

Emergency Preparedness is **KEY** *for* **Acute Hyperammonemia (HA)**

Carbaglu® (carglumic acid) is a Carbamoyl Phosphate Synthetase 1 (CPS1) activator indicated as:

Adjunctive therapy for the treatment of acute hyperammonemia due to the deficiency of the hepatic enzyme N-acetylglutamate synthase (NAGS). During acute hyperammonemic episodes concomitant administration of CARBAGLU with other ammonia lowering therapies such as alternate pathway medications, hemodialysis, and dietary protein restriction are recommended.

IMPORTANT SAFETY INFORMATION

The most common adverse reactions in $\geq 13\%$ of patients are: infections, vomiting, abdominal pain, pyrexia, tonsillitis, anemia, ear infection, diarrhea, nasopharyngitis, and headache.

See next page for additional Important Safety Information.



Any episode of acute symptomatic hyperammonemia (HA) should be treated as a life-threatening emergency.¹

Carbaglu® (carglumic acid) is a Carbamoyl Phosphate Synthetase 1 (CPS 1) activator indicated as:

- Adjunctive therapy in pediatric and adult patients for the treatment of acute hyperammonemia due to the deficiency of the hepatic enzyme N-acetylglutamate synthase (NAGS). During acute hyperammonemic episodes concomitant administration of CARBAGLU with other ammonia lowering therapies such as alternate pathway medications, hemodialysis, and dietary protein restriction are recommended.

Important Safety Information

HYPERAMMONEMIA:

- Management of hyperammonemia due to N-acetylglutamate synthase (NAGS) deficiency and CARBAGLU treatment should be initiated by a physician experienced in the treatment of metabolic disorders.
- Any episode of acute symptomatic hyperammonemia should be treated as a life-threatening emergency. Treatment of hyperammonemia may require dialysis, preferably hemodialysis, to remove a large burden of ammonia. Uncontrolled hyperammonemia can rapidly result in brain injury/damage or death, and prompt use of all therapies necessary to reduce plasma ammonia levels is essential.
- Ongoing monitoring of plasma ammonia levels, neurological status, laboratory tests and clinical responses in patients receiving CARBAGLU is crucial to assess patient response to treatment.

THERAPEUTIC MONITORING:

- Plasma ammonia levels should be maintained within normal range for age via individual dose adjustment.

NUTRITIONAL MANAGEMENT:

- Since hyperammonemia is the result of protein catabolism, complete protein restriction is recommended to be maintained for 24 to 48 hours and caloric supplementation should be maximized to reverse catabolism and nitrogen turnover.

No drug interaction studies have been performed with CARBAGLU. There is no human pregnancy data, but decreased survival and growth occurred in animal offspring.

Breast feeding by a mother taking CARBAGLU is not recommended.

USE IN OTHER FOODS AND LIQUIDS HAS NOT BEEN STUDIED CLINICALLY AND IS THEREFORE NOT RECOMMENDED.

Carbaglu[®]
carglumic acid



Carbaglu® (carglumic acid) Dosing for Adjuvant Therapy of Acute Hyperammonemia Due to NAGS Deficiency

- 1 CARBAGLU treatment should be initiated by a physician experienced in metabolic disorders.
- 2 Acute initial dosing range is for all ages. ³
- 3 Concomitant administration of other ammonia lowering therapies is recommended. ²
- 4 Initial dose will be in a range from 100 mg/kg/day to 250 mg/kg/day. ²
- 5 Dosing should be titrated based on individual patient plasma ammonia levels and clinical symptoms. ²
- 6 The total daily dose should be divided into 2 to 4 doses and rounded to the nearest 100 mg (i.e., half of a CARBAGLU Tablet). Each 200 mg tablet should be dispersed in a minimum of 2.5 mL of water and taken immediately. ²

Important Safety Information

No drug interaction studies have been performed with CARBAGLU. There is no human pregnancy data, but decreased survival and growth occurred in animal offspring.

Breast feeding by a mother taking CARBAGLU is not recommended.

USE IN OTHER FOODS AND LIQUIDS HAS NOT BEEN STUDIED CLINICALLY AND IS THEREFORE NOT RECOMMENDED.



