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(74) Agents: **SHAPIRO-BARR, Tania** et al.; Dykema Gossett PLLC, 4000 Wells Fargo Center, 90 South Seventh Street, Minneapolis, Minnesota 55402 (US).

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(71) Applicant: **ALLAYSIS, LLC** [US/US]; Suite 205, 5 Ne-shaminy Interplex, Trevose, Pennsylvania 19053 (US).

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(54) Title: INTRAVENOUS BACLOFEN FORMULATIONS AND TREATMENT METHODS

(57) Abstract: An intravenous baclofen solution is disclosed, along with methods of dosing and treatment therewith.

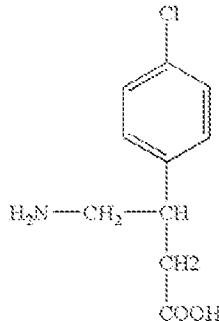
## INTRAVENOUS BACLOFEN FORMULATIONS AND TREATMENT METHODS

## CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to United States provisional patent application no. 62/103,902, filed 15 January 2015, which is hereby incorporated by reference as though fully set forth herein.

## BACKGROUND OF THE INVENTION

[0002] Baclofen is a muscle relaxant and anti-spastic agent. Spasticity is a common symptom of upper motor neuron injury in individuals with cerebral palsy, multiple sclerosis, acquired spinal cord injury, brain injury, and neurodegenerative disorders. Baclofen is a structural analog of the inhibitory neurotransmitter gamma-aminobutyric acid (GABA) and acts as a GABA<sub>B</sub> agonist at the level of the spinal cord. Baclofen is the generic name for 4-amino-3-(4-chlorophenyl) butanoic acid. It is a white or off-white, mostly odorless crystalline powder with a molecular weight of 213.66, and it is slightly soluble in water. Baclofen's structural formula is



[0003] Baclofen is sold under the trademark LIORESAL® in oral (10mg or 20mg tablets) and intrathecal (0.05 mg/mL, 0.5 mg/mL, or 2.0 mg/mL) formulations. The intrathecal formulation is used in conjunction with an implanted programmable pump to provide a constant infusion of the drug. There are several circumstances in which patients treated with oral or intrathecal baclofen must abruptly discontinue therapy. For example, the programmable pump and/or catheter used in intrathecal administration may need to be removed, refilled, or replaced. Moreover, patients taking oral baclofen may be unable to do so during periods of illness, noncompliance, or surgery, for example. Abrupt discontinuation of oral or intrathecal baclofen can result in a severe withdrawal syndrome characterized by

rebound increases in muscle tone and spasms, status epilepticus, hallucinations, and a neuromalignant syndrome-like picture potentially resulting in rhabdomyolysis and multisystem organ failure. The current recommended management of baclofen withdrawal is inadequate, and symptoms are often difficult to control. Agarwal et al., *A Pilot Study Assessing Pharmacokinetics and Tolerability of Oral and Intravenous Baclofen in Healthy Adult Volunteers*, J Child Neurol., (July 14, 2014), <http://jcn.sagepub.com/content/early/2014/07/11/0883073814535504>.

**[0004]** Thus, there is a clinical need for an intravenous baclofen formulation to prevent or minimize complications resulting from interrupted oral or intrathecal therapy.

#### BRIEF SUMMARY OF THE INVENTION

**[0005]** An intravenous baclofen solution is disclosed, along with methods of dosing and treatment therewith. It is believed that intravenous administration of baclofen can permit rapid attainment of necessary drug concentrations, as well as accurate and precise dose titration, thereby allowing for more efficient and effective treatment of withdrawal symptoms or preventing withdrawal altogether.

**[0006]** One embodiment of the invention provides a method of temporarily treating a subject with baclofen during a period of medical fluctuation that comprises (a) discontinuing oral or intrathecal administration of baclofen to the subject; (b) administering to the subject a bolus intravenous dose of a therapeutically effective amount of a solution comprising baclofen at a concentration of up to about 2.0 mg/mL over a time period of about 5 minutes to about 60 minutes; (c) repeating administration of the bolus intravenous dose of baclofen about every 6 to 8 hours until oral or intrathecal administration of baclofen can be resumed; (d) discontinuing administration of bolus intravenous doses of baclofen; and (e) resuming oral or intrathecal administration of baclofen.

