu-Met-Glu-Ser-His
- 39) SEQ ID NO.39:
SVTQAGVQWPNLGSLQPLPPGLKRFSCSLPSSWDYGHLP
PHPANF or Ser-Val-Thr-Gln-Ala-Gly-Val-Gln-Trp-Pro-Asn-Leu-Gly-Ser-Leu-Gln-Pro-Leu-Pro-Pro-Gly-Leu-Lys-Arg-Phe-Ser-Cys-Leu-Ser-Leu-Pro-Ser-Ser-Trp-Asp-Tyr-Gly-His-Leu-Pro-Pro-His-Pro-Ala-Asn-Phe
- 40) SEQ ID NO.40: PPGLKRFSCSLPSSWDYG or Pro-Pro-Gly-Leu-Lys-Arg-Phe-Ser-Cys-Leu-Ser-Leu-Pro-Ser-Ser-Trp-Asp-Tyr-Gly
- 41) SEQ ID NO.41: FSCSLPSSWDYGH or Phe-Ser-Cys-Leu-Ser-Leu-Pro-Ser-Ser-Trp-Asp-Tyr-Gly-His
- 42) SEQ ID NO.42: LSLPSSWDY or Leu-Ser-Leu-Pro-Ser-Ser-Trp-Asp-Tyr
- 43) SEQ ID NO.43:
SSWDYGHLPHPANFCIFIRGGVSPYLSGWSQTPDLR or
Ser-Ser-Trp-Asp-Tyr-Gly-His-Leu-Pro-Pro-His-Pro-Ala-Asn-Phe-Cys-Ile-Phe-Ile-Arg-Gly-Gly-Val-Ser-Pro-Tyr-Leu-Ser-Gly-Trp-Ser-Gln-Thr-Pro-Asp-Leu-Arg
- 44) SEQ ID NO.44: PGFFKLFSCPSLLSSWDYRR or Pro-Gly-Phe-Phe-Lys-Leu-Phe-Ser-Cys-Pro-Ser-Leu-Leu-Ser-Ser-Trp-Asp-Tyr-Arg-Arg
- 45) SEQ ID NO.45: PELKQSTCLSLPKCWDYRR or Pro-Glu-Leu-Lys-Gln-Ser-Thr-Cys-Leu-Ser-Leu-Pro-Lys-Cys-Trp-Asp-Tyr-Arg-Arg

- 46) SEQ ID NO.46: PPGLKRFSCLSLPSSWDYG or Pro-Pro-Gly-Leu-Lys-Arg-Phe-Ser-Cys-Leu-Ser-Leu-Pro-Ser-Ser-Trp-Asp-Tyr-Gly
- 47) SEQ ID NO.47: FSCLSLPSSWDYGH or Phe-Ser-Cys-Leu-Ser-Leu-Pro-Ser-Ser-Trp-Asp-Tyr-Gly-His
- 48) SEQ ID NO.48: STCLSLPKCWDYRR or Ser-Thr-Cys-Leu-Ser-Leu-Pro-Lys-Cys-Trp-Asp-Tyr-Arg-Arg
- 49) SEQ ID NO.49: FSCPSLLSSWDYRR or Phe-Ser-Cys-Pro-Ser-Leu-Leu-Ser-Ser-Trp-Asp-Tyr-Arg-Arg
- 50) SEQ ID NO.50: LSLPSSWDY or Leu-Ser-Leu-Pro-Ser-Ser-Trp-Asp-Tyr
- 51) SEQ ID NO.51: LSLPKCWDYRR or Leu-Ser-Leu-Pro-Lys-Cys-Trp-Asp-Tyr-Arg-Arg
- 52) SEQ ID NO.52: SLLSSWDYRR or Ser-Leu-Leu-Ser-Ser-Trp-Asp-Tyr-Arg-Arg
- 53) SEQ ID NO.53: LPSSWDYRR or Leu-Pro-Ser-Ser-Trp-Asp-Tyr-Arg-Arg
- 54) SEQ ID NO.54: SSWDYRR or Ser-Ser-Trp-Asp-Tyr-Arg-Arg
- 55) SEQ ID NO.55: SSWDY or Ser-Ser-Trp-Asp-Tyr
- 56) SEQ ID NO.56: SSWDYRRFILFFL or Ser-Ser-Trp-Asp-Tyr-Arg-Arg-Phe-Ile-Leu-Phe-Phe-Leu
- 57) SEQ ID NO.57: WDYRRFIFNFL or Trp-Asp-Tyr-Arg-Arg-Phe-Ile-Phe-Asn-Phe-Leu
- 58) SEQ ID NO.58: FNFCLF or Phe-Asn-Phe-Cys-Leu-Phe
- 59) SEQ ID NO.59: FIFNFL or Phe-Ile-Phe-Asn-Phe-Leu
- 60) SEQ ID NO.60: PASASPVAGITGM or Pro-Ala-Ser-Ala-Ser-Pro-Val-Ala-Gly-Ile-Thr-Gly-Met
- 61) SEQ ID NO.61: PASASQVAGTKDM or Pro-Ala-Ser-Ala-Ser-Gln-Val-Ala-Gly-Thr-Lys-Asp-Met
- 62) SEQ ID NO.62: PASASQSAGITGV or Pro-Ala-Ser-Ala-Ser-Gln-Ser-Ala-Gly-Ile-Thr-Gly-Val

- 63) SEQ ID NO.63: PASASPVAG or Pro-Ala-Ser-Ala-Ser-Pro-Val-Ala-Gly
- 64) SEQ ID NO.64: FFLVEM or Phe-Phe-Leu-Val-Glu-Met
- 65) SEQ ID NO.65: SVTQAGVQW or Ser-Val-Thr-Gln-Ala-Gly-Val-Gln-Trp
- 66) SEQ ID NO.66: IDQQVLSRIKLEIKRCL or Ile-Asp-Gln-Gln-Val-Leu-Ser-Arg-Ile-Lys-Leu- Glu-Ile-Lys-Arg-Cys-Leu
- 67) SEQ ID NO.67: LSRIKLEIK or Leu-Ser-Arg-Ile-Lys-Leu-Glu-Ile-Lys
- 68) SEQ ID NO.68: GDHGRPNLSRLKLAIKYEVKKM or Gly-Asp-His-Gly-Arg-Pro-Asn-Leu-Ser-Arg-Leu-Lys-Leu-Ala-Ile-Lys-Tyr-Glu-Val-Lys-Lys-Met
- 69) SEQ ID NO.69: QQSIAVKFLAVFGVSI or Gln-Gln-Ser-Ile-Ala-Val-Lys-Phe-Leu-Ala-Val- Phe-Gly-Val-Ser-Ile
- 70) SEQ ID NO.70: GLLFPVFSVCYLIAPKSPLGL or Gly-Leu-Leu-Phe-Pro-Val-Phe-Ser-Val-Cys-Tyr-Leu-Ile-Ala-Pro-Lys-Ser-Pro-Leu-Gly-Leu
- 71) SEQ ID NO. 71: MMVCWNRFGKWVYFI or Met-Met-Val-Cys-Trp-Asn-Arg-Phe-Gly-Lys-Trp-Val-Tyr-Phe-Ile
- 72) SEQ ID NO. 72: SAIFNFGPRYLYHGV or Ser-Ala-Ile-Phe-Asn-Phe-Gly-Pro-Arg-Tyr-Leu- Tyr-His-Gly-Val
- 73) SEQ ID NO. 73: PFYFLILVRIISFLI or Pro-Phe-Tyr-Phe-Leu-Ile-Leu-Val-Arg-Ile-Ile-Ser-Phe-Leu-Ile
- 74) SEQ ID NO. 74: GDMEDVLLNCTLLKR or Gly-Asp-Met-Glu-Asp-Val-Leu-Leu-Asn-Cys-Thr-Leu-Leu-Lys-Arg
- 75) SEQ ID NO. 75: SSRFRFWGALVCSMD or Ser-Ser-Arg-Phe-Arg-Phe-Trp-Gly-Ala-Leu-Val-Cys-Ser-Met-Asp
- 76) SEQ ID NO. 76: SCRFSRVAVTYRFIT or Ser-Cys-Arg-Phe-Ser-Arg-Val-Ala-Val-Thr-Tyr- Arg-Phe-Ile-Thr
- 77) SEQ ID NO. 77: LLNIPSPAVWMARNT or Leu-Leu-Asn-Ile-Pro-Ser-Pro-Ala-Val-Trp-Met-Ala-Arg-Asn-Thr

- 78) SEQ ID NO. 78: MAQSRLTATSASRVQ or Met-Ala-Gln-Ser-Arg-Leu-Thr-Ala-Thr-Ser-Ala-Ser-Arg-Val-Gln
- 79) SEQ ID NO. 79: AILLSQPPKQLGLRA or Ala-Ile-Leu-Leu-Ser-Gln-Pro-Pro-Lys-Gln-Leu-Gly-Leu-Arg-Ala
- 80) SEQ ID NO. 80: PANTPLIFVFSLEAG or Pro-Ala-Asn-Thr-Pro-Leu-Ile-Phe-Val-Phe-Ser-Leu- Glu-Ala-Gly
- 81) SEQ ID NO. 81: FHHICQAGLKLLTSG or Phe-His-His-Ile-Cys-Gln-Ala-Gly-Leu-Lys-Leu-Leu-Thr-Ser-Gly
- 82) SEQ ID NO. 82: DPPASAFQSAGITGV or Asp-Pro-Pro-Ala-Ser-Ala-Phe-Gln-Ser-Ala-Gly- Ile-Thr-Gly-Val
- 83) SEQ ID NO. 83: SHLTQPANLDKKICS or Ser-His-Leu-Thr-Gln-Pro-Ala-Asn-Leu-Asp-Lys-Lys-Ile-Cys-Ser
- 84) SEQ ID NO. 84: NGGSCYVAQAGLKLLASCNPSK or Asn-Gly-Gly-Ser-Cys-Tyr-Val-Ala-Gln-Ala-Gly-Leu-Lys-Leu-Leu-Ala-Ser-Cys-Asn-Pro-Ser-Lys
- 85) SEQ ID NO. 85: MWTLKSSLVLLCLT or Met-Trp-Thr-Leu-Lys-Ser-Ser-Leu-Val-Leu-Leu-Leu-Cys-Leu-Thr
- 86) SEQ ID NO. 86: CSYAFMFSSLRQKTS or Cys-Ser-Tyr-Ala-Phe-Met-Phe-Ser-Ser-Leu-Arg-Gln-Lys-Thr-Ser
- 87) SEQ ID NO. 87: EPQGKVPCGEHFRIR or Glu-Pro-Gln-Gly-Lys-Val-Pro-Cys-Gly-Glu-His-Phe-Arg-Ile-Arg
- 88) SEQ ID NO. 88: QNLPEHTQGWLGSKW or Gln-Asn-Leu-Pro-Glu-His-Thr-Gln-Gly-Trp-Leu-Gly-Ser-Lys-Trp
- 89) SEQ ID NO. 89: LWLLFAVVPFVILKC or Leu-Trp-Leu-Leu-Phe-Ala-Val-Val-Pro-Phe-Val-Ile-Leu-Lys-Cys
- 90) SEQ ID NO. 90: QRDSEKNKVRMAPFF or Gln-Arg-Asp-Ser-Glu-Lys-Asn-Lys-Val-Arg-Met-Ala-Pro-Phe-Phe
- 91) SEQ ID NO. 91: LHHIDSISGVSGKRMF or Leu-His-His-Ile-Asp-Ser-Ile-Ser-Gly-Val-Ser-Gly-Lys-Arg-Met-Phe
- 92) SEQ ID NO. 92: EAYYTMLHLPTTNRP or Glu-Ala-Tyr-Tyr-Thr-Met-Leu-His-Leu-Pro-Thr-Thr-Asn-Arg-Pro

- 93) SEQ ID NO. 93: KIAHCILFNQPHSPR or Lys-Ile-Ala-His-Cys-Ile-Leu-Phe-Asn-Gln-Pro-His- Ser-Pro-Arg
- 94) SEQ ID NO. 94: SNSHSHPNPLKLHRR or Ser-Asn-Ser-His-Ser-His-Pro-Asn-Pro-Leu-Lys-Leu-His-Arg-Arg
- 95) SEQ ID NO. 95: SHSHNRPRAYILITI or Ser-His-Ser-His-Asn-Arg-Pro-Arg-Ala-Tyr-Ile-Leu-Ile-Thr-Ile
- 96) SEQ ID NO. 96: LPSKCLKLRTHSQSHH or Leu-Pro-Ser-Lys-Leu-Lys-Leu-Arg-Thr-His-Ser-Gln-Ser-His-His
- 97) SEQ ID NO. 97: NPLSRTSNSTPTNSFLMTSSKPR or Asn-Pro-Leu-Ser-Arg-Thr-Ser-Asn-Ser-Thr-Pro-Thr-Asn-Ser-Phe-Leu-Met-Thr-Ser-Ser-Lys-Pro-Arg
- 98) SEQ ID NO. 98: SSSLGLPKCWDYRHE or Ser-Ser-Ser-Leu-Gly-Leu-Pro-Lys-Cys-Trp-Asp-Tyr-Arg-His-Glu
- 99) SEQ ID NO. 99: LLSLALMINFRVMAC or Leu-Leu-Ser-Leu-Ala-Leu-Met-Ile-Asn-Phe-Arg-Val-Met-Ala-Cys
- 100) SEQ ID NO. 100: TFKQHIELRQKISIV or Thr-Phe-Lys-Gln-His-Ile-Glu-Leu-Arg-Gln-Lys-Ile-Ser-Ile-Val
- 101) SEQ ID NO. 101: PRKLCCMGVPVCPVKI or Pro-Arg-Lys-Leu-Cys-Cys-Met-Gly-Pro-Val-Cys-Pro-Val-Lys-Ile
- 102) SEQ ID NO. 102: ALLTINGHCTWLPAS or Ala-Leu-Leu-Thr-Ile-Asn-Gly-His-Cys-Thr-Trp-Leu-Pro-Ala-Ser
- 103) SEQ ID NO. 103: MFVFCLILNREKIKG or Met-Phe-Val-Phe-Cys-Leu-Ile-Leu-Asn-Arg-Glu-Lys-Ile-Lys-Gly
- 104) SEQ ID NO. 104: GNSSFFLLSFFFSFQ or Gly-Asn-Ser-Ser-Phe-Phe-Leu-Leu-Ser-Phe-Phe-Phe-Ser-Phe-Gln
- 105) SEQ ID NO. 105: NCCQCFQCRTTEGYA or Asn-Cys-Cys-Gln-Cys-Phe-Gln-Cys-Arg-Thr-Thr-Glu-Gly-Tyr-Ala
- 106) SEQ ID NO. 106: VECFYCLVDKAAFEWWFYSFDT or Val-Glu-Cys-Phe-Tyr-Cys-Leu-Val-Asp-Lys-Ala-Ala-Phe-Glu-Cys-Trp-Trp-Phe-Tyr-Ser-Phe-Asp-Thr

