

(19) AUSTRALIAN PATENT OFFICE

(54) Title
Methods for treatment of cognitive and menopausal disorders with D-threo methylphenidate

(51)⁶ International Patent Classification(s)

| | | |
|----------------------|--------------------|------|
| C07D 211/34 | 8BMEP | A61P |
| (2006.01) | 3/00 | |
| A61K 31/445 | 20060101ALI2005122 | |
| (2006.01) | 0BMJP | A61P |
| A61K 31/4458 | 9/00 | |
| (2006.01) | 20060101ALI2005122 | |
| A61K 45/06 (2006.01) | 0BMJP | A61P |
| | 15/12 | |
| A61P 3/00 (2006.01) | 20060101ALI2005122 | |
| A61P 9/00 (2006.01) | 0BMJP | A61P |
| A61P 15/12 (2006.01) | 25/20 | |
| A61P 25/20 (2006.01) | 20060101ALI2005122 | |
| A61P 25/22 (2006.01) | 0BMJP | A61P |
| A61P 25/24 (2006.01) | 25/22 | |
| A61P 25/28 (2006.01) | 20060101ALI2005122 | |
| A61P 35/00 (2006.01) | 0BMJP | A61P |
| C07D 211/34 | 25/24 | |
| 20060101AFI2005122 | 20060101ALI2005122 | |
| 0BMJP A61K | 0BMJP | A61P |
| 31/445 | 25/28 | |
| 20060101ALI2005100 | 20060101ALI2005122 | |
| 8BMEP A61K | 0BMJP | A61P |
| 31/4458 | 35/00 | |
| 20060101ALI2005100 | 20060101ALI2005122 | |
| 8BMEP A61K | 0BMJP | |
| 45/06 | PCT/US02/22039 | |
| 20060101ALI2005100 | | |

(21) Application No: 2002318302 (22) Application Date: 2002.07.11

(87) WIPO No: WO03/005962

(30) Priority Data

(31) Number (32) Date (33) Country
09/903,803 2001.07.12 US

(43) Publication Date: 2003.01.29

(43) Publication Journal Date: 2003.05.22

(71) Applicant(s)
Celgene Corporation

(72) Inventor(s)
Zeitlin, Andrew L., Stirling, David I., Faleck, Herbert, Khetani, Vikram, Dariani, Maghsoud M., Zeldis, Jerome B.

(74) Agent/Attorney
Watermark Patent & Trademark Attorneys, The Glasshouse 290 Burwood Road, Hawthorn, VIC, 3122

(56) Related Art
US 5733756A
US 5908850A

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
23 January 2003 (23.01.2003)

PCT

(10) International Publication Number
WO 03/005962 A3

(51) International Patent Classification⁷: A61K 31/445 (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(21) International Application Number: PCT/US02/22039 (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EB, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CT, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(22) International Filing Date: 11 July 2002 (11.07.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data: 09/903,803 12 July 2001 (12.07.2001) US

(71) Applicant (for all designated States except US): CEL-GENE CORPORATION [US/US]; 7 Powder Horn Drive, Warren, NJ 07059 (US).

(72) Inventors; and (75) Inventors/Applicants (for US only): ZELDIS, Jerome, B. [US/US]; 157 Christopher Drive, Princeton, NJ 08540 (US). FALECK, Herbert [US/US]; 19 Lakeview Drive, West Orange, NJ 07052 (US). KHETANI, Vikram [US/US]; 30 Oak Hill Road, Short Hill, NJ 07078 (US). ZEITLIN, Andrew, L. [US/US]; 29 Riverside Drive, Basking Ridge, NJ 07920 (US). DARIANI, Maghsoud, M. [US/US]; 11 Byron Lane, Fanwood, NJ 07023 (US). STIRLING, David, L. [GB/US]; 3281 Roundhill Road, Branchburg, NJ 08876 (US).

(74) Agents: CALDWELL, John, W. et al.; Woodcock Washburn LLP, One Liberty Place - 46th Floor, Philadelphia, PA 19103 (US).



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(54) Title: METHODS FOR TREATMENT OF COGNITIVE AND MENOPAUSAL DISORDERS WITH D-THREO METHYLPHENIDATE

(57) Abstract: In one aspect, the present invention is directed to methods for treating fatigue, neurobehavioral slowing and other cognitive disorders and defects due to cancers and treatments associated with cancers, and similar conditions. In a further aspect, the present invention is directed to methods for treating disorders related to menopause, including executive function defects. The methods involve the administration of a composition comprising D-threo methylphenidate that is substantially free of L-threo methylphenidate and of erythro forms of methylphenidate.

WO 03/005962 A3

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Declaration under Rule 4.17:
of inventorship (Rule 4.17(iv)) for US only

Published:
— with international search report

(88) Date of publication of the international search report:
12 June 2003

**METHODS FOR TREATMENT OF COGNITIVE AND MENOPAUSAL
DISORDERS WITH D-threo METHYLPHENIDATE**

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation in part of U.S. Ser. No. 09/318,151, filed 5 May 25, 1999, which is a continuation in part of U.S. Ser. No. 08/583,317 filed January 5, 1996, now U.S. 5,773,756, and a continuation in part of U.S. Ser. No. 08/827,230, filed April 2, 1997, now U.S. 5,908,850, which is continuation of U.S. Ser. No. 08/567,131, filed December 4, 1995. The contents of each of the foregoing applications are incorporated herein by reference in their entirety.