**[0007]** In another embodiment, a method of intravenously administering baclofen to a subject that has previously been treated with oral baclofen in a therapeutically effective amount comprises (a) discontinuing oral administration of baclofen to the subject; (b) administering to the subject a bolus intravenous dose of solution comprising about 75% of said amount of baclofen over a time period of about 5 minutes to about 60 minutes; (c)

repeating administration of the bolus intravenous dose of baclofen about every 6 to 8 hours until oral administration of baclofen is resumed; (d) discontinuing administration of intravenous baclofen; and (e) resuming oral administration of baclofen.

**[0008]** In another embodiment, a method of temporarily treating a subject with baclofen during a period of medical fluctuation comprises (a) discontinuing oral or intrathecal administration of baclofen to the subject; (b) starting a continuous intravenous infusion of a therapeutically effective amount of a solution comprising baclofen at a concentration up to about 2.0 mg/mL over a time period of about 24 hours; (c) continuing the infusion about every 24 hours until oral or intrathecal administration of baclofen is resumed; (d) discontinuing the continuous intravenous infusion; and (e) resuming oral or intrathecal administration of baclofen.

**[0009]** In another embodiment, a method of intravenously administering baclofen to a subject that has previously been treated with oral baclofen in a therapeutically effective amount comprises (a) discontinuing oral administration of baclofen to the subject; (b) administering a continuous intravenous infusion of solution comprising about 75% of said amount of baclofen over a time period of about 24 hours; (c) continuing the infusion about every 24 hours until oral administration of baclofen is resumed; (d) discontinuing administration of the continuous intravenous infusion; and (e) resuming oral administration of baclofen.

**[0010]** In another embodiment, a method of converting an oral dose of baclofen to an intravenous dose of baclofen comprises (a) determining the oral dose; and (b) multiplying the oral dose by between about 0.45 and about 1.0 to determine the intravenous dose.

**[0011]** In another embodiment, a pharmaceutical solution comprises an effective therapeutic amount of up to about 2.0 mg/mL baclofen dissolved in at least one of normal saline, dextrose solution, Lactated Ringer's solution, or any combination thereof; wherein the solution is adapted to be intravenously administered to a subject.

#### DETAILED DESCRIPTION OF THE INVENTION

**[0012]** Each milliliter of intravenous baclofen solution can contain about 0.5 mg to about 2.0 mg of baclofen and an isotonic amount of sodium chloride dissolved in sterile

water. In an embodiment, the concentration of baclofen in the intravenous solution can be about 0.5-2.0 mg/mL. In an embodiment, the intravenous baclofen solution can include a dextrose solution or Lactated Ringer's solution instead of or in combination with normal saline. The intravenous baclofen solution can further include an anticonvulsant drug, an antispasmodic drug, an anticholinergic drug, and/or an antibiotic.

**[0013]** The present invention also provides a correlation between oral and intravenous dosing of baclofen (see, e.g., Example 2 below). In particular, an equivalent dose of intravenous baclofen can be determined by multiplying the oral dose of baclofen by about 0.45 to about 1.0, preferably by about 0.6 to about 0.9, and more preferably by about 0.75.

**[0014]** Generally, an effective amount of the above-described intravenous baclofen solution can be administered intravenously to temporarily treat a patient during a period of medical fluctuation resulting in the discontinuation of oral or intrathecal baclofen. Temporary treatment with intravenous baclofen may be necessary as bridging therapy (e.g., when a patient is temporarily unable to take oral or intrathecal baclofen) or for management of withdrawal symptoms, for example. As used herein, a "period of medical fluctuation" refers broadly to a time period during which a patient experiences an illness, condition, change in health status, or situation requiring an adjustment to his/her normal medical care or treatment plan. More specifically, a period of medical fluctuation can include at least one of a scheduled or unscheduled surgical procedure, trauma, ileus, bowel obstruction, vomiting, diarrhea, gastrointestinal malabsorption, seizure, stroke, subarachnoid hemorrhage, or patient non-compliance. Furthermore, for patients with implanted intrathecal pumps, periods of medical instability can include an intrathecal hardware failure or a necessity to remove, refill, or replace the intrathecal hardware.