- 107) SEQ ID NO. 107: MEPHTVAQAGVPQHD or Met-Glu-Pro-His-Thr-Val-Ala-Gln-Ala-Gly-Val-Pro-Gln-His-Asp
- 108) SEQ ID NO. 108: LGSLQSLLPRFKRFS or Leu-Gly-Ser-Leu-Gln-Ser-Leu-Leu-Pro-Arg-Phe-Lys-Arg-Phe-Ser
- 109) SEQ ID NO. 109: CLILPKIWDYRNMNT or Cys-Leu-Ile-Leu-Pro-Lys-Ile-Trp-Asp-Tyr-Arg-Asn-Met-Asn-Thr
- 110) SEQ ID NO. 110: ALIKRNRYPETGRKS or Ala-Leu-Ile-Lys-Arg-Asn-Arg-Tyr-Thr-Pro-Glu-Thr-Gly-Arg-Lys-Ser
- 111) SEQ ID NO. 111: IDQQVLSRI or Ile-Asp-Gln-Gln-Val-Leu-Ser-Arg-Ile
- 112) SEQ ID NO. 112: KLEIKRCL or Lys-Leu-Glu-Ile-Lys-Arg-Cys-Leu
- 113) SEQ ID NO. 113: VLSRIK or Val-Leu-Ser-Arg-Ile-Lys
- 114) SEQ ID NO. 114: RIKLEIK or Arg-Ile-Lys-Leu-Glu-Ile-Lys
- 115) SEQ ID NO. 115: VLSRIKLEIKRCL or Val-Leu-Ser-Arg-Ile-Lys-Leu-Glu-Ile-Lys-Arg-Cys-Leu; and
- 116) SEQ ID NO. 116: IDQQVLSRIKLEI or Ile-Asp-Gln-Gln-Val-Leu-Ser-Arg-Ile-Lys-Leu-Glu-Ile.

The expression "NTP peptide" also preferably includes (but is not limited to) the amino acid sequences of SEQ ID NO: 1 to 116.

[0046] The term "fragment" refers to a protein or polypeptide that consists of a continuous subsequence of the amino acid sequence of a protein or peptide and includes naturally occurring fragments such as splice variants and fragments resulting from naturally occurring *in vivo* protease activity. Such a fragment may be truncated at the amino terminus, the carboxy terminus, and/or internally (such as by natural splicing). Such fragments may be prepared with or without an amino terminal methionine. The term "fragment" includes fragments, whether identical or different, from the same protein or peptide, with a contiguous amino acid sequence in common or not, joined together, either directly or through a linker. A person having

ordinary skill in the art will be capable of selecting a suitable fragment for use in the embodiments without undue experimentation using the guidelines and procedures outlined herein.

[0047] The term "variant" refers to a protein or polypeptide in which one or more amino acid substitutions, deletions, and/or insertions are present as compared to the amino acid sequence of a protein or peptide and includes naturally occurring allelic variants or alternative splice variants of a protein or peptide. The term "variant" includes the replacement of one or more amino acids in a peptide sequence with a similar or homologous amino acid(s) or a dissimilar amino acid(s). There are many scales on which amino acids can be ranked as similar or homologous. (Gunnar von Heijne, Sequence Analysis in Molecular Biology, p. 123-39 (Academic Press, New York, N.Y. 1987.) Preferred variants include alanine substitutions at one or more of amino acid positions. Other preferred substitutions include conservative substitutions that have little or no effect on the overall net charge, polarity, or hydrophobicity of the protein. Conservative substitutions are set forth in Table 2 below.

Table 2
Conservative Amino Acid Substitutions

Basic:	arginine lysine histidine
Acidic:	glutamic acid aspartic acid
Uncharged Polar:	glutamine asparagine serine threonine tyrosine
Non-Polar:	phenylalanine tryptophan cysteine glycine alanine valine

	praline methionine leucine isoleucine
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Table 3 sets out another scheme of amino acid substitution:

Table 3

Original Residue	Substitutions
Ala	gly;ser
Arg	lys
Asn	gln;his
Asp	glu
Cys	ser
Gln	asn
Glu	asp
Gly	ala;pro
His	asn;gln
Ile	eu;val
Leu	ile;val
Lys	arg;gln;glu
Met	leu;tyr;ile
Phe	met;leu;tyr
Ser	thr
Thr	ser
Trp	tyr
Tyr	trp;phe
Val	ile;leu

[0048] Other variants can consist of less conservative amino acid substitutions, such as selecting residues that differ more significantly in their effect on maintaining (a) the structure of the polypeptide backbone in the area of the substitution, for example, as a sheet or helical conformation, (b) the charge or hydrophobicity of the molecule at the target site, or (c) the bulk of the side chain. The substitutions that in general are expected to have a more significant effect on function are those in which (a) glycine and/or proline is substituted by another amino acid or is deleted or inserted; (b) a hydrophilic residue, e.g., seryl or threonyl, is substituted for (or by) a hydrophobic residue, e.g., leucyl, isoleucyl, phenylalanyl, valyl, or alanyl; (c)

a cysteine residue is substituted for (or by) any other residue; (d) a residue having an electropositive side chain, e.g., lysyl, arginyl, or histidyl, is substituted for (or by) a residue having an electronegative charge, e.g., glutamyl or aspartyl; or (e) a residue having a bulky side chain, e.g., phenylalanine, is substituted for (or by) one not having such a side chain, e.g., glycine. Other variants include those designed to either generate a novel glycosylation and/or phosphorylation site(s), or those designed to delete an existing glycosylation and/or phosphorylation site(s). Variants include at least one amino acid substitution at a glycosylation site, a proteolytic cleavage site and/or a cysteine residue. Variants also include proteins and peptides with additional amino acid residues before or after the protein or peptide amino acid sequence on linker peptides. For example, a cysteine residue may be added at both the amino and carboxy terminals of an NTP peptide in order to allow the cyclisation of the peptide by the formation of a di-sulphide bond. The term "variant" also encompasses polypeptides that have the amino acid sequence of an NTP peptide with at least one and up to 25 or more additional amino acids flanking either the 3' or 5' end of the peptide.

[0049] The term "derivative" refers to a chemically modified protein or polypeptide that has been chemically modified either by natural processes, such as processing and other post-translational modifications, but also by chemical modification techniques, as for example, by addition of one or more polyethylene glycol molecules, sugars, phosphates, and/or other such molecules, where the molecule or molecules are not naturally attached to wild-type proteins or NTP peptides. Derivatives include salts. Such chemical modifications are well described in basic texts and in more detailed monographs, as well as in a voluminous research literature, and they are well known to those of skill in the art. It will be appreciated that the same type of modification may be present in the same or varying degree at several sites in a given protein or polypeptide. Also, a given protein or polypeptide may contain many types of modifications. Modifications can

occur anywhere in a protein or polypeptide, including the peptide backbone, the amino acid side-chains, and the amino or carboxyl termini.

Modifications include, for example, acetylation, acylation, ADP-ribosylation, amidation, covalent attachment of flavin, covalent attachment of a heme moiety, covalent attachment of a nucleotide or nucleotide derivative, covalent attachment of a lipid or lipid derivative, covalent attachment of phosphatidylinositol, cross-linking, cyclization, disulfide bond formation, demethylation, formation of covalent cross-links, formation of cysteine, formation of pyroglutamate, formylation, gamma-carboxylation, glycosylation, GPI anchor formation, hydroxylation, iodination, methylation, myristoylation, oxidation, proteolytic processing, phosphorylation, prenylation, racemization, glycosylation, lipid attachment, sulfation, gamma-carboxylation of glutamic acid residues, hydroxylation and ADP-ribosylation, selenoylation, sulfation, transfer-RNA mediated addition of amino acids to proteins, such as arginylation, and ubiquitination. See, for instance, *Proteins--Structure And Molecular Properties*, 2nd Ed., T. E. Creighton, W. H. Freeman and Company, New York (1993) and Wold, F., "Posttranslational Protein Modifications: Perspectives and Prospects," pgs. 1-12 in *Posttranslational Covalent Modification Of Proteins*, B. C. Johnson, Ed., Academic Press, New York (1983); Seifter et al., *Meth. Enzymol.* 182:626-646 (1990) and Rattan et al., "Protein Synthesis: Posttranslational Modifications and Aging," *Ann. N.Y. Acad. Sci.* 663: 48-62 (1992). The term "derivatives" include chemical modifications resulting in the protein or polypeptide becoming branched or cyclic, with or without branching. Cyclic, branched and branched circular proteins or polypeptides may result from post-translational natural processes and may be made by entirely synthetic methods, as well.

[0050] The term "homologue" refers to a protein that is at least 60 percent identical in its amino acid sequence of an NTP peptide as determined by standard methods that are commonly used to compare the similarity in position of the amino acids of two polypeptides. The degree of similarity or

identity between two proteins can be readily calculated by known methods, including but not limited to those described in Computational Molecular Biology, Lesk, A. M., ed., Oxford University Press, New York, 1988; Biocomputing: Informatics and Genome Projects, Smith, D. W., ed., Academic Press, New York, 1993; Computer Analysis of Sequence Data, Part I, Griffin, A. M., and Griffin, H. G., eds., Humana Press, New Jersey, 1994; Sequence Analysis in Molecular Biology, von Heinje, G., Academic Press, 1987; Sequence Analysis Primer, Gribskov, M. and Devereux, J., eds., M Stockton Press, New York, 1991; and Carillo H. and Lipman, D., SIAM, J. Applied Math., 48:1073 (1988). Preferred methods to determine identity are designed to give the largest match between the sequences tested. Methods to determine identity and similarity are codified in publicly available computer programs.

[0051] Preferred computer program methods useful in determining the identity and similarity between two sequences include, but are not limited to, the GCG program package (Devereux, J., et al., Nucleic Acids Research, 12(1): 387 (1984)), BLASTP, BLASTN, and FASTA, Atschul, S. F. et al., J. Molec. Biol., 215: 403-410 (1990). The BLAST X program is publicly available from NCBI and other sources (BLAST Manual, Altschul, S., et al., NCBI NLM NIH Bethesda, Md. 20894; Altschul, S., et al., J. Mol. Biol., 215: 403-410 (1990)). By way of example, using a computer algorithm such as GAP (Genetic Computer Group, University of Wisconsin, Madison, Wis.), the two proteins or polypeptides for which the percent sequence identity is to be determined are aligned for optimal matching of their respective amino acids (the "matched span", as determined by the algorithm).

[0052] A gap opening penalty (which is calculated as 3 times the average diagonal; the "average diagonal" is the average of the diagonal of the comparison matrix being used; the "diagonal" is the score or number assigned to each perfect amino acid match by the particular comparison

matrix) and a gap extension penalty (which is usually {fraction (1/10)} times the gap opening penalty), as well as a comparison matrix such as PAM 250 or BLOSUM 62 are used in conjunction with the algorithm. A standard comparison matrix (see Dayhoff et al. in: Atlas of Protein Sequence and Structure, vol. 5, supp.3 for the PAM250 comparison matrix; see Henikoff et al., Proc. Natl. Acad. Sci USA, 89:10915-10919 for the BLOSUM 62 comparison matrix) also may be used by the algorithm. The percent identity then is calculated by the algorithm. Homologues will typically have one or more amino acid substitutions, deletions, and/or insertions as compared with the comparison protein or peptide, as the case may be.

[0053] The term "fusion protein" refers to a protein where one or more peptides are recombinantly fused or chemically conjugated (including covalently and non-covalently) to a protein such as (but not limited to) an antibody or antibody fragment like an F.sub.ab fragment or short chain Fv. The term "fusion protein" also refers to multimers (i.e. dimers, trimers, tetramers and higher multimers) of peptides. Such multimers comprise homomeric multimers comprising one peptide, heteromeric multimers comprising more than one peptide, and heteromeric multimers comprising at least one peptide and at least one other protein. Such multimers may be the result of hydrophobic, hydrophilic, ionic and/or covalent associations, bonds or links, may be formed by cross-links using linker molecules or may be linked indirectly by, for example, liposome formation

[0054] The term "peptide mimetic" or "mimetic" refers to biologically active compounds that mimic the biological activity of a peptide or a protein but are no longer peptidic in chemical nature, that is, they no longer contain any peptide bonds (that is, amide bonds between amino acids). Here, the term peptide mimetic is used in a broader sense to include molecules that are no longer completely peptidic in nature, such as pseudo-peptides, semi-peptides and peptoids. Examples of peptide mimetics in this broader sense (where part of a peptide is replaced by a structure lacking peptide bonds)

are described below. Whether completely or partially non-peptide, peptide mimetics according to the embodiments provide a spatial arrangement of reactive chemical moieties that closely resemble the three-dimensional arrangement of active groups in the peptide on which the peptide mimetic is based. As a result of this similar active-site geometry, the peptide mimetic has effects on biological systems that are similar to the biological activity of the peptide.