Sample Dosing Guides to Help with Emergency Ordering

Carbaglu[®]
carglumic acid

Initial dose will be in a range from 100 mg/kg/day to 250 mg/kg/day ²

The total daily dose should be divided into 2 to 4 doses and rounded to the nearest 100 mg (i.e., half of a CARBAGLU Tablet) ²

For Example			For a 3 day Acute Hyperammonemic Episode
Neonate - 3 Kg (6.61 lbs)	Total Daily mg	# of CARBAGLU 200mg tablets needed per day	# of CARBAGLU 5 tablet and /or 60 tablet bottles
Acute initial dose at 100 mg/kg	300 mg	1 tablet + .5 tab	1 bottle of 5 tablets
Acute initial dose at 250 mg/kg	750 mg	4 tablets	3 bottles of 5 tablets
For Example			For a 3 day Acute Hyperammonemic Episode
Toddler - 10 Kg (22.05 lbs)	Total Daily mg	# of CARBAGLU 200mg tablets needed per day	# of CARBAGLU 5 tablet and /or 60 tablet bottles
Acute initial dose at 100 mg/kg	1000 mg	5 tablets	3 bottles of 5 tablets
Acute initial dose at 250 mg/kg	2500 mg	12 tablets + .5 tab	8 bottles of 5 tablets
For Example			For a 3 day Acute Hyperammonemic Episode
Adult - 60 Kg (132.28 lbs)	Total Daily mg	# of CARBAGLU 200mg tablets needed per day	# of CARBAGLU 5 tablet and /or 60 tablet bottles
Acute initial dose at 100 mg/kg	6000 mg	30 tablets	6 bottles of 5 tablets and 1 of 60 tablets
Acute initial dose at 250 mg/kg	15000 mg	75 tablets	9 bottles of 5 tablets and 3 of 60 tablets



Important Safety Information

ADVERSE REACTIONS

The most common adverse reactions in $\geq 13\%$ of patients are: infections, vomiting, abdominal pain, pyrexia, tonsillitis, anemia, ear infection, diarrhea, nasopharyngitis, and headache.

To report SUSPECTED ADVERSE REACTIONS, contact Recordati Rare Diseases Inc. at 1-888-575-8344, or FDA at 1-800-FDA-1088 or www.fda.gov/medwatch.

Step by step guide on the Carbaglu® (carglumic acid) STAT delivery



HOSPITAL MEDICAL HA TEAM

Call Pharmacy and request **CARBAGLU STAT delivery**. Make sure to indicate the number of 5 tablet and/or 60 tablet bottles that are needed.

Helpful tips:

Update and check your hospitals' Emergency Hyperammonemia Protocol on a regular basis.



HOSPITAL PHARMACY TEAM

Call **CARBAGLU** number 1-888-454-8860 and specify **STAT 6 hour delivery**.

Helpful tips:

Make sure after hours/nighttime delivery address is known to Accredo if applicable.



ACCREDO CARBAGLU TEAM

The Accredo **CARBAGLU** team will review and process the order as quickly as possible. (Note: 6 hour delivery is dependent on weather conditions and is not guaranteed.)

Helpful tips:

Communicate estimated delivery time to Hospital Pharmacy Team.



HOSPITAL PHARMACY TEAM

CARBAGLU will be delivered in a cold temperature setting.

Helpful tips:

Outreach from the Accredo **CARBAGLU** Team will take place 1-2 days after **CARBAGLU** STAT delivery to help answer questions about patient set up, if applicable.

Carbaglu® (carglumic acid) 6hr STAT ORDERING PROCESS

The following is the process necessary to obtain CARBAGLU in approximately 6 hours:



Tell the CARBAGLU team representative that you need to speak with the Accredo Specialty Distribution Department (Wholesale) for an emergency CARBAGLU order with STAT delivery. CARBAGLU can be delivered to most hospitals within 6 hours of order.* This service is provided 24 hours a day, 7 days a week. Inform Accredo of contact address for quick delivery of CARBAGLU.

* 6-hour delivery is dependent on weather conditions and is not guaranteed.

ACCREDO

WWW.ACCREDO.COM | Accredo is the exclusive distributor of CARBAGLU in the United States.

PATIENT ASSISTANCE PROGRAMS

For patients experiencing financial hardship to get CARBAGLU treatment, Recordati Rare Diseases supports two programs administered by Accredo: a Patient Assistance Program and a Co-Pay Assistance Program. To reach Accredo, please visit: www.accredo.com or call: 1-888-454-8860

For more information about CARBAGLU, visit: www.carbaglu.net

References:

1. Carbaglu Prescribing Information Section 5.1 (2015)
2. Carbaglu Prescribing Information Section 2.1 and 2.4 (2015)
3. Carbaglu Prescribing Information Section 2 (2015)



Carbaglu is a licensed trademark of Recordati Rare Diseases Inc.
Full Prescribing Information to follow on next pages

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PP-CBGL-US-0032

HIGHLIGHTS OF PRESCRIBING INFORMATION

These highlights do not include all the information needed to use Carbaglu® safely and effectively. See full prescribing information for Carbaglu®.