10 FIELD OF THE INVENTION

In one aspect, the present invention is directed to methods for treating fatigue, neurobehavioral slowing and other cognitive disorders and defects due to cancers and treatments associated with cancers, and similar conditions. In a further aspect, the present invention is directed to methods for treating disorders related to menopause, 15 including executive function defects. The methods involve the administration of a composition comprising D-threo methylphenidate that is substantially free of L-threo methylphenidate and of erythro forms of methylphenidate.

BACKGROUND OF THE INVENTION

Advanced cancer typically produces severe pain in patients. This pain is 20 often controlled by the administration of large doses of analgesics, including opioid analgesics. However, the pain relief is often accompanied by undesirable side-effects such

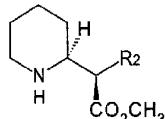
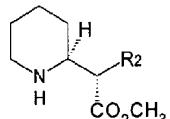
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as unacceptable sedation and/or a decrease in cognitive function. These side effects have a significant negative impact on the quality of life of the patient. In addition, cancer patients often display one or more of a decrease in cognitive function, fatigue, and neurobehavioral slowing that is unrelated to the administration of analgesics, but may be related to the underlying cancer, the treatment of the cancer, or both.

Menopause is accompanied by several side effects, including an executive function defect. For example, many menopausal women report impairment in short term memory, inability to screen distractions and sustain attention in organization of thoughts and tasks. In addition, women diagnosed with ADD prior to menopause report 10 exacerbation of ADD symptoms during the protracted perimenopausal period and thereafter. See Brown, T.E., *Attention-Deficit Disorders and Comorbidities in Children, Adolescents and Adults*, American Psychiatric Press, Washington, D.C., 2000, at p. 40-41.

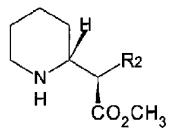
Methylphenidate has been used to treat nervous system disorders including Attention Deficit Disorder (ADD), a commonly diagnosed nervous system illness in children, Attention Deficit Hyperactivity Disorder (ADHD), and cognitive decline in patients with Acquired Immunodeficiency Syndrome (AIDS) or AIDS related conditions. See, e.g., Brown, G., *Intl. J. Psych. Med.* 25(1): 21-37 (1995); Holmes et al., *J. Clin. Psychiatry* 50: 5-8 (1989). The racemic form of methylphenidate also has been proposed to improve cognitive function in patients receiving large doses of medication. See, for example, Bruera et al., *Pain* (1992) 163-166, Yee et al., *Journal of Pain and Symptom Management* (1994), Vol. 9, No.2, 122-125, and Meyers et al., *Journal of Clinical Oncology* (1998) Vol. 16, No. 7, 2522-2527.

Methylphenidate exists as four separate optical isomers as follows:



25 *l-threo*

d-erythro

*d-threo**l-erythro*

wherein R₂ is phenyl. Pharmaceutically acceptable salts are generally administered clinically. Other phenidate drugs, which also can be administered according to the 5 invention, include those in which the methyl group in the above structures is replaced by C₂-C₄ alkyl and those in which R₂ is optionally substituted with C₁-C₄ alkyl.

Clinically, the *threo* pair of enantiomers of methylphenidate hydrochloride is generally administered for the treatment of ADD and ADHD. The hydrochloride salt is commonly referred to simply as "methylphenidate". Unless indicated otherwise, the term 10 "methylphenidate" is used broadly herein to include methylphenidate and pharmaceutically acceptable salts thereof, including methylphenidate hydrochloride.

The *threo* racemate (pair of enantiomers) of methylphenidate is a mild 15 central nervous system stimulant with pharmacological activity qualitatively similar to that of amphetamines. Undesirable side effects associated with the use of the DL-*threo* racemate of methylphenidate include anorexia, weight loss, insomnia, dizziness and dysphoria. Furthermore, the racemate, which is a Schedule II controlled substance, produces a euphoric effect when administered intravenously or through inhalation or 20 ingestion, and thus carries a high potential for abuse.

Srinivas et al. studied the administration of DL-*threo*-, D-*threo*, and L-*threo*- 25 methylphenidate to children suffering from ADHD, and reported that the pharmacodynamic activity of DL-*threo*-methylphenidate resides in the D-*threo* isomer (*Clin. Pharmacol. Ther.*, 52: 561-568 (1992)). While DL-*threo*-methylphenidate is generally used therapeutically, this racemate includes the L isomer which apparently makes no significant contribution to the pharmacological effectiveness of the drug. The removal of the L isomer is expensive, however, and there has been no reason to do so.

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It has been discovered that the use of the D-threo isomer (2R:2'R) of methylphenidate, substantially free of the L-threo isomer, produces a methylphenidate medication which retains high activity levels and simultaneously may possess reduced euphoric effect and reduced potential for abuse among patients. See U.S. Patent Ser. No. 5 5,908,850, incorporated herein by reference in its entirety. Thus, D-threo-methylphenidate (2R:2'R) may possess enhanced therapeutic activity with reduced side effects, and L-threo-methylphenidate may produce undesirable side effects, euphoria and drug abuse potential in patients.

There remains a need for improved methods for alleviating the undesirable 10 symptoms and side-effects described above. This invention is directed to these, as well as other, important ends.