[0055] The peptide mimetics of the embodiments are preferably substantially similar in both three-dimensional shape and biological activity to the peptides described herein. Examples of methods of structurally modifying a peptide known in the art to create a peptide mimetic include the inversion of backbone chiral centers leading to D-amino acid residue structures that may, particularly at the N-terminus, lead to enhanced stability for proteolytical degradation without adversely affecting activity. An example is given in the paper "Tritiated D-ala.sup.1-Peptide T Binding", Smith C. S. et al., Drug Development Res., 15, pp. 371-379 (1988). A second method is altering cyclic structure for stability, such as N to C interchain imides and lactames (Ede et al. in Smith and Rivier (Eds.) "Peptides: Chemistry and Biology", Escom, Leiden (1991), pp. 268-270). An example of this is given in conformationally restricted thymopentin-like compounds, such as those disclosed in U.S. Pat. No. 4,457,489 (1985), Goldstein, G. et al., the disclosure of which is incorporated by reference herein in its entirety. A third method is to substitute peptide bonds in the peptide by pseudopeptide bonds that confer resistance to proteolysis.

[0056] A number of pseudopeptide bonds have been described that in general do not affect peptide structure and biological activity. One example of this approach is to substitute retro-inverso pseudopeptide bonds ("Biologically active retroinverso analogues of thymopentin", Sisto A. et al in Rivier, J. E. and Marshall, G. R. (eds) "Peptides, Chemistry, Structure and Biology", Escom, Leiden (1990), pp. 722-773) and Dalpozzo, et al. (1993),

Int. J. Peptide Protein Res., 41:561-566, incorporated herein by reference). According to this modification, the amino acid sequences of the peptides may be identical to the sequences of an NTP peptide described above, except that one or more of the peptide bonds are replaced by a retro-inverso pseudopeptide bond. Preferably the most N-terminal peptide bond is substituted, since such a substitution will confer resistance to proteolysis by exopeptidases acting on the N-terminus. Further modifications also can be made by replacing chemical groups of the amino acids with other chemical groups of similar structure. Another suitable pseudopeptide bond that is known to enhance stability to enzymatic cleavage with no or little loss of biological activity is the reduced isostere pseudopeptide bond (Couder, et al. (1993), Int. J. Peptide Protein Res., 41:181-184, incorporated herein by reference in its entirety).

[0057] Thus, the amino acid sequences of these peptides may be identical to the sequences of an NTP peptide, except that one or more of the peptide bonds are replaced by an isostere pseudopeptide bond. Preferably the most N-terminal peptide bond is substituted, since such a substitution would confer resistance to proteolysis by exopeptidases acting on the N-terminus. The synthesis of peptides with one or more reduced isostere pseudopeptide bonds is known in the art (Couder, et al. (1993), cited above). Other examples include the introduction of ketomethylene or methylsulfide bonds to replace peptide bonds.

[0058] Peptoid derivatives of peptides represent another class of peptide mimetics that retain the important structural determinants for biological activity, yet eliminate the peptide bonds, thereby conferring resistance to proteolysis (Simon, et al., 1992, Proc. Natl. Acad. Sci. USA, 89:9367-9371, incorporated herein by reference in its entirety). Peptoids are oligomers of N-substituted glycines. A number of N-alkyl groups have been described, each corresponding to the side chain of a natural amino acid (Simon, et al. (1992), cited above). Some or all of the amino acids of the peptides may be

replaced with the N-substituted glycine corresponding to the replaced amino acid.

[0059] The term "peptide mimetic" or "mimetic" also includes reverse-D peptides and enantiomers as defined below.

[0060] The term "reverse-D peptide" refers to a biologically active protein or peptide consisting of D-amino acids arranged in a reverse order as compared to the L-amino acid sequence of an peptide. Thus, the carboxy terminal residue of an L-amino acid peptide becomes the amino terminal for the D-amino acid peptide and so forth. For example, the peptide, ETESH, becomes $H_dS_dE_dT_dE_d$, where E_d , H_d , S_d , and T_d are the D-amino acids corresponding to the L-amino acids, E, H, S, and T respectively.

[0061] The term "enantiomer" refers to a biologically active protein or peptide where one or more the L-amino acid residues in the amino acid sequence of an peptide is replaced with the corresponding D-amino acid residue(s).

[0062] A "composition" as used herein, refers broadly to any composition containing a recited peptide or amino acid sequence and, optionally an additional active agent. The composition may comprise a dry formulation, an aqueous solution, or a sterile composition. Compositions comprising peptides may be employed as hybridization probes. The probes may be stored in freeze-dried form and may be associated with a stabilizing agent such as a carbohydrate. In hybridizations, the probe may be deployed in an aqueous solution containing salts, e.g., NaCl, detergents, e.g., sodium dodecyl sulfate (SDS), and other components, e.g., Denhardt's solution, dry milk, salmon sperm DNA, etc.

[0063] The expression "active agent" is used herein to denote any agent capable of decreasing the size of, and/or removing unwanted cellular proliferations and/or tissue growth. Suitable active agents may include, but

are not limited to: (i) smooth muscle antagonists/agonists (alpha blockers) that aid bladder contractions and urethral motility, but do not necessarily kill or remove cells; (ii) 5 α -reductase inhibitors (e.g., finasteride and/or dutasteride) that lead to prostate shrinkage by cellular shrinkage; (iii) anti-cancer active agents (such as alkylating agents, topoisomerase I inhibitors, topoisomerase II inhibitors, RNA/DNA antimetabolites, and antimitotic agents); (iv) active agents for treating benign growths such as anti-acne and anti-wart active agents; (v) anti-androgen compounds, (cyproterone acetate (1 α , 2 β -methylene-6-chloro-17 α -acetoxy-6-dehydroprogesterone) Tamoxifen, aromatase inhibitors); (vi) alpha1-adrenergic receptor blockers (tamsulosin, terazosin, doxazosin, prazosin, bunazosin, indoramin, alfulzosin, silodosin); (vii) phosphodiesterase type 5 (PDE5) inhibitors (tadalafil) and combinations thereof.

[0064] The embodiments are directed to methods of treating a mammal in need of removal or destruction of unwanted cellular proliferations comprising administering a composition comprising the NTP peptides as defined above, together with an additional active agent. The additional active agent can be administered together with (or in the same formulation as) the NTP peptide-containing composition, or the additional active agent can be administered separately. For example, the composition comprising the NTP peptide may be administered by injection, whereas the additional active agent may be taken at different point(s) in time as an oral medication (in the form of a tablet, gel capsule, etc.).

[0065] Other peptide sequences derived from an NTP peptide found to be an effective agent for causing cell death also may be effective agents for causing cell death. A person ordinarily skilled in the art can, using the guidelines provided herein, synthesize without undue experimentation fragments of an effective Peptide spanning the entire amino acid sequence of that protein in order to identify other effective peptide sequences.

[0066] The inventor discovered that use of the NTP peptides in treating mammals in need of removal or destruction of unwanted cellular elements provided an unexpectedly superior clinical benefit if combined with additional active agents, when compared to mammals that had been treated only with the additional active agents. The efficacy of treatment of benign prostatic hyperplasia, for example, can be evaluated symptomatically. Symptomatic evaluation can be measured by the International Prostate Symptom Score (IPSS) which is a quantitative scale used to gauge prostatic symptomatic improvement or worsening. The IPSS quantifies the following: 1) incomplete bladder emptying after urination; 2) frequent urination; 3) stopping and starting during urination; 4) urgent need to urinate; 5) weakness of urinary stream; 6) need to push or strain during urination; 7) need to urinate after going to sleep at night (nocturia). The inventor discovered that administering the NTP peptide in combination with the additional active agent resulted in an IPSS improvement of from about 15-150% greater than the IPSS improvement in patients only receiving the additional active agent. In some embodiments, the improvement is within the range of from about 25 to about 125%, or from about 30% to about 115%, or from about 40% to about 110%.

[0067] The inventors discovered that the improvement is even more pronounced in patients who had not previously taken an additional active agent, (or who had not previously received treatment for such condition) were treated with the NTP peptide, and then subsequently were administered the additional active agent. The IPSS improvement for patients who received the NTP peptide and subsequently were administered the additional active agent was from 50% to 400% greater than the IPSS improvement in patients who received a placebo, and subsequently were administered the additional active agent. In some embodiments, the improvement is within the range of from about 75 to about 300%, or from about 150% to about 250%, or from about 200% to about 225%.

[0068] The embodiments include a method of treating a mammal suffering from a condition requiring the removal or destruction of unwanted cellular proliferations, wherein the mammal had or had not previously received treatment for such condition, comprising administering an NTP peptide to the mammal, in combination with administration of an additional active agent. The method includes, but is not limited to, administering the NTP-peptides intramuscularly, orally, intravenously, intraperitoneally, intracerebrally (intraparenchymally), intracerebroventricularly, intralesionally, intraocularly, intraarterially, intrathecally, intratumorally, intranasally, topically, transdermally, subcutaneously, or intradermally, either alone or conjugated to a carrier. The unwanted cellular proliferations include, inter alia, benign and malignant tumors, glandular (e.g. prostate) hyperplasia, unwanted facial hair, warts, and unwanted fatty tissue. Preferred NTP peptides include one or more of the following:

SEQ ID No. 66	IDQQVLSRIKLEIKRCL	Ile-Asp-Gln-Gln-Val-Leu-Ser-Arg-Ile-Lys-Leu- Glu-Ile-Lys-Arg-Cys-Leu
SEQ ID NO. 111	IDQQVLSRI	Ile-Asp-Gln-Gln-Val-Leu-Ser-Arg-Ile
SEQ ID NO. 115	VLSRIKLEIKRCL	Val-Leu-Ser-Arg-Ile-Lys-Leu-Glu-Ile-Lys-Arg-Cys-Leu
SEQ ID NO. 116	IDQQVLSRIKLEI	Ile-Asp-Gln-Gln-Val-Leu-Ser-Arg-Ile-Lys-Leu-Glu-Ile

[0069] Any mammal can benefit from use of the invention, including humans, mice, rabbits, dogs, sheep and other livestock, any mammal treated or treatable by a veterinarian, zoo-keeper, or wildlife preserve employee. Preferred mammals are humans, sheep, and dogs.

[0070] It will be apparent to one of skill in the art that other smaller fragments of the above NTP peptides may be selected such that these peptides will possess the same or similar biological activity. Other fragments of may be selected by one skilled in the art such that these peptides will possess the same or similar biological activity. The peptides of the embodiments encompass these other fragments. In general, the

peptides of the embodiments have at least 4 amino acids, preferably at least 5 amino acids, and more preferably at least 6 amino acids.

[0071] The embodiments also encompass methods of treating mammals (or patients) in need of removal or destruction of unwanted cellular proliferations comprising administering a composition comprising NTP peptides comprising two or more NTP peptides joined together, together with an additional active agent. To the extent that an NTP peptide has the desired biological activity, it follows that two such Peptides would also possess the desired biological activity.

[0072] NTP peptides and fragments, variants, derivatives, homologues, fusion proteins and mimetics thereof encompassed by this embodiment can be prepared using methods known to those of skill in the art, such as recombinant DNA technology, protein synthesis and isolation of naturally occurring peptides, proteins, NTP-protein and fragments, variants, derivatives and homologues thereof.

[0073] NTP peptides and fragments, variants, derivatives, homologues, fusion proteins and mimetics thereof can be prepared from other peptides, proteins, and fragments, variants, derivatives and homologues thereof using methods known to those having skill in the art. Such methods include (but are not limited to) the use of proteases to cleave the peptide, or protein into the desired NTP peptides.

[0074] An NTP peptide can be prepared using well known recombinant DNA technology methods such as those set forth in Sambrook et al. *Molecular Cloning: A Laboratory Manual*, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y. and/or Ausubel et al., eds., *Current Protocols in Molecular Biology*, Green Publishers Inc. and Wiley and Sons, N.Y. .

[0075] A gene or cDNA encoding an NTP peptide may be obtained for example by screening a genomic or cDNA library, or by PCR amplification. Probes or primers useful for screening the library can be generated based on sequence information for other known genes or gene fragments from the same or a related family of genes, such as, for example, conserved motifs found in other peptides or proteins. In addition, where a gene encoding an NTP peptide has been identified, all or a portion of that gene may be used as a probe to identify homologous genes. The probes or primers may be used to screen cDNA libraries from various tissue sources believed to express an NTP peptide gene. Typically, conditions of high stringency will be employed for screening to minimize the number of false positives obtained from the screen.

[0076] Another means to prepare a gene encoding an NTP peptide is to employ chemical synthesis using methods well known to the skilled artisan, such as those described by Engels et al., *Angew. Chem. Intl. Ed.*, 28:716-734. These methods include, inter alia, the phosphotriester, phosphoramidite, and H-phosphonate methods for nucleic acid synthesis. A preferred method for such chemical synthesis is polymer-supported synthesis using standard phosphoramidite chemistry. Typically, the DNA encoding an peptide or protein will be several hundred nucleotides in length. Nucleic acids larger than about 100 to nucleotides can be synthesized as several fragments using these methods. The fragments then can be ligated together to form the full length peptide or protein. Usually, the DNA fragment encoding the amino terminus of the protein will have an ATG, which encodes a methionine residue. This methionine may or may not be present on the mature form of the protein or peptide, depending on whether the protein produced in the host cell is designed to be secreted from that cell.

[0077] The gene, cDNA, or fragment thereof encoding the NTP peptide can be inserted into an appropriate expression or amplification vector using

standard ligation techniques. The vector is typically selected to be functional in the particular host cell employed (i.e., the vector is compatible with the host cell machinery such that amplification of the gene and/or expression of the gene can occur). The gene, cDNA or fragment thereof encoding the NTP peptide may be amplified/expressed in prokaryotic, yeast, insect (baculovirus systems) and/or eukaryotic host cells. Selection of the host cell will depend in part on whether the NTP peptide is to be glycosylated and/or phosphorylated. If so, yeast, insect, or mammalian host cells are preferable.