**[0015]** In one embodiment of the invention, a method is provided to temporarily treat a patient with intravenous baclofen during a period of medical fluctuation that comprises discontinuation of oral or intrathecal administration of baclofen to the patient, followed by administration of an intravenous bolus dose of a therapeutically effective amount of a baclofen solution (e.g., between about 1 mg and about 50 mg baclofen per bolus dose) over a time period of about 5 to 60 minutes. The intravenous bolus dose can be administered repeatedly about every 6 to 8 hours until oral or intrathecal administration of baclofen can be

resumed. Once intravenous bolus dosing has been discontinued, oral or intrathecal administration of baclofen can be resumed.

**[0016]** In another embodiment of the invention, a method of temporarily treating a patient with intravenous baclofen during a period of medical fluctuation is provided that can include discontinuation of oral or intrathecal administration of baclofen, followed by administration of a continuous intravenous infusion of a therapeutically effective amount of a baclofen solution continued until oral or intrathecal administration of baclofen can be resumed. Once continuous intravenous infusions have been discontinued, oral or intrathecal administration of baclofen can be resumed. It is believed that continuous intravenous infusion of baclofen can mimic intrathecal administration of baclofen, can eliminate or mitigate any peaks or troughs in baclofen levels in a patient's cerebral spinal fluid or blood (which may occur during intravenous bolus administration, for example), and can reduce the risk or incidence of adverse events associated with intravenous baclofen.

**[0017]** The invention will be further described by the following detailed examples.

**[0018]** EXAMPLE 1 – Preparation of Intravenous Baclofen Solution

**[0019]** 108 g of sodium chloride were placed in a 600 ml beaker and then added to a 20L beaker containing 8.4 L of sterile water for injection. The resulting sodium chloride solution was stirred in the 20L beaker until dissolution occurred. Approximately 50 ml of sterile water for injection were used to rinse any residual sodium chloride from the 600ml beaker, and the rinsings were added to the 20L beaker. Next, 24.1 g of baclofen powder were placed in a 1L beaker and then gradually (over a time period of about 2 hours) added and dissolved in the solution in the 20L beaker. Approximately 50 ml of sterile water for injection was used to rinse any residual baclofen from the 1L beaker, and the rinsings were added to the 20L beaker. Approximately 3500 mL of sterile water for injection were then added to the 20L beaker, and the solution was mixed for a minimum of 10 minutes to ensure homogeneity. The solution was then filtered using a Mini Kleenpak<sup>TM</sup> (0.2 $\mu$ m) filter at 20 rpm.

**[0020]** An automated, aseptic filling machine was used to fill approximately 1090 13.5-mL glass vials with approximately 11.0 ml of the solution per vial. The vials were then

stoppered, caps were placed on the vials, and the caps were crimped. The vials were stored at about 15 degrees Celsius to about 25 degrees Celsius.

[0021] EXAMPLE 2 – Administration of Intravenous Baclofen

[0022] A. Subjects

[0023] Twelve healthy human volunteers were recruited. The volunteers were medication free for 48 hours before, during, and 24 hours after the administration of the study drug.

[0024] B. Study Design

[0025] The 12 volunteers participated in a randomized, open-label, 2-way crossover study to compare the pharmacokinetics and bioavailability of oral baclofen with an intravenous baclofen formulation. The oral formulation was a 10 mg baclofen tablet. A single intravenous dose of 5 mg was administered over 15 minutes, using the commercially available 2mg/mL intrathecal baclofen formulation (Lioresal Intrathecal). Blood samples (6 mL) for the measurement of plasma concentrations of baclofen were collected in blood collection tubes containing K2 ethylenediaminetetraacetic acid at the following times: prior to dosing; at 5, 15, and 30 minutes; and at 1, 2, 4, 6, 8, 10, 12, and 24 hours after drug administration.