SUMMARY OF THE INVENTION

In one aspect, the present invention provides methods for treating fatigue, neurobehavioral slowing and cognitive side effects arising from cancer, or from a 15 treatment therefor, such as chemotherapy, radiation therapy and administration of medication to control pain. In further aspects, the invention provides methods for alleviation of depression caused by cognitive dysfunction (a "cognitive side effect") and fatigue associated with cancer, and treatments therefor. The methods of the invention involve the administration of D-threo-methylphenidate or a pharmaceutically acceptable 20 salt thereof, substantially free of both L-threo-methylphenidate and erythro methylphenidates.

In some embodiments of the invention, methods are provided for alleviating fatigue and/or neurobehavioral slowing arising from an oncological condition, said method comprising the steps of identifying a patient suffering from said fatigue or neurobehavioral 25 slowing, and administering to said patient a therapeutically effective amount of D-threo-methylphenidate (2R:2'R) or a pharmaceutically acceptable salt thereof, substantially free of the L-threo isomer.

In further aspects, the present invention provides methods for alleviating fatigue or neurobehavioral slowing arising from the administration of a treatment for an 30 oncological condition, said method comprising the steps of identifying a patient suffering

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from said fatigue or neurobehavioral slowing, and administering to said patient a therapeutically effective amount of D-threo-methylphenidate (2R:2'R) or a pharmaceutically acceptable salt thereof, substantially free of the 1-threo isomer.

Also provided in accordance with the present invention are methods for

5 alleviating a cognitive side effect of a treatment for an oncological condition, comprising the steps of identifying a patient suffering from a cognitive side-effect of a treatment for an oncological condition; and administering to said patient a therapeutically effective amount of D-threo-methylphenidate (2R:2'R) or a pharmaceutically acceptable salt thereof, substantially free of the 1-threo isomer.

10 In some embodiments of the methods of the invention, the treatment for the oncological condition is the administration of pain management and biological therapies, including pain relief medication, chemotherapy, radiation therapy, and surgery. In some particularly preferred embodiments, the treatment for the oncological condition is chemotherapy or the administration of pain relief medication. In further embodiments of 15 the foregoing methods, the pain relief medication is one or more opioid analgesics, nerve blocks or other psychotropic agents.

In further embodiments of the foregoing methods, the oncological condition is a cancer selected from the group consisting of all malignant conditions, including both solid tumors and nonsolid tumors. In some preferred embodiments, the oncological 20 condition is a solid tumor.

In some embodiments of the foregoing methods, the cognitive side effect is sedation, decreased cognitive function, major depressive disorder, or neurobehavioral slowing. In some preferred embodiments, the cognitive side effect is sedation or decreased cognitive function.

25 In further aspects, the present invention provides methods for treating a symptom of menopause comprising the steps of identifying a patient suffering from a symptom of menopause; and administering to said patient a therapeutically effective amount of D-threo-methylphenidate (2R:2'R) or a pharmaceutically acceptable salt thereof, substantially free of the 1-threo isomer.

30 In some embodiments of the foregoing methods, the symptom of menopause is impairment in short term memory, decreased cognitive function, mental

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depression, vasomotor instability, nervousness, excitability, fatigue, neurobehavioral slowing, and/or apathy.

In some preferred embodiments of the foregoing methods, the administration of the D-threo-methylphenidate (2R:2'R), or the pharmaceutically acceptable salt thereof, gives rise to efficacious treatment without interfering with patient sleep patterns or engendering anoretic behavior.

5 acceptable salt thereof, gives rise to efficacious treatment without interfering with patient sleep patterns or engendering anoretic behavior.

DETAILED DESCRIPTION

The methods of the invention involve the administration of D-threo-methylphenidate or a pharmaceutically acceptable salt thereof, substantially free of both L-threo-methylphenidate and erythro methylphenidates. It is now believed that the L isomer 10 may contribute to the side effects associated with the commercial drug, and that it is thus desirable to administer only the active D-threo form of the drug.

Thus, in some embodiments of the invention, methods are provided for alleviating fatigue or neurobehavioral slowing arising from an oncological condition, said 15 method comprising the steps of identifying a patient suffering from said fatigue or neurobehavioral slowing, and administering to said patient a therapeutically effective amount of D-threo-methylphenidate (2R:2'R) or a pharmaceutically acceptable salt thereof, substantially free of the 1-threo isomer.

In further aspects, the present invention provides methods for alleviating 20 fatigue or neurobehavioral slowing arising from the administration of a treatment for an oncological condition, said method comprising the steps of identifying a patient suffering from said fatigue or neurobehavioral slowing, and administering to said patient a therapeutically effective amount of D-threo-methylphenidate (2R:2'R) or a pharmaceutically acceptable salt thereof, substantially free of the 1-threo isomer.

25 Also provided in accordance with the present invention are methods for alleviating a cognitive side effect (e.g., neurobehavioral slowing) of a treatment for an oncological condition, comprising the steps of identifying a patient suffering from a cognitive side-effect of a treatment for an oncological condition; and administering to said

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patient a therapeutically effective amount of D-threo-methylphenidate (2R:2'R) or a pharmaceutically acceptable salt thereof, substantially free of the 1-threo isomer.