[0078] Typically, the vectors used in any of the host cells will contain at least a 5' flanking sequence (also referred to as a promoter) and other regulatory elements as well, such as an enhancer(s), an origin of replication element, a transcriptional termination element, a complete intron sequence containing a donor and acceptor splice site, a signal peptide sequence, a ribosome binding site element, a polyadenylation sequence, a polylinker region for inserting the nucleic acid encoding the polypeptide to be expressed, and a selectable marker element. Each of these elements is discussed below. Optionally, the vector may contain a tag sequence, i.e., an oligonucleotide molecule located at the 5' or 3' end of the protein or peptide coding sequence; the oligonucleotide molecule encodes polyHis (such as hexaHis), or other tag such as FLAG, HA (hemagglutinin Influenza virus) or myc for which commercially available antibodies exist. This tag is typically fused to the polypeptide upon expression of the polypeptide, and can serve as means for affinity purification of the protein or peptide from the host cell. Affinity purification can be accomplished, for example, by column chromatography using antibodies against the tag as an affinity matrix. Optionally, the tag can subsequently be removed from the purified protein or peptide by various means such as using certain peptidases.

[0079] The human immunoglobulin hinge and Fc region could be fused at either the N-terminus or C-terminus of the NTP peptide by one skilled in the

art. The subsequent Fc-fusion protein could be purified by use of a Protein A affinity column. Fc is known to exhibit a long pharmacokinetic half-life in vivo and proteins fused to Fc have been found to exhibit a substantially greater half-life in vivo than the unfused counterpart. Also, fusion to the Fc region allows for dimerization/multimerization of the molecule that may be useful for the bioactivity of some molecules.

[0080] The 5' flanking sequence may be homologous (i.e., from the same species and/or strain as the host cell), heterologous (i.e., from a species other than the host cell species or strain), hybrid (i.e., a combination of 5' flanking sequences from more than one source), synthetic, or it may be the native protein or peptide gene 5' flanking sequence. As such, the source of the 5' flanking sequence may be any unicellular prokaryotic or eukaryotic organism, any vertebrate or invertebrate organism, or any plant, provided that the 5' flanking sequence is functional in, and can be activated by, the host cell machinery.

[0081] The 5' flanking sequences useful in the vectors of this embodiment may be obtained by any of several methods well known in the art. Typically, 5' flanking sequences useful herein other than the protein or peptide gene flanking sequence will have been previously identified by mapping and/or by restriction endonuclease digestion and can thus be isolated from the proper tissue source using the appropriate restriction endonucleases. In some cases, the full nucleotide sequence of the 5' flanking sequence may be known. Here, the 5' flanking sequence may be synthesized using the methods described above for nucleic acid synthesis or cloning.

[0082] Where all or only a portion of the 5' flanking sequence is known, it may be obtained using PCR and/or by screening a genomic library with suitable oligonucleotide and/or 5' flanking sequence fragments from the same or another species.

[0083] Where the 5' flanking sequence is not known, a fragment of DNA containing a 5' flanking sequence may be isolated from a larger piece of DNA that may contain, for example, a coding sequence or even another gene or genes. Isolation may be accomplished by restriction endonuclease digestion using one or more carefully selected enzymes to isolate the proper DNA fragment. After digestion, the desired fragment may be isolated by agarose gel purification, Qiagen® column or other methods known to the skilled artisan. Selection of suitable enzymes to accomplish this purpose will be readily apparent to one of ordinary skill in the art.

[0084] The origin of replication element is typically a part of prokaryotic expression vectors purchased commercially, and aids in the amplification of the vector in a host cell. Amplification of the vector to a certain copy number can, in some cases, be important for optimal expression of the protein or peptide. If the vector of choice does not contain an origin of replication site, one may be chemically synthesized based on a known sequence, and ligated into the vector. The transcription termination element is typically located 3' of the end of the protein or peptide coding sequence and serves to terminate transcription of the protein or peptide. Usually, the transcription termination element in prokaryotic cells is a G-C rich fragment followed by a poly T sequence. While the element may be cloned from a library or purchased commercially as part of a vector, it can also be readily synthesized using methods for nucleic acid synthesis such as those described above.

[0085] A selectable marker gene element encodes a protein necessary for the survival and growth of a host cell grown in a selective culture medium. Typical selection marker genes encode proteins that (a) confer resistance to antibiotics or other toxins, e.g., ampicillin, tetracycline, or kanamycin for prokaryotic host cells, (b) complement auxotrophic deficiencies of the cell; or (c) supply critical nutrients not available from complex media. Preferred

selectable markers are the kanamycin resistance gene, the ampicillin resistance gene, and the tetracycline resistance gene.

[0086] The ribosome binding element, commonly called the Shine-Dalgarno sequence (prokaryotes) or the Kozak sequence (eukaryotes), is usually necessary for translation initiation of mRNA. The element is typically located 3' to the promoter and 5' to the coding sequence of the protein or peptide to be synthesized. The Shine-Dalgarno sequence is varied but is typically a polypurine (i.e., having a high A-G content). Many Shine-Dalgarno sequences have been identified, each of which can be readily synthesized using methods set forth above and used in a prokaryotic vector.

[0087] In those cases where it is desirable for an NTP peptide to be secreted from the host cell, a signal sequence may be used to direct the Peptide out of the host cell where it is synthesized, and the carboxy-terminal part of the protein may be deleted in order to prevent membrane anchoring. Typically, the signal sequence is positioned in the coding region of the NTP peptide gene or cDNA, or directly at the 5' end of the Peptide gene coding region. Many signal sequences have been identified, and any of them that are functional in the selected host cell may be used in conjunction with the Peptide gene or cDNA. Therefore, the signal sequence may be homologous or heterologous to the Peptide gene or cDNA, and may be homologous or heterologous to the Peptide gene or cDNA. Additionally, the signal sequence may be chemically synthesized using methods set forth above. In most cases, secretion of the polypeptide from the host cell via the presence of a signal peptide will result in the removal of the amino terminal methionine from the polypeptide.

[0088] In many cases, transcription of the NTP peptide gene or cDNA is increased by the presence of one or more introns in the vector; this is particularly true where the Peptide is produced in eukaryotic host cells,

especially mammalian host cells. The introns used may be naturally occurring within the Peptide gene, especially where the gene used is a full length genomic sequence or a fragment thereof. Where the intron is not naturally occurring within the gene (as for most cDNAs), the intron(s) may be obtained from another source. The position of the intron with respect to the flanking sequence and the Peptide gene generally is important, as the intron must be transcribed to be effective. As such, where the Peptide gene inserted into the expression vector is a cDNA molecule, the preferred position for the intron is 3' to the transcription start site, and 5' to the polyA transcription termination sequence. Preferably for Peptide cDNA, the intron or introns will be located on one side or the other (i.e., 5' or 3') of the cDNA such that it does not interrupt this coding sequence. Any intron from any source, including any viral, prokaryotic and eukaryotic (plant or animal) organisms, may be used to practice this embodiment, provided that it is compatible with the host cell(s) into which it is inserted. Also included herein are synthetic introns. Optionally, more than one intron may be used in the vector.

[0089] Where one or more of the elements set forth above are not already present in the vector to be used, they may be individually obtained and ligated into the vector. Methods used for obtaining each of the elements are well known to the skilled artisan and are comparable to the methods set forth above (i.e., synthesis of the DNA, library screening, and the like).

[0090] The final vectors used to practice this embodiment may be constructed from starting vectors such as a commercially available vector. Such vectors may or may not contain some of the elements to be included in the completed vector. If none of the desired elements are present in the starting vector, each element may be individually ligated into the vector by cutting the vector with the appropriate restriction endonuclease(s) such that the ends of the element to be ligated in and the ends of the vector are compatible for ligation. In some cases, it may be necessary to blunt the

ends to be ligated together in order to obtain a satisfactory ligation. Blunting is accomplished by first filling in "sticky ends" using Klenow DNA polymerase or T4 DNA polymerase in the presence of all four nucleotides. This procedure is well known in the art and is described for example in Sambrook et al., *supra*. Alternatively, two or more of the elements to be inserted into the vector may first be ligated together (if they are to be positioned adjacent to each other) and then ligated into the vector.

[0091] An additional method for constructing the vector is to conduct all ligations of the various elements simultaneously in one reaction mixture. Here, many nonsense or nonfunctional vectors will be generated due to improper ligation or insertion of the elements, however the functional vector may be identified and selected by restriction endonuclease digestion.

[0092] Preferred vectors for practicing this embodiment are those that are compatible with bacterial, insect, and mammalian host cells. Such vectors include, *inter alia*, pCRII, pCR3, and pcDNA3.1 (Invitrogen Company, San Diego, Calif.), pBSII (Stratagene Company, La Jolla, Calif.), pET15b (Novagen, Madison, Wis.), PGEX (Pharmacia Biotech, Piscataway, N.J.), pEGFP-N2 (Clontech, Palo Alto, Calif.), pETL (BlueBachl; Invitrogen), and pFastBacDual (Gibco/BRL, Grand Island, N.Y.).

[0093] After the vector has been constructed and a nucleic acid molecule encoding full length or truncated protein or peptide has been inserted into the proper site of the vector, the completed vector may be inserted into a suitable host cell for amplification and/or polypeptide expression. Host cells may be prokaryotic host cells (such as *E. coli*) or eukaryotic host cells (such as a yeast cell, an insect cell, or a vertebrate cell). The host cell, when cultured under appropriate conditions, can synthesize protein or peptide which can subsequently be collected from the culture medium (if the host cell secretes it into the medium) or directly from the host cell producing it (if it is not secreted).

[0094] After collection, the NTP peptide can be purified using methods such as molecular sieve chromatography, affinity chromatography, and the like. Selection of the host cell for protein or peptide production will depend in part on whether the Peptide is to be glycosylated or phosphorylated (in which case eukaryotic host cells are preferred), and the manner in which the host cell is able to fold the Peptide into its native tertiary structure (e.g., proper orientation of disulfide bridges, etc.) such that biologically active protein is prepared by the Peptide that has biological activity, the Peptide may be folded after synthesis using appropriate chemical conditions as discussed below. Suitable cells or cell lines may be mammalian cells, such as Chinese hamster ovary cells (CHO), human embryonic kidney (HEK) 293, 293T cells, or 3T3 cells. The selection of suitable mammalian host cells and methods for transformation, culture, amplification, screening and product production and purification are known in the art. Other suitable mammalian cell lines, are the monkey COS-1 and COS-7 cell lines, and the CV-1 cell line. Further exemplary mammalian host cells include primate cell lines and rodent cell lines, including transformed cell lines. Normal diploid cells, cell strains derived from in vitro culture of primary tissue, as well as primary explants, are also suitable. Candidate cells may be genotypically deficient in the selection gene, or may contain a dominantly acting selection gene. Other suitable mammalian cell lines include but are not limited to, mouse neuroblastoma N2A cells, HeLa, mouse L-929 cells, 3T3 lines derived from Swiss, Balb-c or NIH mice, BHK or HaK hamster cell lines.

[0095] Similarly useful as host cells suitable for the present embodiments are bacterial cells. For example, the various strains of *E. coli* (e.g., HB101, DH5.alpha., DH10, and MC1061) are well-known as host cells in the field of biotechnology. Various strains of *B. subtilis*, *Pseudomonas* spp., other *Bacillus* spp., *Streptomyces* spp., and the like may also be employed in this method. Many strains of yeast cells known to those skilled in the art also are available as host cells for expression of the polypeptides of the present embodiments.

[0096] Additionally, where desired, insect cell systems may be utilized in the methods of the present embodiments. Such systems are described for example in Kitts et al. (Biotechniques, 14:810-817), Lucklow (Curr. Opin. Biotechnol., 4:564-572) and Lucklow et al. (J. Virol., 67:4566-4579). Preferred insect cells are Sf-9 and Hi5 (Invitrogen, Carlsbad, Calif.).

[0097] Insertion (also referred to as transformation or transfection) of the vector into the selected host cell may be accomplished using such methods as calcium chloride, electroporation, microinjection, lipofection, or the DEAE-dextran method. The method selected will in part be a function of the type of host cell to be used. These methods and other suitable methods are well known to the skilled artisan, and are set forth, for example, in Sambrook et al., supra.

[0098] The host cells containing the vector (i.e., transformed or transfected) may be cultured using standard media well known to the skilled artisan. The media will usually contain all nutrients necessary for the growth and survival of the cells. Suitable media for culturing E. coli cells are for example, Luria Broth (LB) and/or Terrific Broth (TB). Suitable media for culturing eukaryotic cells are RPMI 1640, MEM, DMEM, all of which may be supplemented with serum and/or growth factors as required by the particular cell line being cultured. A suitable medium for insect cultures is Grace's medium supplemented with yeastolate, lactalbumin hydrolysate, and/or fetal calf serum as necessary. Typically, an antibiotic or other compound useful for selective growth of the transformed cells only is added as a supplement to the media. The compound to be used will be dictated by the selectable marker element present on the plasmid with which the host cell was transformed. For example, where the selectable marker element is kanamycin resistance, the compound added to the culture medium will be kanamycin.

[0099] The amount of NTP peptide produced in the host cell can be evaluated using standard methods known in the art. Such methods include, without limitation, Western blot analysis, SDS-polyacrylamide gel electrophoresis, non-denaturing gel electrophoresis, HPLC separation, mass spectroscopy, immunoprecipitation, and/or activity assays such as DNA binding gel shift assays.

[0100] If the protein or peptide has been designed to be secreted from the host cells, the majority of the protein or peptide may be found in the cell culture medium. Proteins prepared in this way will typically not possess an amino terminal methionine, as it is removed during secretion from the cell. If however, the protein or peptide is not secreted from the host cells, it will be present in the cytoplasm and/or the nucleus (for eukaryotic host cells) or in the cytosol (for gram negative bacteria host cells) and may have an amino terminal methionine.

[0101] For an NTP peptide situated in the host cell cytoplasm and/or nucleus, the host cells are typically first disrupted mechanically or with detergent to release the intra-cellular contents into a buffered solution. The Peptide can then be isolated from this solution.