[0026] C. Determination of Baclofen Concentration in Plasma

[0027] Study plasma samples were prepared by adding 50  $\mu$ L of a 500  $\mu$ g/mL levetiracetam solution (internal standard) to 250  $\mu$ L of K<sub>2</sub> ethylenediaminetetraacetic acid (EDTA) human plasma. Baclofen and the internal standard were extracted from plasma by precipitating the protein with methanol and drying it under nitrogen at approximately 40°C. The dried residues were reconstituted in 300  $\mu$ L of a mobile phase consisting of 20 mM ammonium acetate–methanol (75:25) solution. After 1 minute of vortex mixing, the reconstituted sample solution was filtered and injected onto the high-performance liquid chromatograph–mass spectrometer system. Standard curve samples over a range of 20 to 400 ng/mL baclofen and quality control samples containing 30 (low), 80 (medium), and 240 ng/mL (high) baclofen were prepared and analyzed in triplicate along with the study samples.

The assay was linear over the range 20–400 ng/mL with a lower limit of quantification of 20 ng/mL.

**[0028]** Baclofen concentration–time data were analyzed using a noncompartmental pharmacokinetic approach with Phoenix software (version 6.2; Pharsight Corporation, Mountain View, CA). The terminal rate constant ( $\lambda_z$ ) was determined from the slope of the terminal log-linear portion of the plasma concentration–time curve, and the terminal half-life ( $t_{1/2}$ ) was calculated as  $\ln 2/(\lambda_z)$ . Maximum plasma concentrations ( $C_{max}$ ) and time to maximum concentration ( $T_{max}$ ) were determined by direct observation of the data. The area under the concentration–time curve to the last nonzero plasma concentration ( $C_{last}$ ) that was above half the lower limit of quantification (10 ng/mL) was calculated by the trapezoidal rule and reported as  $AUC_{last}$ . The area under the concentration–time curve extrapolated to infinity ( $AUC_{0-\infty}$ ) was calculated as  $AUC_{last} + (C_{last}/\lambda_z)$ . Mean and standard deviation values for the parameters were also obtained using the descriptive statistics tool in Phoenix version 6.2. A paired t-test was used to determine if statistical differences existed in log normalized, dose-adjusted area under the curve between oral and intravenous arms.

**[0029]** **D. Results**

**[0030]** A summary of the pharmacokinetic parameters is presented in Table 1. The mean concentration–time profiles for both (5 mg intravenous and 10 mg oral) arms are shown in Figure 1. When the subjects received the intravenous formulation, the observed maximum baclofen concentration occurred at the 5-minute time point, whereas the median  $T_{max}$  for oral administration was 1 hour. The mean (standard deviation)  $C_{max}$  values for the oral (10 mg) and intravenous (5 mg) doses were 176 (15) ng/mL and 313 (75) ng/mL, respectively (Figure 1). The mean  $t_{1/2}$  was similar for both the oral and intravenous arms (4 and 4.52 hours, respectively). The mean absolute bioavailability of the oral baclofen tablets (Table 1) was 74%. There was a significant difference in log-normalized, dose-adjusted area under the curves ( $P = .0024$ ) between oral and intravenous dosing with similar variability (coefficient of variation: 18%-24%).

**Table I.** Mean  $\pm$  SD of Baclofen Pharmacokinetic Parameters Following Oral (10 mg) and Intravenous (5 mg) Administration.