In some embodiments of the methods of the invention, the treatment for the oncological condition is the administration of pain management and biological therapies, 5 including pain relief medication, chemotherapy, radiation therapy, and surgery. In some particularly preferred embodiments, the treatment for the oncological condition is chemotherapy or the administration of pain relief medication. In further embodiments of the foregoing methods, the pain relief medication is one or more opioid analgesics, nerve blocks or other psychotropic agents.

10 In further embodiments of the foregoing methods, the oncological condition is a cancer selected from the group consisting of all malignant conditions, including both solid tumors and nonsolid tumors. In some preferred embodiments, the oncological condition is a solid tumor.

15 In some embodiments of the foregoing methods, the cognitive side effect is sedation, decreased cognitive function, major depressive disorder, or neurobehavioral slowing. In some preferred embodiments, the cognitive side effect is sedation or decreased cognitive function.

20 In further aspects, the present invention provides methods for treating a symptom of menopause comprising the steps of identifying a patient suffering from a symptom of menopause; and administering to said patient a therapeutically effective amount of D-threo-methylphenidate (2R:2'R) or a pharmaceutically acceptable salt thereof, substantially free of the 1-threo isomer.

25 In some embodiments of the foregoing methods, the symptom of menopause is impairment in short term memory, decreased cognitive function, mental depression, vasomotor instability, nervousness, excitability, fatigue, neurobehavioral slowing and/or apathy.

30 In some preferred embodiments of the foregoing methods, the administration of the D-threo-methylphenidate (2R:2'R), or the pharmaceutically acceptable salt thereof, gives rise to efficacious treatment without interfering with patient sleep patterns or engendering anorectic behavior.

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The administration of the pharmacodynamically active D-threo form of methylphenidate may provide efficacious treatment for an entire day with minimal undesirable side effects such as interference with patient sleep patterns or anoretic behavior. It has been surprisingly and unexpectedly discovered that the beneficial effects 5 of the D-threo isomer persist for a longer period time when the D-threo isomer is administered alone than when it is administered in combination with the L-threo isomer.

While it is not intended that the present invention be bound by any particular theory, it is believed that the L isomer functions as an antagonist to the D isomer. Thus, another aspect of the present invention provides methods for ameliorating or 10 counteracting the effects of methylphenidate drugs, comprising administering L-threo methylphenidate to a patient who has a serum level of D-threo methylphenidate.

The present inventors have observed that in the context of ADD, D-threo methylphenidate has a longer duration of action than DL-methylphenidate of at least six hours. Patients who were given the D-threo isomer free of the L isomer performed better in 15 objective tests than patients who received the DL-threo racemate or a placebo, at the 6 hour time point. In contrast, the patients who received DL-threo racemate did not perform better after that time period than those who received a placebo. Furthermore, subjective observations of the same patients indicated that those who received only the D-threo isomer experienced beneficial effects of the drug for longer times than did those who 20 received the DL-threo racemate.

It is expected that D-threo methylphenidate will be particularly useful in treating patients affected by fatigue, neurobehavioral slowing, and other cognitive defects ("cognitive side effects") that are due to cancer, and that are exacerbated by the administration of treatments for cancer such as chemotherapy, radiation therapy, bone 25 marrow transplants, stem cell transplants and administration of medication to control pain. Examples of such cognitive defects include but are not limited to neurobehavioral slowing, sedation, diminished executive function, decreased cognitive function, major depressive disorder and impaired quality of life.

As used herein, the term "oncological condition" is intended to mean all 30 malignant conditions, including all cancers, for example solid tumors and nonsolid tumors. Examples of "oncological conditions" include cancers of the skin, mouth, brain and other

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nervous tissue, bone, lung, colon and rectum, pancreas, prostate, urinary tract, leukemias and lymphomas.

As used herein, the term "arising from the administration of a treatment for an oncological condition" is intended to mean that the indicated symptom or condition is 5 in whole or in part caused by (i.e., is a side-effect of) the administration of a therapeutic agent used for the treatment of cancer, or for the management of a symptom of the cancer. Examples of agents used for the treatment of cancer include chemotherapeutic agents, including both chemical and radiotherapeutics, and radiation. Examples of agents used for the management of a symptom of the cancer include pain relief medications such as opioid 10 or opioid-like analgesics and non-steroidal anti-inflammatory agents.

As used herein, the term "alleviating a cognitive side effect of a treatment for an oncological condition" means the lessening of the severity of a cognitive side effect caused in whole or in part by the administration of a treatment for an oncological condition. The term "cognitive side effect" as used herein denotes an impairment of one or 15 more cognitive functions that results in whole or in part from the administration of an agent used for the treatment of cancer. Examples of cognitive side effects include sedation, neurobehavioral slowing, decreased cognitive function, depression, apathy, decreased libido and derepersonalization. The term "decreased cognitive function" is intended to mean a decrease in any or all aspects of thought, attention, perception, and/or 20 memory.

As used herein, the term "menopause" is given its normal meaning of the period during which marks the permanent cessation of menstrual activity. The term "symptom of menopause" is intended to include those symptoms associated with menopause, including vasomotor instability, nervousness, excitability, fatigue, 25 neurobehavioral slowing, apathy, mental depression and impairment of short term memory. As used herein, the term "executive function defect" is intended to include but is not limited to one or more defects in the cognitive mechanisms responsible for focusing attention, goal-related behavior, strategic planning and problem solving.