[0102] Purification of NTP peptides from solution can be accomplished using a variety of techniques. If the NTP peptide has been synthesized such that it contains a tag such as hexaHistidine (e.g. peptide/hexaHis) or other small peptide such as FLAG (Sigma-Aldrich, St. Louis, Mo.) or calmodulin-binding peptide (Stratagene, La Jolla, Calif.) at either its carboxyl or amino terminus, it may essentially be purified in a one-step process by passing the solution through an affinity column where the column matrix has a high affinity for the tag or for the protein directly (i.e., a monoclonal antibody specifically recognizing the peptide). For example, polyhistidine binds with great affinity and specificity to nickel, zinc and cobalt; thus immobilized metal ion affinity chromatography which employs a

nickel-based affinity resin (as used in Qiagen's QIAexpress system or Invitrogen's Xpress System) or a cobalt-based affinity resin (as used in BD Biosciences-CLONTECH's Talon system) can be used for purification of peptide/polyHis. (See, for example, Ausubel et al., eds., Current Protocols in Molecular Biology, Section 10.11.8, John Wiley & Sons, New York).

[0103] Where the NTP peptide is prepared without a tag attached, and no antibodies are available, other well known procedures for purification can be used. Such procedures include, without limitation, ion exchange chromatography, hydroxyapatite chromatography, hydrophobic interaction chromatography, molecular sieve chromatography, HPLC, native gel electrophoresis in combination with gel elution, and preparative isoelectric focusing (Isoprime machine/technique, Hoefer Scientific). In some cases, two or more of these techniques may be combined to achieve increased purity.

[0104] If it is anticipated that the NTP peptide will be found primarily intracellularly, the intracellular material (including inclusion bodies for gram-negative bacteria) can be extracted from the host cell using any standard technique known to the skilled artisan. For example, the host cells can be lysed to release the contents of the periplasm/cytoplasm by French press, homogenization, and/or sonication followed by centrifugation. If the Peptide has formed inclusion bodies in the cytosol, the inclusion bodies can often bind to the inner and/or outer cellular membranes and thus will be found primarily in the pellet material after centrifugation. The pellet material then can be treated at pH extremes or with chaotropic agent such as a detergent, guanidine, guanidine derivatives, urea, or urea derivatives in the presence of a reducing agent such as dithiothreitol at alkaline pH or tris carboxyethyl phosphine at acid pH to release, break apart, and solubilize the inclusion bodies. The Peptide in its now soluble form can then be analyzed using gel electrophoresis, immunoprecipitation or the like. If it is desired to isolate the Peptide, isolation may be accomplished using

standard methods such as those set forth below and in Marston et al. Meth. Enz., 182:264-275 .

[0105] In some cases, the NTP peptide may not be biologically active upon isolation. Various methods for refolding or converting the polypeptide to its tertiary structure and generating disulfide linkages, can be used to restore biological activity. Such methods include exposing the solubilized polypeptide to a pH usually above 7 and in the presence of a particular concentration of a chaotrope. The selection of chaotrope is very similar to the choices used for inclusion body solubilization but usually at a lower concentration and is not necessarily the same chaotrope as used for the solubilization. In most cases the refolding/oxidation solution will also contain a reducing agent or the reducing agent plus its, oxidized form in a specific ratio to generate a particular redox potential allowing for disulfide shuffling to occur in the formation of the protein's cysteine bridge(s). Some of the commonly used redox couples include cysteine/cystamine, glutathione (GSH)/dithiobis GSH, cupric chloride, dithiothreitol(DTT)/dithiane DTT, 2-mercaptoethanol(bME)/dithio-b(ME). In many instances a cosolvent is necessary to increase the efficiency of the refolding and the more common reagents used for this purpose include glycerol, polyethylene glycol of various molecular weights, and arginine.

[0106] If NTP peptide inclusion bodies are not formed to a significant degree in the host cell, the NTP peptide will be found primarily in the supernatant after centrifugation of the cell homogenate, and the NTP peptide can be isolated from the supernatant using methods such as those set forth below.

[0107] In those situations where it is preferable to partially or completely isolate the NTP peptide, purification can be accomplished using standard methods well known to the skilled artisan. Such methods include, without limitation, separation by electrophoresis followed by electroelution, various

types of chromatography (immunoaffinity, molecular sieve, and/or ion exchange), and/or high pressure liquid chromatography. In some cases, it may be preferable to use more than one of these methods for complete purification.

[0108] In addition to preparing and purifying NTP peptides using recombinant DNA techniques, the NTP peptides and their fragments, variants, homologues, fusion proteins, peptide mimetics, and derivatives may be prepared by chemical synthesis methods (such as solid phase peptide synthesis) using techniques known in the art such as those set forth by Merrifield et al., J. Am. Chem. Soc., 85:2149, Houghten et al. Proc Natl Acad. Sci. USA, 82:5132, and Stewart and Young, Solid Phase Peptide Synthesis, Pierce Chemical Co., Rockford, Ill. Such Peptides may be synthesized with or without a methionine on the amino terminus. Chemically synthesized NTP peptides may be oxidized using methods set forth in these references to form disulfide bridges. The NTP peptides are expected to have biological activity comparable to Peptides produced recombinantly or purified from natural sources, and thus may be used interchangeably with recombinant or natural Peptide.

[0109] Chemically modified NTP peptide compositions in which the Peptide is linked to a polymer are included within the scope of the present embodiments. The polymer selected is typically water soluble so that the protein to which it is attached does not precipitate in an aqueous environment, such as a physiological environment. The polymer selected is usually modified to have a single reactive group, such as an active ester for acylation or an aldehyde for alkylation, so that the degree of polymerization may be controlled as provided for in the present methods. The polymer may be of any molecular weight, and may be branched or unbranched. Included within the scope of peptide polymers is a mixture of polymers.

[0110] In some cases, it may be desirable to prepare nucleic acid and/or amino acid variants of the naturally occurring NTP peptides. Nucleic acid variants may be produced using site directed mutagenesis, PCR amplification, or other appropriate methods, where the primer(s) have the desired point mutations (see Sambrook et al., supra, and Ausubel et al., supra, for descriptions of mutagenesis techniques). Chemical synthesis using methods described by Engels et al., supra, may also be used to prepare such variants. Other methods known to the skilled artisan may be used as well.

[0111] Preferred nucleic acid variants are those containing nucleotide substitutions accounting for codon preference in the host cell that is to be used to produce NTP peptides. Such codon optimization can be determined via computer algorithms which incorporate codon frequency tables such as Ecohigh. Cod for codon preference of highly expressed bacterial genes as provided by the University of Wisconsin Package Version 9.0, Genetics Computer Group, Madison, Wis. Other useful codon frequency tables include *Celegans_high.cod*, *Celegans_low.cod*, *Drosophila_high.cod*, *Human_high.cod*, *Maize_high.cod*, and *Yeast_high.cod*. Other preferred variants are those encoding conservative amino acid changes as described above (e.g., wherein the charge or polarity of the naturally occurring amino acid side chain is not altered substantially by substitution with a different amino acid) as compared to wild type, and/or those designed to either generate a novel glycosylation and/or phosphorylation site(s), or those designed to delete an existing glycosylation and/or phosphorylation site(s).

[0112] NTP peptides and fragments, homologs, variants, fusion proteins, peptide mimetics, derivatives and salts thereof also can be made using conventional peptide synthesis techniques known to the skilled artisan. These techniques include chemical coupling methods (cf. Wunsch, E: "Methoden der organischen Chemie", Volume 15, Band 1+2, Synthese von Peptiden, thime Verlag, Stuttgart (1974), and Barrany, G.; Marrifield, R. B.:

"The Peptides," eds. E. Gross, J. Meienhofer, Volume 2, Chapter 1, pp. 1-284, Academic Press (1980)), enzymatic coupling methods (cf. Widmer, F. Johansen, J. T., Carlsberg Res. Commun., Vol. 44, pp. 37-46 (1979); Kullmann, W.: "Enzymatic Peptide Synthesis", CRC Press Inc. Boca Raton, Fla. (1987); and Widmer, F., Johansen, J. T. in "Synthetic Peptides in Biology and Medicines," eds. Alitalo, K., Partanen, P., Väterli, A., pp.79-86, Elsevier, Amsterdam (1985)), or a combination of chemical and enzymatic methods if this is advantageous for the process design and economy. Using the guidelines provided herein, those skilled in the art are capable of varying the peptide sequence of the NTP peptide to make a homologue having the same or similar biological activity (bioactivity) as the original or native NTP peptide.

[0113] Advantages exist for using a mimetic of a given NTP peptide rather than the Peptide itself. In general, peptide mimetics are more bioavailable, have a longer duration of action and can be cheaper to produce than the native proteins and peptides.

[0114] Peptide mimetics of NTP peptides can be developed using combinatorial chemistry techniques and other techniques known in the art (see e.g. Proceedings of the 20th European Peptide Symposium, ed. G. Jung, E. Bayer, pp. 289-336, and references therein). Examples of methods known in the art for structurally modifying a peptide to create a peptide mimetic include the inversion of backbone chiral centers leading to D-amino acid residue structures that may, particularly at the N-terminus, lead to enhanced stability for proteolytical degradation without adversely affecting activity. An example is provided in the paper "Tritiated D-ala.sup.1-Peptide T Binding", Smith C. S. et al., Drug Development Res. 15, pp. 371-379 (1988).

[0115] A second method is altering cyclic structure for stability, such as N to C interchain imides and lactames (Ede et al. in Smith and Rivier (Eds.)

"Peptides: Chemistry and Biology", Escom, Leiden (1991), pp. 268-270). An example of this is given in conformationally restricted thymopentin-like compounds, such as those disclosed in U.S. Pat. No. 4,457,489 (1985), Goldstein, G. et al., the disclosure of which is incorporated by reference herein in its entirety.

[0116] A third method is to substitute peptide bonds in the NTP peptide by pseudopeptide bonds that confer resistance to proteolysis. A number of pseudopeptide bonds have been described that in general do not affect peptide structure and biological activity. One example of this approach is to substitute retro-inverso pseudopeptide bonds ("Biologically active retroinverso analogues of thymopentin", Sisto A. et al in Rivier, J. E. and Marshall, G. R. (eds) "Peptides, Chemistry, Structure and Biology", Escom, Leiden (1990), pp. 722-773) and Dalpozzo, et al. (1993), Int. J. Peptide Protein Res., 41:561-566, incorporated herein by reference). According to this modification, the amino acid sequences of the peptides may be identical to the sequences of the peptides described above, except that one or more of the peptide bonds are replaced by a retro-inverso pseudopeptide bond. Preferably the most N-terminal peptide bond is substituted, since such a substitution will confer resistance to proteolysis by exopeptidases acting on the N-terminus.

[0117] The synthesis of peptides with one or more reduced retro-inverso pseudopeptide bonds is known in the art (Sisto (1990) and Dalpozzo, et al. (1993), cited above). Thus, peptide bonds can be replaced by non-peptide bonds that allow the peptide mimetic to adopt a similar structure, and therefore biological activity, to the original peptide. Further modifications also can be made by replacing chemical groups of the amino acids with other chemical groups of similar structure. Another suitable pseudopeptide bond that is known to enhance stability to enzymatic cleavage with no or little loss of biological activity is the reduced isostere pseudopeptide bond is a (Couder, et al. (1993), Int. J. Peptide Protein Res., 41:181-184,

incorporated herein by reference in its entirety). Thus, the amino acid sequences of these peptides may be identical to the sequences of an peptide, except that one or more of the peptide bonds are replaced by an isostere pseudopeptide bond. Preferably the most N-terminal peptide bond is substituted, since such a substitution would confer resistance to proteolysis by exopeptidases acting on the N-terminus. The synthesis of peptides with one or more reduced isostere pseudopeptide bonds is known in the art (Couder, et al. (1993), cited above). Other examples include the introduction of ketomethylene or methylsulfide bonds to replace peptide bonds.

[0118] Peptoid derivatives of NTP peptides represent another class of peptide mimetics that retain the important structural determinants for biological activity, yet eliminate the peptide bonds, thereby conferring resistance to proteolysis (Simon, et al., 1992, Proc. Natl. Acad. Sci. USA, 89:9367-9371 and incorporated herein by reference in its entirety). Peptoids are oligomers of N-substituted glycines. A number of N-alkyl groups have been described, each corresponding to the side chain of a natural amino acid (Simon, et al. (1992), cited above and incorporated herein by reference in its entirety). Some or all of the amino acids of the peptide are replaced with the N-substituted glycine corresponding to the replaced amino acid.

[0119] The development of peptide mimetics can be aided by determining the tertiary structure of the original peptide by NMR spectroscopy, crystallography and/or computer-aided molecular modeling. These techniques aid in the development of novel compositions of higher potency and/or greater bioavailability and/or greater stability than the original peptide (Dean (1994), BioEssays, 16: 683-687; Cohen and Shatzmiller (1993), J. Mol. Graph., 11: 166-173; Wiley and Rich (1993), Med. Res. Rev., 13: 327-384; Moore (1994), Trends Pharmacol. Sci., 15: 124-129; Hruby (1993), Biopolymers, 33: 1073-1082; Bugg et al. (1993), Sci. Am., 269: 92-98, all incorporated herein by reference in their entirety).

[0120] Once a potential peptide mimetic compound is identified, it may be synthesized and assayed using the methods outlined in the examples below to assess its activity. The peptide mimetic compounds obtained by the above methods, having the biological activity of the peptides and similar three-dimensional structure, are encompassed by this embodiment. It will be readily apparent to one skilled in the art that a peptide mimetic can be generated from any of the peptides bearing one or more of the modifications described above. It will furthermore be apparent that the peptide mimetics of this embodiment can be further used for the development of even more potent non-peptidic compounds, in addition to their utility as therapeutic compounds.

[0121] A number of organizations exist today that are capable of synthesizing the peptides described herein. For example, given the sequence of an NTP peptide, the organization can synthesize the Peptide and forward the synthesized Peptide with accompanying documentation and proof of the identity of the Peptide.

[0122] The present embodiments are directed to methods of treating mammals with conditions requiring removal of cells, such as benign and malignant tumors, glandular (e.g. prostate) hyperplasia, unwanted facial hair, warts, and unwanted fatty tissue, or the inhibition or prevention of unwanted cellular proliferation, such as stenosis of a stent. Such a method comprises administering to a mammal in need, or coating a device such as a stent with, a therapeutically effective amount of NTP peptide, in combination with an additional active agent.