| Pharmacokinetic parameter                        | 5 mg IV<br>(mean <sup>a</sup> $\pm$ SD) | 10 mg oral<br>(mean $\pm$ SD) |
|--|---|-------------------------------|
| $C_{max}$ (ng/mL)                                | 310 $\pm$ 74                            | 174 $\pm$ 16                  |
| $T_{max}$ (h) <sup>b</sup>                       | ~                                       | 1.0 (0.5-2.0)                 |
| $AUC_{last}$ (ng·h/mL)                           | 593 $\pm$ 111                           | 878 $\pm$ 199                 |
| $AUC_{0-\infty}$ (ng·h/mL)                       | 707 $\pm$ 166                           | 1023 $\pm$ 232                |
| $AUC_{0-\infty}$ /Dose <sup>c</sup> (ng·h/mL/mg) | 141 $\pm$ 33                            | 102 $\pm$ 23                  |
| Bioavailability (%)                              | ~                                       | 74 $\pm$ 15                   |
| $T_{1/2}$ (h)                                    | 4.52 $\pm$ 1.6                          | 4.03 $\pm$ 0.73               |

Abbreviations: AUC, area under the curve; IV, intravenous; SD, standard deviation.

<sup>a</sup>Mean values are presented as arithmetic means

<sup>b</sup>Median (min, max) reported for  $T_{max}$ .

<sup>c</sup>Two-tailed *P* value < .05 (paired t-test performed on dose-normalized area under the curve)

[0031] The investigational intravenous formulation was well tolerated. All treatment-emergent adverse events were characterized by the investigator as being mild in severity, and all subjects returned to their baseline values within 6 hours of drug administration.

[0032] E. Discussion

[0033] This example illustrates that absolute oral baclofen bioavailability is about 75%, indicating that approximately 25% of a 10-mg dose is either not absorbed or undergoes first-pass metabolism prior to drug reaching systemic circulation. This suggests that a smaller intravenous baclofen dose can be used when it is substituted for an oral dose. For example, assuming linear kinetics, the total systemic exposure (area under the curve) after an intravenous dose of 15 mg would be equivalent to the total exposure achieved after 20 mg of oral baclofen dose. Thus, this example suggest that when intravenous baclofen is substituted for oral baclofen, an equivalent intravenous dose will be about 75% of the oral dose.

[0034] In one embodiment of the invention, a method of converting an oral dose of baclofen to an intravenous dose of baclofen comprises (a) determining the oral dose; and (b)

multiplying the oral dose by between about 0.45 and about 1.0 to determine the intravenous dose. In another embodiment of the invention, a method of converting an oral dose of baclofen to an intravenous dose of baclofen comprises (a) determining the oral dose; and (b) multiplying the oral dose by between about 0.6 and about 0.9 to determine the intravenous dose. In yet another embodiment of the invention, a method of converting an oral dose of baclofen to an intravenous dose of baclofen comprises (a) determining the oral dose; and (b) multiplying the oral dose by about 0.75 to determine the intravenous dose.

**[0035]** All publications, patents, and patent applications cited above are incorporated by reference herein as though fully set forth.

**[0036]** It will be apparent to those skilled in the art that many modifications and equivalents thereof may be made without departing from the spirit and scope of the invention.

## CLAIMS

What is claimed is:

1. A method of temporarily treating a subject with baclofen during a period of medical fluctuation, the method comprising:
  - (a) discontinuing oral or intrathecal administration of baclofen to the subject;
  - (b) administering to the subject a bolus intravenous dose of a therapeutically effective amount of a solution comprising baclofen at a concentration of up to about 2.0 mg/mL over a time period of about 5 minutes to about 60 minutes;
  - (c) repeating administration of the bolus intravenous dose of baclofen about every 6 to 8 hours until oral or intrathecal administration of baclofen is resumed;
  - (d) discontinuing administration of bolus intravenous doses of baclofen; and
  - (e) resuming oral or intrathecal administration of baclofen.
2. The method of claim 1, wherein the medical fluctuation comprises at least one of the following: an intrathecal hardware failure, a necessity to remove, refill, or replace intrathecal hardware, a scheduled or unscheduled surgical procedure, trauma, ileus, bowel obstruction, vomiting, diarrhea, gastrointestinal malabsorption, seizure, stroke, subarachnoid hemorrhage, or patient non-compliance.
3. The method of claim 1, wherein the solution comprises baclofen at a concentration of about 0.5-2.0 mg/mL.
4. The method of claim 1, wherein the solution comprises baclofen at a concentration of about 0.5-1.0 mg/mL.
5. The method of claim 1, wherein the subject is experiencing baclofen withdrawal symptoms.
6. A method of intravenously administering baclofen to a subject presently treated with oral baclofen in a therapeutically effective amount, the method comprising:
  - (a) discontinuing oral administration of baclofen to the subject;