The methods of the invention will find use with patients, including 30 outpatients, with all types of cancer, either primary or metastatic.

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According to one method of the present invention, dosage forms are administered of D-threo methylphenidate substantially free of L-threo methylphenidate and of erythro methylphenidates. "Substantially free", as used herein, means that the dosage forms comprise at least about 95 percent, preferably at least about 97 percent, and more 5 preferably at least about 99 percent of the D-threo isomer, to the exclusion of the L-threo and erythro forms. The D-threo form can be isolated by methods known to those skilled in the art.

In accordance with the present invention, the D-threo methylphenidate can be administered in any of a variety of dosage regimes. Such regimes include chronic 10 single, bolus dosages, i.e., where one dose being administered in a predetermined time period, for example twenty four hours. Further dosage regimes include those where multiple dosages are manually administered, and dosage forms where a single dosage form is administered that effectively mimics multiple dosages, such as pulsatile release dosage forms. Further dosage forms useful with the present invention include delay release and 15 extended release (i.e., "time release") dosage forms. The selection of appropriate dosage forms for an individual patient will depend upon the individual circumstances, and will be apparent to those of skill in the art.

"Chronic", as used herein, refers to continuous, regular, long-term therapeutic administration, i.e. periodic administration without substantial interruption, 20 such as, for example, daily, for a time period of at least several weeks or months to several years, for the purpose of treating a patient needing treatment.

"Bolus", as used herein, refers to administration of a drug as a single event. The term "bolus" is intended to exclude dosage forms such as sustained release, pulsed release, and time release, and includes any dosage form which can be used to deliver a 25 single dose. According to the present invention, a bolus is preferably administered to a patient in need of treatment once daily, more preferably in the morning. The bolus dosages of the present invention may be administered in any conventional form known to those skilled in the art. Suitable methods for administration include oral dosage forms, injection, and infusion.

30 For pharmaceutical use, the D-threo methylphenidate substantially free of L-threo methylphenidate and of erythro methylphenidates as described herein can be taken

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up in pharmaceutically acceptable carriers, such as, for example, solutions, suspensions, tablets, capsules, ointments, elixirs and injectable compositions. Pharmaceutical preparations generally can contain from about 1 % to about 90% by weight of active ingredient. Preparations which are in single dose form, "unit dosage form", preferably 5 contain from about 20 % to about 90 % active ingredient. As used herein, the term "active ingredient" refers to D-threo methylphenidate substantially free of L-threo methylphenidate and of erythro methylphenidates as described herein, salts thereof, and mixtures of D-threo methylphenidate as described herein with other pharmaceutically active compounds.

Dosage unit forms such as, for example, tablets or capsules, typically contain from about 10 0.001 to about 1.0g of active ingredient. Pharmaceutical preparations may be administered orally, parenterally, or topically. Pharmaceutical preparations containing compounds described herein may be prepared by methods known to those skilled in the art, such as, for example, conventional mixing, granulating, dissolving, or lyophilizing. Oral dosage forms include capsules, pills, tablets, troches, lozenges, melts, powders, solutions, 15 suspensions and emulsions. The oral dosage forms provided by the invention can be in the form of tablets, caplets, and the like and can be of any shape suitable for oral administration of a drug, such as spheroidal, cube-shaped, oval, bean shaped, or ellipsoidal. For oral dosage forms, for example, the compounds may be combined with one or more solid pharmaceutically acceptable carriers, optionally granulating the resulting 20 mixture. Pharmaceutically acceptable adjuvants may optionally be included, such as, for example, flow-regulating agents and lubricants. Suitable carriers include, for example, fillers such as sugars, cellulose preparations, calcium phosphates; and binders such as methylcellulose, hydroxymethylcellulose, and starches, such as, for example, maize starch, potato starch, rice starch, and wheat starch. The dosage form may be in the form of 25 granules, which may be irregularly shaped. The dosage form can comprise a capsule containing particles. Examples of orally administrable pharmaceutical preparations are dry-filled capsules consisting of gelatin, and soft sealed capsules consisting of gelatin and a plasticizer such as glycerol or sorbitol. The dry-filled capsules may contain the active ingredient in the form of a granulate, for example in admixture with fillers, binders, 30 glidants, and stabilizers. In soft capsules, the active ingredient is preferably dissolved or suspended in a suitable liquid adjuvant, such as, for example, a fatty oil, paraffin oil, or

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liquid polyethylene glycol, optionally in the presence of stabilizers. Other oral administrable forms include syrups containing active ingredient, for example, in suspended form at a concentration of from about .01% to 20%, or in a similar concentration that provides a suitable single dose when administered, for example, in measures of from about 5 to about 5 milliliters. Suitable excipients for use in oral liquid dosage forms include diluents such as water and alcohols, for example ethanol, benzyl alcohol and polyethylene alcohols, either with or without the addition of a pharmaceutically acceptable surfactant, suspending agent, or emulsifying agent. Also suitable are powdered or liquid concentrates for combining with liquids such as milk. Such concentrates may also be packed in single dose quantities.