[0123] The additional active agent can be one or more active agents selected from (i) anti-cancer active agents (such as alkylating agents, topoisomerase I inhibitors, topoisomerase II inhibitors, RNA/DNA antimetabolites, and antimitotic agents); (ii) active agents for treating benign growths such as anti-acne and anti-wart active agents (salicylic acid); (iii)

antiandrogen compounds, (cyproterone acetate (1 α , 2 β -methylene-6-chloro-17 α -acetoxy-6-dehydroprogesterone)) Tamoxifen, aromatase inhibitors); (iv) α 1-adrenergic receptor blockers (tamsulosin, terazosin, doxazosin, prazosin, bunazosin, indoramin, alfuzosin, silodosin); (v) 5 α -reductase inhibitors (finasteride, dutasteride); (vi) phosphodiesterase type 5 (PDE5) inhibitors (tadalafil) and combinations thereof. Preferably, the additional active agent is selected from the group consisting of tamsulosin, finasteride, terazosin, doxazosin, prazosin, tadalafil, alfuzosin, silodosin, dutasteride, combinations of dutasteride and tamsulosin, and mixtures and combinations thereof.

[0124] The condition can be, for example, tumors of lung, breast, stomach, pancreas, prostate, bladder, bone, ovary, skin, kidney, sinus, colon, intestine, stomach, rectum, esophagus, blood, brain and its coverings, spinal cord and its coverings, muscle, connective tissue, adrenal, parathyroid, thyroid, uterus, testis, pituitary, reproductive organs, liver, gall bladder, eye, ear, nose, throat, tonsils, mouth, lymph nodes and lymphoid system, and other organs.

[0125] As used herein, the term "malignant tumor" is intended to encompass all forms of human carcinomas, sarcomas and melanomas which occur in the poorly differentiated, moderately differentiated, and well-differentiated forms.

[0126] This embodiment satisfies a need in the art for treatments that can remove benign tumors with less risk and fewer of the undesirable side effects of surgery. A method for removing benign tumors in surgically hazardous areas such as in deep locations in the body (e.g., brain, heart, lungs, and others) is particularly needed.

[0127] The method of treating conditions where cells must be removed can be used in conjunction with conventional methods of treating such conditions, such as surgical excision, chemotherapy, and radiation. In one

embodiment, there is provided a method of administering a composition comprising an NTP peptide (either alone or in combination in an additional active agent), followed by surgical treatment. The inventors surprisingly discovered that patients who received the NTP peptide and subsequently underwent surgical treatment had an IPSS improvement of from about 15-150% greater than the IPSS improvement in patients receiving a placebo and subsequently undergoing surgical treatment. In some embodiments, the improvement is within the range of from about 25 to about 100%, or from about 30% to about 75%, or from about 40% to about 65%.

[0128] The condition to be treated can also be a hyperplasia, hypertrophy, or overgrowth of a tissue selected from the group consisting of lung, breast, stomach, pancreas, prostate, bladder, bone, ovary, skin, kidney, sinus, colon, intestine, stomach, rectum, esophagus, blood, brain and its coverings, spinal cord and its coverings, muscle, connective tissue, adrenal, parathyroid, thyroid, uterus, testis, pituitary, reproductive organs, liver, gall bladder, eye, ear, nose, throat, tonsils, mouth, and lymph nodes and lymphoid system.

[0129] Other conditions that can be treated using the method of the embodiments are virally, bacterially, or parasitically altered tissue selected from the group consisting of lung, breast, stomach, pancreas, prostate, bladder, bone, ovary, skin, kidney, sinus, colon, intestine, stomach, rectum, esophagus, blood, brain and its coverings, spinal cord and its coverings, muscle, connective tissue, adrenal, parathyroid, thyroid, uterus, testis, pituitary, reproductive organs, liver, gall bladder, eye, ear, nose, throat, tonsils, mouth, and lymph nodes and lymphoid system.

[0130] The condition to be treated can also be a malformation or disorder of a tissue selected from the group consisting of lung, breast, stomach, pancreas, prostate, bladder, bone, ovary, skin, kidney, sinus, colon, intestine, stomach, rectum, esophagus, blood, brain and its coverings,

spinal cord and its coverings, muscle, connective tissue, adrenal, parathyroid, thyroid, uterus, testis, pituitary, reproductive organs, liver, gall bladder, eye, ear, nose, throat, tonsils, mouth, and lymph nodes and lymphoid system.

[0131] In particular, the condition to be treated can be tonsillar hypertrophy, prostatic hyperplasia, psoriasis, eczema, dermatoses or hemorrhoids. The condition to be treated can be a vascular disease, such as atherosclerosis or arteriosclerosis, or a vascular disorder, such as varicose veins, stenosis or restenosis of an artery or a stent. The condition to be treated can also be a cosmetic modification to a tissue, such as skin, eye, ear, nose, throat, mouth, muscle, connective tissue, hair, or breast tissue.

[0132] Therapeutic compositions of NTP peptides may comprise a therapeutically effective amount of an NTP peptide in admixture with a pharmaceutically acceptable carrier. In some embodiments, the additional active agent can be administered in the same composition with the NTP peptide, and in other embodiment, the composition comprising the NTP peptide is administered as an injection, whereas the additional active agent is formulated into an oral medication (gel, capsule, tablet, liquid, etc.). The carrier material may be water for injection, preferably supplemented with other materials common in solutions for administration to mammals. Typically, an NTP peptide for therapeutic use will be administered in the form of a composition comprising purified peptide in conjunction with one or more physiologically acceptable carriers, excipients, or diluents. Neutral buffered saline or saline mixed with serum albumin are exemplary appropriate carriers. Preferably, the product is formulated as a lyophilizate using appropriate excipients (e.g., sucrose). Other standard carriers, diluents, and excipients may be included as desired. Compositions of the embodiments also may comprise buffers known to those having ordinary skill in the art with an appropriate range of pH values, including Tris buffer

of about pH 7.0-8.5, or acetate buffer of about pH 4.0-5.5, which may further include sorbitol or a suitable substitute therefor.

[0133] The use of NTP peptides conjugated or linked or bound to an antibody, antibody fragment, antibody-like molecule, or a molecule with a high affinity to a specific tumor marker, such as a cellular receptor, signal peptide or over-expressed enzyme, for targeting to the unwanted cellular elements in a naïve mammal also is encompassed by the scope of the embodiments. The antibody, antibody fragment, antibody-like molecule, or molecule with a high affinity to a specific tumor marker is used to target the Peptide conjugate to a specific cellular or tissue target. For example, a tumor with a distinctive surface antigen or expressed antigen can be targeted by the antibody, antibody fragment, or antibody-like binding molecule and the tumor cells can be killed by the Peptide. Such an approach using antibody targeting has the anticipated advantages of decreasing dosage, increasing the likelihood of binding to and uptake by the target cells, and increased usefulness for targeting and treating metastatic tumors and microscopic sized tumors.

[0134] This embodiment also encompasses the use of NTP peptides conjugated or linked or bound to a protein or other molecule to form a composition that, upon cleavage at or near the site(s) of the tumor or other unwanted cells by a tumor- or site-specific enzyme or protease or by an antibody conjugate that targets tumor or other unwanted cells, releases the Peptide at or near the site(s) of the tumor or other unwanted cells

[0135] This embodiment also encompasses the use of NTP peptides conjugated or linked or bound to a protein or other molecule to form a composition that releases the Peptide or some biologically active fragment of the Peptide upon exposure of the tissue to be treated to light (as in laser therapies or other photo-dynamic or photo-activated therapy), other forms of electromagnetic radiation such as infra-red radiation, ultraviolet radiation,

x-ray or gamma ray radiation, localized heat, alpha or beta radiation, ultrasonic emissions, or other sources of localized energy.

[0136] The embodiments also encompass therapeutic compositions of NTP peptides employing dendrimers, fullerenes, and other synthetic molecules, polymers and macromolecules where the Peptide and/or its corresponding DNA molecule is conjugated with, attached to or enclosed in the molecule, polymer or macromolecule, either by itself or in conjunction with other species of molecule such as a tumor-specific marker. For example, U.S. Pat. No. 5,714,166, Bioactive and/or Targeted Dendrimer Conjugates, provides a method of preparing and using, inter alia, dendritic polymer conjugates composed of at least one dendrimer with a target director(s) and at least one bioactive agent conjugated to it. The disclosure of U.S. Pat. No. 5,714,166 is incorporated by reference herein in its entirety.

[0137] This embodiment also encompasses methods of treating mammals with therapeutic compositions of NTP peptides and/or genes and drug delivery vehicles such as lipid emulsions, micelle polymers, polymer microspheres, electroactive polymers, hydrogels and liposomes, in combination with an additional active agent.

[0138] The use of NTP peptides or related genes or gene equivalents transferred to the unwanted cells in a mammal also is encompassed by the embodiments. Overexpression of the NTP peptide within the tumor can be used to induce the cells in the tumor to die and thus reduce the tumor cell population. The gene or gene equivalent transfer of NTP peptide to treat the unwanted cellular elements is anticipated to have the advantage of requiring less dosage, and of being passed on to the cellular progeny of the targeted cellular elements, thus necessitating less frequent therapy, and less total therapy. This embodiment also encompasses the transfer of genes that code for a fusion protein containing an NTP peptide to the

unwanted cells or neighboring cells where, following the expression of the gene and the production and/or secretion of the fusion protein, the fusion protein is cleaved either by native enzymes or proteases or by a prodrug to release the NTP peptide in, at or near the unwanted cells.

[0139] The use of cloned recombinant peptide-antibody conjugates; cloned recombinant peptide-antibody fragment conjugates; and cloned recombinant peptide-antibody-like protein conjugates for administration to treatment naïve mammals also is encompassed by the scope of the embodiments. The advantages of a cloned NTP peptide combined with targeting conjugate (such as an antibody, antibody fragment, antibody-like molecule, or a molecule with a high affinity to a cancer-specific receptor or other tumor marker) are that such a molecule combines the targeting advantages described above in addition to advantages for manufacturing and standardized production of the cloned conjugated molecule.

[0140] This embodiment also encompasses the use of therapeutic compositions of NTP peptides or genes or gene equivalents as a component of the coating of a medical device such as a stent in order to remove, inhibit or prevent unwanted cellular proliferation or accumulation, in combination with an additional active agent.

[0141] Solid dosage forms for oral administration include but are not limited to, capsules, tablets, pills, powders, and granules. In such solid dosage forms, the additional active agent, and/or the NTP peptide can be admixed with at least one of the following: (a) one or more inert excipients (or carrier), such as sodium citrate or dicalcium phosphate; (b) fillers or extenders, such as starches, lactose, sucrose, glucose, mannitol, and silicic acid; (c) binders, such as carboxymethylcellulose, alginates, gelatin, polyvinylpyrrolidone, sucrose and acacia; (d) humectants, such as glycerol; (e) disintegrating agents, such as agar-agar, calcium carbonate, potato or tapioca starch, alginic acid, certain complex silicates, and sodium

carbonate; (f) solution retarders, such as paraffin; (g) absorption accelerators, such as quaternary ammonium compounds; (h) wetting agents, such as acetyl alcohol and glycerol monostearate; (i) adsorbents, such as kaolin and bentonite; and (j) lubricants, such as talc, calcium stearate, magnesium stearate, solid polyethylene glycols, sodium lauryl sulfate, or mixtures thereof. For capsules, tablets, and pills, the dosage forms may also comprise buffering agents.

[0142] Liquid dosage forms for oral administration include pharmaceutically acceptable emulsions, solutions, suspensions, syrups, and elixirs. In addition to the active compounds, the liquid dosage forms may comprise inert diluents commonly used in the art, such as water or other solvents, solubilizing agents, and emulsifiers. Exemplary emulsifiers are ethyl alcohol, isopropyl alcohol, ethyl carbonate, ethyl acetate, benzyl alcohol, benzyl benzoate, propyleneglycol, 1,3-butyleneglycol, dimethylformamide, oils, such as cottonseed oil, groundnut oil, corn germ oil, olive oil, castor oil, and sesame oil, glycerol, tetrahydrofurfuryl alcohol, polyethyleneglycols, fatty acid esters of sorbitan, or mixtures of these substances, and the like.

[0143] Besides such inert diluents, the composition can also include adjuvants, such as wetting agents, emulsifying and suspending agents, sweetening, flavoring, and perfuming agents.

[0144] Actual dosage levels of active ingredients in the compositions of the embodiments may be varied to obtain an amount of NTP peptide and additional active agent that is effective to obtain a desired therapeutic response for a particular composition and method of administration. The selected dosage level therefore depends upon the desired therapeutic effect, the route of administration, the desired duration of treatment, and other factors.

[0145] With mammals, including humans, the effective amounts can be administered on the basis of body surface area. The interrelationship of

dosages for animals of various sizes, species and humans (based on mg/M^2 of body surface) is described by E. J. Freireich et al., Cancer Chemother. Rep., 50 (4):219 (1966). Body surface area may be approximately determined from the height and weight of an individual (see e.g., Scientific Tables, Geigy Pharmaceuticals, Ardsley, N.Y. pp. 537-538 (1970)).

[0146] The total daily dose of the NTP peptide and additional active agent administered to a host may be in single or divided doses. Dosage unit compositions may contain such amounts of such submultiples thereof as may be used to make up the daily dose. It will be understood, however, that the specific dose level for any particular patient will depend upon a variety of factors including the body weight, general health, sex, diet, time and route of administration, potency of the administered drug, rates of absorption and excretion, combination with other drugs and the severity of the particular disease being treated.

[0147] A method of administering an NTP peptide composition according to the embodiments includes, but is not limited to, administering the compounds intramuscularly, orally, intravenously, intraperitoneally, intracerebrally (intraparenchymally), intracerebroventricularly, intratumorally, intralesionally, intradermally, intrathecally, intranasally, intraocularly, intraarterially, topically, transdermally, via an aerosol, infusion, bolus injection, implantation device, sustained release system etc. A method of administering the additional active agent includes administering the additional active agent together with the NTP peptide or separately, preferably as an oral medication.