- (b) administering to the subject a bolus intravenous dose of solution comprising about 75% of said amount of baclofen over a time period of about 5 minutes to about 60 minutes;
- (c) repeating administration of the bolus intravenous dose of baclofen about every 6 to 8 hours until oral administration of baclofen is resumed;
- (d) discontinuing administration of intravenous baclofen; and
- (e) resuming oral administration of baclofen.

7. The method of claim 6, further comprising performing steps (a) – (d) during a period of medical fluctuation; wherein the medical fluctuation comprises at least one of the following: an intrathecal hardware failure, a necessity to remove, refill, or replace intrathecal hardware, a scheduled or unscheduled surgical procedure, trauma, ileus, bowel obstruction, vomiting, diarrhea, gastrointestinal malabsorption, seizure, stroke, subarachnoid hemorrhage, or patient non-compliance.

8. The method of claim 6, wherein the solution comprises baclofen at a concentration of about 0.5-2.0 mg/mL.

9. The method of claim 6, wherein the solution comprises baclofen at a concentration of about 0.5-1.0 mg/mL.

10. A method of temporarily treating a subject with baclofen during a period of medical fluctuation, the method comprising:

- (a) discontinuing oral or intrathecal administration of baclofen to the subject;
- (b) starting a continuous intravenous infusion of a therapeutically effective amount of a solution comprising baclofen at a concentration of about 2.0 mg/mL or less over a time period of about 24 hours;
- (c) continuing the infusion until oral or intrathecal administration of baclofen is resumed;
- (d) discontinuing the continuous intravenous infusion; and
- (e) resuming oral or intrathecal administration of baclofen.

11. The method of claim 10, wherein the medical fluctuation comprises at least one of the following: an intrathecal hardware failure, a necessity to remove, refill, or replace

intrathecal hardware, a scheduled or unscheduled surgical procedure, trauma, ileus, bowel obstruction, vomiting, diarrhea, gastrointestinal malabsorption, seizure, stroke, subarachnoid hemorrhage, or patient non-compliance.

12. The method of claim 10, wherein the solution comprises baclofen at a concentration of about 0.5-2.0 mg/mL.

13. The method of claim 10, wherein the solution comprises baclofen at a concentration of about 0.5-1.0 mg/mL.

14. The method of claim 10, wherein the subject is experiencing baclofen withdrawal symptoms.

15. A method of intravenously administering baclofen to a subject presently treated with oral baclofen in a therapeutically effective amount, the method comprising:

- (a) discontinuing oral administration of baclofen to the subject;
- (b) administering to the subject a continuous intravenous infusion of solution comprising about 75% of said amount of baclofen over a time period of about 24 hours;
- (c) repeating administration of the continuous intravenous infusion about every 24 hours until oral administration of baclofen is resumed;
- (d) discontinuing the continuous intravenous infusion; and
- (e) resuming oral administration of baclofen.

16. The method of claim 15, further comprising performing steps (a) – (d) during a period of medical fluctuation; wherein the medical fluctuation comprises at least one of the following: an intrathecal hardware failure, a necessity to remove, refill, or replace intrathecal hardware, a scheduled or unscheduled surgical procedure, trauma, ileus, bowel obstruction, vomiting, diarrhea, gastrointestinal malabsorption, seizure, stroke, subarachnoid hemorrhage, or patient non-compliance.

17. The method of claim 15, wherein the solution comprises baclofen at a concentration of about 0.5-2.0 mg/mL.

18. The method of claim 15, wherein the solution comprises baclofen at a concentration of about 0.5-1.0 mg/mL.

19. A method of converting an oral dose of baclofen to an intravenous dose of baclofen, the method comprising:

- (a) determining the oral dose; and
- (b) multiplying the oral dose by between about 0.45 and about 1.0 to determine the intravenous dose.