In accordance with the present invention, D-threo methylphenidate as described herein may be administered parenterally, that is, subcutaneously, intravenously, intramuscularly, or interperitoneally, as injectable dosages of the compound in a physiologically acceptable diluent with a pharmaceutical carrier. Solutions for parenteral administration may be in the form of infusion solutions. A pharmaceutical carrier may be, for example, a sterile liquid or mixture of liquids such as water, saline, aqueous dextrose and related sugar solutions, an alcohol such as ethanol, glycols such as propylene glycol or polyethylene glycol, glycerol ketals such as 2,2-dimethyl-1,3-dioxolane-4-methanol, ethers such as poly(ethyleneglycol)400, oils, fatty acids, fatty acid esters or glycerides, with or without the addition of a pharmaceutically acceptable surfactant such as a soap or detergent, suspending agent such as pectin, carboxomers, methylcellulose, hydroxypropylmethylcellulose, or carboxymethylcellulose, or emulsifying agent or other pharmaceutically acceptable adjuvants. Examples of oils which may be used in parenteral formulations include petroleum, animal, vegetable, or synthetic oils such as, for example, peanut oil, soybean oil, sesame oil, cottonseed oil, corn oil, olive oil, petrolatum, and mineral oil. Suitable fatty acids include, for example, oleic acid, stearic acid, and isostearic acid. Suitable fatty acid esters include ethyl oleate and isopropyl myristate. Suitable soaps include alkaline metal, ammonium and triethanolamine salts of fatty acids. Suitable detergents include cationic detergents such as dimethyl dialkyl ammonium halides and alkyl pyridinium halides; anionic detergents such as alkyl, aryl and olefin sulfonates, monoglyceride sulfates and sulfosuccinates; nonionic detergents such as fatty

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amine oxides, fatty acid alkanolamides and polyoxyethylenepropylene copolymers; and amphoteric detergents such as alkyl-(aminopropionates and 2-alkylimidazoline quaternary ammonium salts; as well as mixtures of detergents. Parenteral preparations will typically contain at least about 0.01% by weight of active ingredient in solution. Preservatives and 5 buffers may also be used advantageously. Injection suspensions may include viscosity-increasing substances such as, for example, sodium carboxymethylcellulose, sorbitol or dextran, and may also include stabilizers. In order to minimize irritation at the site of injection, injectable compositions may contain a non-ionic surfactant having a hydrophile-lipophile balance (HLB) of from about 12 to about 17. The quantity of 10 surfactant in such formulations ranges from about 5% to about 15% by weight. The surfactant may be a single component having the above HLB or a mixture of two or more components having the desired HLB. Particular examples of useful surfactants include polyethylene sorbitan fatty acid esters, such as, for example, sorbitan monooleate.

In addition to parenteral administration, D-threo methylphenidate as 15 described herein can be formulated for nasal administration, particularly in the form of powders, nasal drops, or aerosols. The compounds of the invention also can be administered dermally, via, for example, trans-dermal patches.

The preferred quantity of D-threo methylphenidate to be used in a dosage 20 for treating a particular patient can be readily determined by one skilled in the art. Factors determining the appropriate dosage include the weight and age of the patient, the type and extent of the disorder being treated, and other conditions of the patient including other 25 disorders and other medications, if any, that the patient is taking. Generally, the dosage of D-threo methylphenidate will be from about 0.01 mg/kg of patient body weight to about 1 mg/kg of patient body weight. Appropriate quantities can be determined by one skilled in the art. For example, a relatively small child will generally require a dose of from about 0.03 to about 0.3 mg/kg, while a larger child or an adult may require a dose of from about 0.1 mg/kg to about 0.4 or 0.5 mg/kg.

A physician treating a patient with cancer will generally titrate the dose of 30 methylphenidate until the desired therapeutic effects is achieved. For example, a patient with cancer receiving an opioid analgesic for pain management will initially be

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administered a minimum dose of 2.5 mg of *d*-MPH b.i.d. at the time of the opioid analgesic, with dose increasing a clinically warranted.

Response by patients with cognitive deficiencies described herein is generally determined by two types of measurements: objective measures of a patient's 5 ability to concentrate and remain focused on a task such as performing a math test; and subjective scores of a patient's performance.

The following examples are merely illustrative of the present invention and should not be considered limiting of the scope of the invention in any way. These examples and equivalents thereof will become more apparent to those skilled in the art in 10 light of the present disclosure and the accompanying claims.

Examples:

Determination of Symptoms

Patients can be evaluated for cognitive impairment by any of the tests known in the art. For example, High Sensitivity Cognitive Screen (HSCS) can test six 15 cognitive domains: memory, language, visual-motor, spatial, attention/concentration, and self-regulation and planning (see, for example, Faust D. and Fogel B.S.: The development and initial validation of a sensitive bedside cognitive screening test. *J. Nerv. Ment. Dis.*; 177:25-31, 1989).

Global cognitive function can be evaluated by the Mini-Mental State Exam 20 (MMSE; see, for example, Folstein M.F., Folstein S.E., McHugh P.R.: "Minimental State": a practical method for grading the cognitive state of patients for the clinician. *J. Psychiatry Res.* 12:189-198, 1975) Attention and concentration can be evaluated via the Trail Making Test-Part A (See, for example, Reitan, R.M.: Validity of the Trail Making Test as an indicator of organic brain damage. *Perceptual Motor Skills* 8:271-276, 1958), and the 25 Digit Span, Forward and Backward test (see, for example, Wechsler D. *Wechsler Adult Intelligence Scale-Revised Manual*. New York; Psychological Corporation, 1981)).