[0148] Another method of administering an NTP peptide of the embodiments is by a transdermal or transcutaneous route. The additional active agent may be employed together with the NTP peptide, or may be administered separately as discussed above. One example of such an

embodiment is the use of a patch. In particular, a patch can be prepared with a fine suspension of Peptide in, for example, dimethylsulfoxide (DMSO), or a mixture of DMSO with cottonseed oil and brought into contact with the skin of the tumor carrying mammals away from the tumor location site inside a skin pouch. Other mediums or mixtures thereof with other solvents and solid supports would work equally as well. The patch can contain the Peptide compound in the form of a solution or a suspension. The patch can then be applied to the skin of the patient, for example, by means of inserting it into a skin pouch of the patient formed by folding and holding the skin together by means of stitches, clips or other holding devices. This pouch should be employed in such a manner so that continuous contact with the skin is assured without the interference of the mammal. Besides using a skin pouch, any device can be used which ensures the firm placement of the patch in contact with the skin. For instance, an adhesive bandage could be used to hold the patch in place on the skin.

[0149] NTP peptides, in combination with an additional active agent, may be administered in a sustained release formulation or preparation. Suitable examples of sustained-release preparations include semipermeable polymer matrices in the form of shaped articles, e.g. films, or microcapsules. Sustained release matrices include polyesters, hydrogels, polylactides (U.S. Pat. No. 3,773,919, EP 58,481), copolymers of L-glutamic acid and gamma ethyl-L-glutamate (Sidman et al., *Biopolymers*, 22: 547-556), poly(2-hydroxyethyl-methacrylate) (Langer et al., *J. Biomed. Mater. Res.*, 15: 167-277 and Langer, *Chem. Tech.*, 12: 98-105), ethylene vinyl acetate (Langer et al., *supra*) or poly-D(-)-3-hydroxybutyric acid (EP 133,988). Sustained-release compositions also may include liposomes, which can be prepared by any of several methods known in the art (e.g., Epstein et al., *Proc. Natl. Acad. Sci. USA*, 82: 3688-3692; EP 36,676; EP 88,046; and EP 143,949).

[0150] Another method of administering an NTP peptide of the embodiments is by direct or indirect infusion of the NTP peptide into the tumor or other tissue to be treated. In this embodiment, the additional active agent typically will be administered via a different route of administration than the NTP peptide. One example of such an embodiment is the direct injection of NTP peptide into the tumor or other tissue to be treated. The treatment may consist of a single injection, multiple injections on one occasion or a series of injections over a period of hours, days or months with the regression or destruction of the tumor or other tissue to be treated being monitored by means of biopsy, imaging or other methods of monitoring tissue growth. The injection into the tumor or other tissue to be treated may be by a device inserted into an orifice such as the nose, mouth, ear, vagina, rectum or urethra or through an incision in order to reach the tumor or tissue in vivo and may be performed in conjunction with an imaging or optical system such as ultrasound or fibre optic scope in order to identify the appropriate site for the injection(s). Another example of such an embodiment is the use of a device that can provide a constant infusion of NTP peptide to the tissue over time.

[0151] Another method of administering an NTP peptide and additional active agent of the embodiments is in conjunction with a surgical or similar procedure employed to physically excise, ablate or otherwise kill or destroy tumor or other tissue or cellular elements required or desired to be removed or destroyed wherein an NTP peptide of the embodiments is administered to the immediate area(s) surrounding the area(s) where the tumor or other tissue was removed in order to destroy or impede the growth of any tumor cells or other cellular elements not removed or destroyed by the procedure

[0152] Another method of administering an NTP peptide of the embodiments is by implantation of a device within the tumor or other tissue to be treated. In this embodiment, the additional active agent typically will be administered via a different route of administration than the NTP

peptide. One example of such an embodiment is the implantation of a wafer containing Peptide in the tumor or other tissue to be treated, and the administration of the additional active agent via oral administration. The wafer releases a therapeutic dose of NTP peptide into the tissue over time. Alternatively or additionally, the composition may be administered locally via implantation into the affected area of a membrane, sponge, or other appropriate material on to which the NTP peptide has been absorbed. Where an implantation device is used, the device may be implanted into any suitable tissue or organ, and delivery of the Peptide may be directly through the device via bolus, or via continuous administration, or via catheter using continuous infusion.

[0153] An alternative method of administration is to introduce one or more copies of an NTP peptide-encoding gene into the cell being targeted and, if necessary, inducing the copy(ies) of the gene to begin producing Peptide intracellularly. In this embodiment, the additional active agent typically will be administered via a different route of administration than the NTP peptide. One manner in which gene therapy can be applied is to use the NTP peptide-encoding gene (either genomic DNA, cDNA, and/or synthetic DNA encoding the Peptide (or a fragment, variant, homologue or derivative thereof)) which may be operably linked to a constitutive or inducible promoter to form a gene therapy DNA construct. The promoter may be homologous or heterologous to an endogenous Peptide-encoding gene, provided that it is active in the cell or tissue type into which the construct will be inserted. Other components of the gene therapy DNA construct may optionally include, as required, DNA molecules designed for site-specific integration (e.g., endogenous flanking sequences useful for homologous recombination), tissue-specific promoter, enhancer(s) or silencer(s), DNA molecules capable of providing a selective advantage over the parent cell, DNA molecules useful as labels to identify transformed cells, negative selection systems, cell specific binding agents (as, for example, for cell targeting) cell-specific internalization factors, and transcription factors to

enhance expression by a vector as well as factors to enable vector manufacture.

[0154] Means of gene delivery to a cell or tissue in vivo or ex vivo include (but are not limited to) direct injection of bare DNA, ballistic methods, liposome-mediated transfer, receptor-mediated transfer (ligand-DNA complex), electroporation, and calcium phosphate precipitation. See U.S. Pat. Nos. 4,970,154, WO 96/40958, U.S. Pat. No. 5,679,559, U.S. Pat. No. 5,676,954, and U.S. Pat. No. 5,593,875, the disclosures of each of which are incorporated by reference herein in their entirety. They also include use of a viral vector such as a retrovirus, adenovirus, adeno-associated virus, pox virus, lentivirus, papilloma virus or herpes simplex virus, use of a DNA-protein conjugate and use of a liposome. The use of gene therapy vectors is described, for example, in U.S. Pat. Nos. 5,672,344, U.S. Pat. No. 5,399,346, U.S. Pat. No. 5,631,236, and U.S. Pat. No. 5,635,399, the disclosures of each of which are incorporated by reference herein in their entirety.

[0155] The NTP peptide-encoding gene may be delivered through implanting into patients certain cells that have been genetically engineered ex vivo, using methods such as those described herein, to express and secrete the NTP peptide or fragments, variants, homologues, or derivatives thereof. Such cells may be animal or human cells, and may be derived from the patient's own tissue or from another source, either human or non-human. Optionally, the cells may be immortalized or be stem cells. However, in order to decrease the chance of an immunological response, it is preferred that the cells be encapsulated to avoid infiltration of surrounding tissues. The encapsulation materials are typically biocompatible, semi-permeable polymeric enclosures or membranes that allow release of the protein product(s) but prevent destruction of the cells by the patient's immune system or by other detrimental factors from the surrounding tissues. Methods used for membrane encapsulation of cells

are familiar to the skilled artisan, and preparation of encapsulated cells and their implantation in patients may be accomplished without undue experimentation. See, e.g., U.S. Pat. Nos. 4,892,538; 5,011,472; and 5,106,627, the disclosures of each of which are incorporated by reference herein in their entirety. A system for encapsulating living cells is described in PCT WO 91/10425. Techniques for formulating a variety of other sustained or controlled delivery means, such as liposome carriers, bio-erodible particles or beads, are also known to those in the art, and are described, for example, in U.S. Pat. No. 5,653,975, the disclosure of which is incorporated by reference herein in their entirety. The cells, with or without encapsulation, may be implanted into suitable body tissues or organs of the patient.

[0156] Particularly preferred embodiments of methods of treating a disorder requiring the removal or destruction of cells by administering one or more NTP peptides and additional active agents of the embodiments, and the cells to be removed or destroyed are lymphoid tissue. Other preferred embodiments include treating conditions that require removal or destruction of cells such as any one selected from individually or in combination tonsillary hypertrophy, prostatic hyperplasia, vascular disease (atherosclerosis or arteriosclerosis), hemorrhoids, varicose veins, psoriasis, eczema, dermatosis, and a cosmetic modification to a tissue. Other treatable conditions include stenosis, restenosis, occlusion or blockage of an artery or of a stent placed or implanted in an artery. Suitable tissue that can be treated in the preferred embodiments include skin, eye, ear, nose, throat, mouth, muscle, connective, hair, and breast.

[0157] Other preferred conditions treated in accordance with the embodiments include those selected from an inflammatory disease, autoimmune disease, metabolic disease, hereditary/genetic disease, traumatic disease or physical injury, nutritional deficiency disease, infectious disease, amyloid disease, fibrosis disease, storage disease,

congenital malformation, enzyme deficiency disease, poisoning, intoxication, environmental disease, radiation disease, endocrine disease, degenerative disease and mechanical disease. In another preferred embodiment, the peptide is conjugated, linked, or bound to a molecule selected from an antibody, antibody fragment, and an antibody-like binding molecule, wherein said molecule has a higher affinity for binding to a tumor or other target than binding to other cells. In another embodiment, the peptide is part of a single new cloned recombinant molecule consisting of the peptide and a molecule selected from the group consisting of an antibody, antibody fragment, and antibody-like binding molecule, wherein the molecule has a higher affinity for binding to a tumor or other target than binding to other cells.

[0158] In certain embodiments, the invention provides a method of treating BPH which comprises administering a therapeutically effective amount of an NTP peptide, specifically an isolated peptide comprising the amino acid sequence in SEQ ID NO. 66 (Ile-Asp-Gln-Gln-Val-Leu-Ser-Arg-Ile-Lys-Leu-Glu-Ile-Lys-Arg-Cys-Leu), in combination with at least one active agent selected from the group consisting of (1) of an inhibitor of 5 α -reductase and/or an antiestrogen, (2) an inhibitor of 5 α -reductase and/or an aromatase inhibitor, (3) a 5 α -reductase inhibitor and/or a 17 β -HSD inhibitor, (4) a 5 α -reductase inhibitor, an antiestrogen and an aromatase inhibitor, (5) a 5 α -reductase inhibitor, an antiestrogen and a 17 β -HSD inhibitor, (6) a 5 α -reductase inhibitor, an aromatase inhibitor, an antiestrogen and a 17 β -HSD inhibitor, (7) a 5 α -reductase inhibitor, an antiandrogen and an antiestrogen, (8), a 5 α -reductase inhibitor, an antiandrogen and an aromatase inhibitor, (9) a 5 α -reductase inhibitor, an antiandrogen and a 17 β -HSD inhibitor, (10) a 5 α -reductase inhibitor, an antiandrogen, an antiestrogen and an aromatase inhibitor, (11) a 5 α -reductase inhibitor, an antiandrogen, an aromatase inhibitor and a 17 β -HSD inhibitor, (12) a 5 α -reductase inhibitor, an antiandrogen, an aromatase inhibitor, an antiestrogen and a 17 β -HSD inhibitor, (13) a 17 β -

HSD inhibitor and an antiestrogen, (14) a 17 β -HSD inhibitor and an aromatase inhibitor, (15) a 17 β -HSD inhibitor, an aromatase inhibitor and an antiestrogen, (16) a 17 β -HSD inhibitor, an antiandrogen and an antiestrogen, (17) a 17 β -HSD inhibitor, an antiandrogen and an aromatase inhibitor, (18) a 17 β -HSD inhibitor, an antiandrogen, an antiestrogen and an aromatase inhibitor, (19) an antiestrogen and an aromatase inhibitor and (20) an antiestrogen, an aromatase inhibitor, and an antiandrogen, (21) an LHRH agonist or antagonist, an inhibitor of 5 α -reductase and an antiestrogen, (22) an LHRH agonist or antagonist, an inhibitor of 5 α -reductase and an aromatase inhibitor, (23) an LHRH agonist or antagonist, a 5 α reductase inhibitor and a 17 β -HSD inhibitor, (24) an LHRH agonist or antagonist, a 5 α -reductase inhibitor, an antiestrogen and an aromatase inhibitor, (25) an LHRH agonist or antagonist, a 5 α -reductase inhibitor, an antiestrogen and a 17 β -HSD inhibitor, (26) an LHRH agonist or antagonist, a 5 α -reductase inhibitor, an aromatase inhibitor, an antiestrogen and a 17 β -HSD inhibitor, (27) an LHRH agonist or antagonist, a 5 α -reductase inhibitor, an antiandrogen and an antiestrogen, (28), an LHRH agonist or antagonist, a 5 α -reductase inhibitor, an antiandrogen and an aromatase inhibitor, (29) an LHRH agonist or antagonist, a 5 α -reductase inhibitor, an antiandrogen and an 17 β -HSD inhibitor, (30) an LHRH agonist or antagonist, a 5 α -reductase inhibitor, an antiandrogen, an antiestrogen and an aromatase inhibitor, (31) an LHRH agonist or antagonist, a 5 α -reductase inhibitor, an antiandrogen, an aromatase inhibitor and a 17 β -HSD inhibitor, (32) an LHRH agonist or antagonist, a 5 α -reductase inhibitor, an antiandrogen, an aromatase inhibitor, an antiestrogen and a 17 β -HSD inhibitor, (33) an LHRH agonist or antagonist, a 17 β -HSD inhibitor and an antiestrogen, (34) an LHRH agonist or antagonist, a 17 β -HSD inhibitor and an aromatase inhibitor, (35) an LHRH agonist or antagonist, a 17 β -HSD inhibitor, an aromatase inhibitor and an antiestrogen, (36) an LHRH agonist or antagonist, a 17 β -HSD inhibitor, an antiandrogen and an antiestrogen, (37) an LHRH agonist or antagonist, a 17 β -HSD inhibitor, an

antiandrogen and an aromatase inhibitor, (38) an LHRH agonist or antagonist, a 17 β -HSD inhibitor, an antiandrogen, an antiestrogen and an aromatase inhibitor, (39) an LHRH agonist or antagonist, an antiestrogen and an aromatase inhibitor and (40) an LHRH agonist or antagonist, an antiestrogen, an aromatase inhibitor, and an antiandrogen.