20. The method of claim 19, wherein step (b) comprises multiplying the oral dose by between about 0.6 and about 0.9 to determine the intravenous dose.

21. The method of claim 20, wherein step (b) comprises multiplying the oral dose by between about 0.7 and about 0.8 to determine the intravenous dose.

22. A pharmaceutical solution comprising  
an effective therapeutic amount of up to about 2.0 mg/mL baclofen dissolved  
in at least one of normal saline, dextrose solution, Lactated Ringer's solution, or any  
combination thereof;  
wherein the solution is adapted to be intravenously administered to a subject.

23. The solution of claim 22, further comprising at least one of an anticonvulsant  
drug, an antispasmodic drug, an anticholinergic drug, or an antibiotic drug.

24. The solution of claim 22, wherein the solution is sterile.

25. The solution of claim 22, wherein the solution comprises baclofen at a  
concentration of about 0.5-2.0 mg/mL.

26. The solution of claim 22, wherein the solution comprises baclofen at a  
concentration of about 0.5-1.0 mg/mL.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US16/13672

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A61K 31/192, 31/195, 31/197, 47/18 (2016.01)

CPC - A61K 31/192, 31/195, 31/197, 47/18

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)

IPC (8) - A61K 31/192, 31/195, 31/197, 47/12, 47/18; A61P 25/00 (2016.01);

CPC - A61K 9/0019, 9/08, 31/192, 31/195, 31/197, 47/183; USPC - 514/557, 561, 567, 570, 758

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)

PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, Other Countries (INPADOC), RU, AT, CH, TH, BR, PH); EBSCO; Google/Google Scholar, IP.com; PubMed; baclofen, intravenous, bolus, oral, intrathecal, fluctuation, infusion, therapeutically effective amount, saline, dextrose, Lactated Ringer's, intrathecal hardware failure, anticonvulsant, continuous, antibiotic

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages  | Relevant to claim No.                     |
|-----------|---|---|
| X         | (KRACH, LE et al.) Clinical Tolerance and Toxicity of Intravenous Baclofen: A Pilot Study in a Canine Model. Journal of Pediatric Rehabilitation Medicine: An Interdisciplinary Approach. 2011. vol. 4; page 89, second column, second paragraph; page 90, first column, second paragraph; page 91, first column, first-second paragraphs; second column, third paragraph; page 95, second column, second paragraph; page 96, first column, fourth paragraph; second column, first-third paragraphs | 1-3, 5<br>---<br>4, 6-18                  |
| X         | (KRIEL, RL et al.) Prevention of Baclofen Withdrawal Syndrome: Pharmacokinetics and Tolerability of Oral and Intravenous Baclofen in Healthy Adult Volunteers. Physical Medicine and Rehabilitation. 2014. vol. 6, issue 9S; S221, Poster 110; objective; intervention; conclusion  | 19-22, 24-25<br>---<br>6-9, 15-18, 23, 26 |
| Y         | US 6,969,383 B2 (HILDEBRAND, KR) 29 November 2005; column 8, lines 59-60; column 9, lines 2-6   | 4, 9, 13, 18, 26                          |
| Y         | (BRENNAN, PM et al.) Intrathecal Baclofen Therapy for Neurological Disorders: a Sound Knowledge Base But Many Challenges Remain. British Journal of Neurosurgery. August 2008. vol. 22, no. 4; abstract; page 508, first column, second paragraph   | 10-18                                     |
| Y         | US 2013/0012586 A1 (ROBERTS, K et al.) 10 January 2013; paragraphs [0032], [0034], [0064], [0066]   | 23  |
| Y         | US 8,357,379 B2 (TRISSEL, LA et al.) 22 January 2013; column 1, lines 61-67; column 7, lines 44-46  | 22- 24, 26                                |

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

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Mail Stop PCT, Attn: ISA/US, Commissioner for Patents  
P.O. Box 1450, Alexandria, Virginia 22313-1450  
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