Visuospatial skills can be evaluated by, for example, the Revised-Rey 30 Osterrieth Complex Figure test, (see, for example, Osterrieth R.A. *Le test de copie d'une figure complexe. Archives de Psychologie*, 1944, 30, 206-356). Impairment to language functions can be evaluated by, for example, the Verbal Fluency (F-A-S) test (see, for

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example Kaplan, E.F., Goodglass, H., Weintraub, S. The Boston Naming Test. Boston: E. Kaplan & H. Goodglass, 1978).

Learning impairment can be evaluated by, for example, the California Verbal Learning Test (see, for example, Delis, D.C., Kramer, J.H., Kaplan, E., Ober, B.A. 5 California Verbal Learning Test-Research Edition. The Psychological Corp., New York, 1987).

Memory impairment can be evaluated by, for example, the Revised-Rey Osterrieth Complex Figure, Immediate Recall test and/or the Revised-Rey Osterrieth Complex Figure, Delayed Recall test, (see, for example, Osterrieth RA, above); the 10 California Verbal Learning Test, Immediate Recall, and/or the California Verbal Learning Test, Delayed Recall, the California Verbal Learning Test, Recognition (See, for example, Delis et al., above).

Executive function impairment can be evaluated by, for example, the Trail Making Test-Part B (See, for example, Reitan et al., above).

15 Quality of Life can be evaluated by the FACIT-F tests (Fatigue Scale), the FACT-F test (Functional Assessment of Cancer Therapy – Fatigue Scale), the FACT-G test (Functional Assessment of Cancer Therapy - General Scale), and the FACT-BR test (Functional Assessment of Cancer Therapy - Brain Subscale), (see, for example Cella, D.F., Tulsky, D.S., Gray, G., Sarafian, B., Linn E. Bonomi, A., et al.: The functional 20 assessment of cancer therapy scale: development and validation of the general measure. J. Clin. Oncol. 11:570-579, 1993; Weitzner, M.A., Meyers, C.A., Gelke, C.K., Byrne, K.S., Cell, D.F., Levin, V.A.: The Functional Assessment of Cancer Therapy (FACT) scale: Development of a brain subscale and revalidation of the general version (FACT-G) in patients with primary brain tumors. Cancer 75:1151-1161, 1995; and Yellin, S.B., Cell, 25 D.F., Webster, K., Blendowsky, C., Kaplan, E.: Measuring fatigue and other anemia-related symptoms with the Functional Assessment of Cancer Therapy (FACT) Measurement System., J. Pain Symptom Manage. 13:63-74, 1997). Each of the foregoing publications are incorporated herein by reference in their entirety.

30 Depression can be evaluated by, for example, the Center for Epidemiologic Studies Depression (CES-D) Scale (see, for example, Radloff, L.S.: The CES-D scale: A self-report depression scale for research in the general population. Applied Psychological

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Measurement 1:385-401, 1977), or by Beck Depression Inventory (BDI) (see, for example, Beck, A.T. and Beamesderfer, A: Assessment of depression: the Depression Inventory. Mod. Probl. Pharmacopsychiatry; 7:155-169, 1974).

**Example 1: Administration of *D*-threo-methylphenidate hydrochloride (*d*-MPH) in
5 the treatment of cognitive dysfunction related to chemotherapy in adult cancer
patients.**

Patients that have received at least one cycle of cytotoxic chemotherapy, preferably within 2 months prior to treatment, and who display one or more symptoms of cognitive dysfunction are evaluated as candidates for *d*-MPH treatment. Prior to 10 commencement of treatment, patients are evaluated for the following: medical history/concomitant illnesses, physical examination, 12-lead electrocardiogram, routine laboratory tests and assessments of cognitive function. Tests for cognitive function can include those known to those of skill in the art, for example those described above.

Patients having no medical contraindication to the use of methylphenidate are then initially 15 administered *d*-MPH 5 mg/day (2.5 mg b.i.d given 4 to 6 hours apart). The dose may be increased as clinically warranted if there are no adverse effects that preclude dose-escalation and there is no significant therapeutic response. Daily doses can be administered two or three times per day. The maximum dose will be 50 mg/day, given two to three times per day.

20 Patients are evaluated periodically for one or more of fatigue, neurobehavioral slowing, sedation, decreased cognitive function, and major depressive disorder. Patients receiving the foregoing treatment will display an alleviation of one or more of the foregoing symptoms.

**Example 2: Administration of *D*-threo-methylphenidate hydrochloride (*d*-MPH) in
25 the treatment of menopausal women.**

Menopausal women who display one or more symptoms including an executive function defect, decreased cognitive function, mental depression, vasomotor instability, nervousness, excitability, fatigue, neurobehavioral slowing, apathy, or impairment of short term memory are evaluated as candidates for *d*-MPH treatment. Prior

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to commencement of treatment, patients are evaluated for the following: medical history/concomitant illnesses, physical examination, 12-lead electrocardiogram, routine laboratory tests and assessments of the severity of the symptom.

Patients having no medical contraindication to the use of methylphenidate
5 are then initially administered *d*-MPH 5 mg/day (2.5 mg b.i.d given 4 to 6 hours apart). The dose may be increased as clinically warranted if there are no adverse effects that preclude dose-escalation and there is no significant therapeutic response. Daily doses can be administered two or three times per day. The maximum dose will be 50 mg/day, given two to three times per day. Once a patient's optimal dose has been determined, the patient
10 will remain on this dose for at least 2 weeks.