[0159] The following examples are provided to illustrate the present embodiments. It should be understood, however, that the embodiments are not to be limited to the specific conditions or details described in these examples. Throughout the specification, any and all references to a publicly available document, including a U.S. patent, are specifically incorporated by reference. In particular, the embodiments expressly incorporate by reference the examples contained in pending U.S. patent application Publication Nos. 2003/0054990 (now abandoned); 2007/0237780 (now abandoned); 2003/0054990 (now US Patent No. 7,172,893); 2003/0096350 (now US Patent No. 6,924,266); 2003/0096756 (now US Patent No. 7,192,929); 2003/0109437 (now US Patent No. 7,241,738); 2003/0166569 (now US Patent No. 7,317,077); and 2005/0032704 (now US Patent No. 7,408,021), each of which reveal that certain peptides specified therein are effective agents for causing cell death in vivo in normal rodent muscle tissue, subcutaneous connective tissue, dermis and other tissue.

Example One

[0160] In a study of 97 patients who had or had not previously ever taken conventional approved oral medications for their benign prostatic hyperplasia (BPH), the patients received a double-blind single injection of a specific peptide described by the amino acid sequence Ile-Asp-Gln-Gln-Val-Leu-Ser-Arg-Ile-Lys-Leu-Glu-Ile-Lys-Arg-Cys-Leu (hereinafter "DRUG") (n=61) or vehicle alone (placebo) (n=36) and were followed clinically for 2-5 years. Patients with BPH were given an intraprostatic injection of either a)

DRUG in phosphate buffered saline pH 7.2 ("PBS") or b) PBS alone, under double-blind conditions by a urologist in an office setting under ultrasound guidance. Patients were followed for 2 to 5 years with regular physical examinations, laboratory tests, and evaluations of symptoms. Patients who a) received DRUG and subsequently received in addition conventional oral medications used to treat BPH including alpha blockers such as tamsulosin, terazosin, doxazosin, silodosin, etc. or 5-alpha reductase inhibitors such as finasteride, dutasteride, or phosphodiesterase type 5 (PDE5) inhibitors such as tadalafil, or combinations thereof were compared to patients who b) received vehicle only (PBS) injections, and subsequently received conventional oral medications such as those described in a) above.

[0161] Symptomatic evaluation was measured by the International Prostate Symptom Score (IPSS) which is a quantitative scale used to gauge prostatic symptomatic improvement or worsening. The IPSS quantifies the following: 1) incomplete bladder emptying after urination; 2) frequent urination; 3) stopping and starting during urination; 4) urgent need to urinate; 5) weakness of urinary stream; 6) need to push or strain during urination; 7) need to urinate after going to sleep at night (nocturia). The difference from baseline IPSS was compared in patients who were given DRUG plus conventional oral medications vs patients who received PBS alone plus conventional oral BPH medications. Surprisingly the oral medication results in subjects who had a single prior injection of DRUG were superior to the oral medication results for subjects who had a prior injection of vehicle alone. The results are summarized in Table 4.

Table 4

Group	N	Treatment	Duration After Treatment	Mean IPSS Improvement
DRUG plus additional oral medication	61	DRUG	2-5 years	7.61* (std. dev. 6.85)
Placebo plus additional oral medication	36	PBS	2-5 years	5.44 (std. dev. 6.51)

* $p < .01$ compared to expected mean improvement of 4 points with oral drug alone.

[0162] In accordance with this example, use of the NTP peptide in combination with additional oral medication in treating BPH provided a Mean IPSS Improvement, when compared to the control, of about 40%.

Example Two

[0163] In a study of 30 patients who had not previously ever taken conventional approved oral medications for their BPH, the patients received a double-blind single injection of DRUG (n=21) or vehicle alone (placebo) (n=9) and were followed clinically for 2-5 years. Patients from both of the above drug and vehicle only placebo groups who had not previously received conventional oral medications and subsequently went on conventional oral medications were evaluated for their responses to the conventional oral BPH medications. Surprisingly, patients who had received DRUG treatment had a significantly better than expected BPH symptomatic response of improvement after conventional oral BPH medication (mean improvement of 7.48 points in Symptom Score compared to expected improvement of 3-5 points from conventional oral drug treatment alone, $p < .02$), whereas vehicle only placebo patients did not (mean improvement of 2.33 points compared to expected improvement of 3-5 points).

[0164] In accordance with this example, use of the NTP peptide in combination with additional oral medication in treating BPH provided a Mean IPSS Improvement, when compared to the control, of about 221%.

Example Three

[0165] In another study, patients with BPH were given an intraprostatic injection of PBS pH 7.2 vehicle alone, under double-blind conditions by a urologist in an office setting under ultrasound guidance. Patients were followed for 1 to 3 years with regular physical examinations, laboratory tests, and evaluations of symptoms. Patients who received PBS vehicle alone injections and who subsequently received in addition conventional oral medications used to treat BPH such as alpha blockers were assessed before and after receiving an additional injection of DRUG in phosphate buffered saline pH 7.2 ("PBS"). Symptomatic evaluation was measured by the International Prostate Symptom Score (IPSS) which is a quantitative scale used to gauge prostatic symptomatic improvement or worsening. The difference from baseline IPSS was compared in patients who were given blinded PBS only plus conventional oral medications vs results in the same patients on oral medications after cross-over to DRUG. Surprisingly the symptomatic results were far better in subjects on oral BPH medications after an injection of DRUG as compared to the prior results in the same subjects receiving blinded vehicle alone. The results are summarized in Table 5.

Table 5

Group	N	Treatment	Duration After Treatment	Mean IPSS Improvement
DRUG	3	PBS + oral medication + DRUG	1-3 years, reassessed 6 months	11.83* (s.d. 4.17)
Control	3	PBS + oral medication	1-3 years	5.67 (s.d. 512)

* $p < .05$ compared to expected mean of 4 points with oral drug alone

[0166] In accordance with this example, use of the NTP peptide in combination with additional oral medication in treating BPH provided a Mean IPSS Improvement, when compared to the control, of about 110%.

Example Four

[0167] 973 patients who had not previously ever undergone surgical procedures for their BPH (including all types of surgical procedures such as transurethral resection of the prostate, laser ablation, microwave, needle ablation, and other minimally invasive surgical treatments) received a double-blind single injection of DRUG or vehicle alone (placebo) and were followed clinically for 2-5 years. All (N=58) patients from the above drug and vehicle alone placebo groups who had not previously undergone surgical treatment for their BPH and who subsequently underwent surgical treatment for their BPH (N=58) were then evaluated for their responses to the surgical procedures. Surprisingly, patients who had received DRUG treatment (n=31) had a significantly better than expected BPH symptom response of improvement after surgery (mean improvement of 15.3 points in Symptom Score compared to expected improvement of 10 points, $p = .001$), whereas vehicle alone (placebo)(n=27) patients did not (mean improvement of 10.8 points compared to expected improvement of 10 points).

[0168] In accordance with this example, use of the NTP peptide prior to surgical treatment provided a Mean IPSS Improvement, when compared to the control, of about 142%.

[0169] The results from the foregoing examples illustrate the unexpectedly superior effect of the NTP peptides, in combination with one or more additional active agents, in treatment of mammals having a condition requiring the removal or destruction of unwanted cellular proliferations. It will be apparent to those skilled in the art that various modifications and variations can be made in the methods and compositions of the present embodiments without departing from the spirit or scope of the embodiments.

What is claimed is:

1. A method of treating a mammal for removal or destruction of unwanted cellular proliferations comprising administering to the mammal a therapeutically effective amount of an isolated peptide comprising the amino acid sequence in SEQ ID NO. 66 (Ile-Asp-Gln-Gln-Val-Leu-Ser-Arg-Ile-Lys-Leu-Glu-Ile-Lys-Arg-Cys-Leu), in combination with at least one active agent capable of treating symptoms of, reducing, blocking, inhibiting treating and/or killing unwanted cellular proliferations in mammals, wherein the method removes or destroys unwanted cellular proliferations.
2. The method of claim 1, wherein the method comprises administration of a therapeutically effective amount of at least one of the peptides as claimed in claim 1 and a carrier.
3. The method of claim 1, wherein the at least one active agent capable of treating symptoms of, reducing, blocking, inhibiting treating and/or killing unwanted cellular proliferations in mammals, is one or more agents selected from the group consisting of of tamsulosin, finasteride, terazosin, doxazosin, prazosin, tadalafil, alfuzosin, silodosin, dutasteride, combinations of dutasteride and tamsulosin, and mixtures and combinations thereof.
4. The method of claim 3, wherein the at least one active agent capable of treating symptoms of, reducing, blocking, inhibiting treating and/or killing unwanted cellular proliferations in mammals is one or more agents selected from the group consisting of of tamsulosin, finasteride, terazosin, doxazosin, tadalafil, dutasteride, combinations of dutasteride and tamsulosin, and mixtures and combinations thereof.
5. The method of claim 1, wherein the method comprises administration of a therapeutically effective amount of at least one of the peptides as claimed in claim 1 and at least one and up to 25 additional

amino acids flanking either the N-terminus or C-terminus of the isolated peptide of claim 1.

6. The method of claim 1, wherein the peptide is administered by a method selected from the group consisting of orally, subcutaneously, intradermally, intranasally, intravenously, intramuscularly, intrathecally, intranasally, intratumorally, topically, and transdermally.

7. The method of claim 1, wherein the method is carried out on the mammal before, during, or after treatment of the mammal with a treatment selected from the group consisting of surgical excision, transplantation, grafting, chemotherapy, immunotherapy, vaccination, thermal or electrical ablation, cryotherapy, laser therapy, phototherapy, gene therapy, and radiation.

8. The method of claim 1, wherein the condition is a benign or malignant tumor of a tissue selected from the group consisting of lung, breast, stomach, pancreas, prostate, bladder, bone, ovary, skin, kidney, sinus, colon, intestine, stomach, rectum, esophagus, heart, spleen, salivary gland, blood, brain and its coverings, spinal cord and its coverings, muscle, connective tissue, adrenal, parathyroid, thyroid, uterus, testis, pituitary, reproductive organs, liver, gall bladder, eye, ear, nose, throat, tonsils, mouth, and lymph nodes and lymphoid system.

9. The method of claim 1, wherein the condition is a hyperplasia, hypertrophy, or overgrowth of a tissue selected from the group consisting of lung, breast, stomach, pancreas, prostate, bladder, bone, ovary, skin, kidney, sinus, colon, intestine, stomach, rectum, esophagus, heart, spleen, salivary gland, blood, brain and its coverings, spinal cord and its coverings, muscle, connective tissue, adrenal, parathyroid, thyroid, uterus, testis, pituitary, reproductive organs, liver, gall bladder, eye, ear, nose, throat, tonsils, mouth, and lymph nodes and lymphoid system.

10. The method of claim 1, wherein the condition is a virally, bacterially, or parasitically altered tissue selected from the group consisting of lung, breast, stomach, pancreas, prostate, bladder, bone, ovary, skin, kidney, sinus, colon, intestine, stomach, rectum, esophagus, heart, spleen, salivary gland, blood, brain and its coverings, spinal cord and its coverings, muscle, connective tissue, adrenal, parathyroid, thyroid, uterus, testis, pituitary, reproductive organs, liver, gall bladder, eye, ear, nose, throat, tonsils, mouth, and lymph nodes and lymphoid system.

11. The method of claim 1, wherein the condition is a malformation of a tissue selected from the group consisting of lung, breast, stomach, pancreas, prostate, bladder, bone, ovary, skin, kidney, sinus, colon, intestine, stomach, rectum, esophagus, heart, spleen, salivary gland, blood, brain and its coverings, spinal cord and its coverings, muscle, connective tissue, adrenal, parathyroid, thyroid, uterus, testis, pituitary, reproductive organs, liver, gall bladder, eye, ear, nose, throat, tonsils, mouth, and lymph nodes and lymphoid system.

12. The method of claim 1, wherein the condition is benign prostatic hyperplasia (BPH).

13. The method of claim 1, wherein the method provides a Mean IPSS (International Prostate Symptom Score) improvement, when compared to the improvement found by treating a mammal with a placebo in combination with an additional active agent capable of treating symptoms of, reducing, blocking, inhibiting treating and/or killing unwanted cellular proliferations in mammals, of from about 15% to about 150%.

14. The method of claim 13, wherein the improvement is about 40%.

15. The method of claim 1, wherein the at least one active agent is administered separately or at different times from the at least one isolated peptide.

16. The method of claim 15 wherein the at least one isolated peptide is administered by a method selected from the group consisting of intravenously, intramuscularly, intrathecally, intranasally, intratumorally, topically, and transdermally, and the at least one active agent is administered orally.
17. A method of treating mammal for removal or destruction of unwanted cellular proliferations comprising administering to the mammal a therapeutically effective amount of an isolated peptide comprising the amino acid sequence in SEQ ID NO. 66 (Ile-Asp-Gln-Gln-Val-Leu-Ser-Arg-Ile-Lys-Leu-Glu-Ile-Lys-Arg-Cys-Leu), followed by surgical treatment of the unwanted cellular proliferations.
18. The method of claim 17, wherein the method provides a Mean IPSS (International Prostate Symptom Score) improvement, when compared to the improvement found by treating a mammal with a placebo in combination with surgical treatment of from about 15% to about 150%.

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2016/053483

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61K38/17 A61K38/10 A61P35/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61K A61P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 03/008444 A2 (NYMOX CORP [CA]; AVERBACK PAUL A [CA]; GEMMELL JACK [CA]) 30 January 2003 (2003-01-30)	1,2,5-18
Y	the whole document claims 23-45 page 10, lines 21-27 page 11, lines 12-14 NTP-122; page 16, lines 3-6; sequence 15 page 80, lines 24-28 example 1 ----- -/--	1-18



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

6 September 2016

Date of mailing of the international search report

21/09/2016

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INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2016/053483

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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X	WO 2007/098588 A1 (NYMOX CORP [CA]; AVERBACK PAUL A [CA]; GEMMELL JACK [CA]) 7 September 2007 (2007-09-07)	1,2,5-18
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Information on patent family members

International application No

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