Patients are evaluated for one or more of executive function defect, decreased cognitive function, mental depression, vasomotor instability, nervousness, excitability, fatigue, neurobehavioral slowing, apathy, or impairment of short term memory. Patients receiving the foregoing treatment will display an alleviation of one or
15 more of the foregoing symptoms.

Example 3: Administration of *d*-threo-methylphenidate hydrochloride (*d*-MPH) in the treatment of menopausal women having previously diagnosed Attention Deficit Disorder (ADD).

Menopausal women who have been previously been diagnosed with
20 Attention Deficit Disorder ("ADD") and who are suspected having exacerbated ADD symptoms are evaluated for one or more symptoms of ADD according to previously published methods (for example, see American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV). Washington, D.C., 1994, pp 78-85).

Patients having no medical contraindication to the use of methylphenidate
25 are then initially administered *d*-MPH 5 mg/day (2.5 mg b.i.d given 4 to 6 hours apart). The dose may be increased as clinically warranted if there are no adverse effects that preclude dose-escalation and there is no significant therapeutic response. Daily doses can be administered two or three times per day. The maximum dose will generally be
30 approximately 50 mg/day, given two to three times per day.

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Patients are periodically evaluated for efficacy of treatment. Patients receiving the foregoing treatment will display an alleviation of one or more of the foregoing symptoms.

It is intended that each of the patents, applications, and printed publications
5 mentioned or referred to in this specification be hereby incorporated by reference in their
entirety.

As those skilled in the art will appreciate, numerous changes and
modifications may be made to the preferred embodiments of the invention without
departing from the spirit of the invention. It is intended that all such variations fall within
10 the scope of the invention.

CLAIMS:

1. A method for alleviating fatigue arising from an oncological condition, said method comprising the steps of:
 - 5 identifying a patient suffering from said fatigue, and administering to said patient a therapeutically effective amount of D-threo-methylphenidate substantially free of the 1-threo isomer.
2. A method for alleviating fatigue arising from the administration of a treatment for an oncological condition, said method comprising the steps of:
 - 10 identifying a patient suffering from said fatigue, and administering to said patient a therapeutically effective amount of D-threo-methylphenidate substantially free of the 1-threo isomer.
3. A method for alleviating neurobehavioral slowing arising from an oncological condition, said method comprising the steps of:
 - 15 identifying a patient suffering from said neurobehavioral slowing, and administering to said patient a therapeutically effective amount of D-threo-methylphenidate substantially free of the 1-threo isomer.
4. A method for alleviating neurobehavioral slowing arising from the administration of a treatment for an oncological condition, said method comprising the steps of:
 - 20 identifying a patient suffering from said neurobehavioral slowing, and administering to said patient a therapeutically effective amount of D-threo-methylphenidate substantially free of the 1-threo isomer.
5. A method for alleviating a cognitive side effect of a treatment for an oncological condition, comprising the steps of:
 - 25 identifying a patient suffering from a cognitive side-effect of a treatment for an oncological condition; and administering to said patient a therapeutically effective amount of D-threo-methylphenidate substantially free of the 1-threo isomer.

6. A method for treating a symptom of menopause comprising the steps of:
identifying a patient suffering from a symptom of menopause; and
administering to said patient a therapeutically effective amount of D-threo-methylphenidate substantially free of the 1-threo isomer.
- 5 7. The method of any one of claims 1 to 6 wherein said methylphenidate is in the form of a pharmaceutically acceptable salt.
8. The method of any one of claims 1 to 5 wherein said oncological condition is a cancer selected from the group consisting of solid tumors and nonsolid tumors.
- 10 9. The method of any one of claims 1 to 5 wherein said oncological condition is a solid tumor.
10. The method of any one of claims 2 or 4 wherein said treatment for said oncological condition is chemotherapy or radiation therapy.
11. The method of claim 10 wherein said treatment for said oncological condition is chemotherapy.
- 15 12. The method of claim 5 wherein said treatment for said oncological condition is the administration of pain relief medication, chemotherapy, radiation therapy, or surgery.
13. The method of claim 5 wherein said treatment for said oncological condition is the administration of pain relief medication.
- 20 14. The method of claim 13 wherein said pain relief medication is an opioid analgesic.
15. The method of claim 5 wherein said cognitive side effect is sedation, decreased cognitive function, major depressive disorder, or neurobehavioral slowing.

16. The method of claim 15 wherein said cognitive side effect is sedation, decreased cognitive function or neurobehavioral slowing.
17. The method of claim 15 wherein said cognitive side effect is sedation.
18. The method of claim 6 wherein said symptom of menopause is selected from the group of symptoms comprising decreased cognitive function, vasomotor instability, nervousness, mental depression, excitability, fatigue, apathy or impairment of short term memory.
19. The method of any one of claims 1 to 6 wherein said administration of said D-threo-methylphenidate gives rise to efficacious treatment without interfering with patient sleep patterns or engendering anorectic behavior.
20. A method for treating a symptom of menopause or alleviating fatigue, neurobehavioral slowing or cognitive side effects of an oncological condition or treatment of an oncological condition substantially as hereinbefore described with reference to the accompanying examples.

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