Carbaglu® (carglumic acid) tablets

Initial U.S. Approval: 2010

INDICATIONS AND USAGE

Carbaglu® (carglumic acid) is a Carbamoyl Phosphate Synthetase 1 (CPS 1) activator indicated as:

- Adjunctive therapy for the treatment of acute hyperammonemia due to the deficiency of the hepatic enzyme N-acetylglutamate synthase (NAGS) (1.1)
- Maintenance therapy for the treatment of chronic hyperammonemia due to the deficiency of the hepatic enzyme N-acetylglutamate synthase (NAGS) (1.2)

DOSAGE AND ADMINISTRATION

Carbaglu® treatment should be initiated by a physician experienced in metabolic disorders

Adult Dosage and Administration

- Recommended initial dose range for acute hyperammonemia is 100 mg/kg/day to 250 mg/kg/day (2.1)
- Adjust the dose to maintain normal plasma ammonia levels based on age (2.1)
- Divide the total daily dose into two to four doses to be given immediately before meals or feedings (2.1)
- Each divided dose should be rounded to the nearest 100 mg (2.1)
- Each 200 mg tablet should be dispersed in a minimum of 2.5 mL of water and taken immediately (2.2)
- Carbaglu® can be administered orally or through a nasogastric tube (2.3)
- Carbaglu® tablets should not be swallowed whole or crushed (2.2)

Pediatric Dosage and Administration

- Recommended initial dose range for acute hyperammonemia is 100 mg/kg/day to 250 mg/kg/day (2.4)
- The recommended maintenance dose should be titrated to target normal plasma ammonia levels for age (2.4)
- Divide the total daily dose into two to four doses to be given immediately before meals or feedings (2.4)
- Mix each 200 mg tablet in 2.5 mL of water to yield a concentration of 80 mg/mL (2.5)
- Carbaglu® may be administered orally with an oral syringe or through a nasogastric tube (2.5, 2.6)
- Carbaglu® tablets should not be swallowed whole or crushed. (2.2)

USE IN OTHER FOODS AND LIQUIDS HAS NOT BEEN STUDIED CLINICALLY AND IS THEREFORE NOT RECOMMENDED.

DOSAGE FORMS AND STRENGTHS

200 mg tablets, scored (3)

CONTRAINDICATIONS

None. (4)

WARNINGS AND PRECAUTIONS

- Hyperammonemia: Monitor plasma ammonia levels during treatment. Prolonged exposure to elevated plasma ammonia levels can rapidly result in injury to the brain or death. Prompt use of all therapies necessary to reduce plasma ammonia levels is essential. (5.1)
- Therapeutic Monitoring: Plasma ammonia levels should be maintained within normal range for age via

individual dose adjustment. (5.2)

- **Nutritional Management:** In the initial treatment of NAGS deficiency, protein restriction is recommended. When plasma ammonia level is normalized, dietary protein intake can usually be reintroduced. (5.3)

ADVERSE REACTIONS

The most common adverse reactions in $\geq 13\%$ of patients are: infections, vomiting, abdominal pain, pyrexia, tonsillitis, anemia, ear infection, diarrhea, nasopharyngitis, infections and headache (6.1).

To report ADVERSE REACTIONS, contact

Recordati Rare Diseases, Inc. at 1-888-575-8344, or FDA at 1-800-FDA-1088 or www.fda.gov/medwatch.

USE IN SPECIFIC POPULATIONS

Pregnancy: No human data; decreased survival and growth in animal offspring. (8.1)

Nursing Mothers: Human milk-feeding is not recommended. (8.3)

See 17 for PATIENT COUNSELING INFORMATION

Revised: April 2015

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FULL PRESCRIBING INFORMATION

1. INDICATIONS AND USAGE

1.1 Acute hyperammonemia in patients with NAGS deficiency

Carbaglu® is indicated as an adjunctive therapy in pediatric and adult patients for the treatment of acute hyperammonemia due to the deficiency of the hepatic enzyme N-acetylglutamate synthase (NAGS). During acute hyperammonemic episodes concomitant administration of Carbaglu® with other ammonia lowering therapies such as alternate pathway medications, hemodialysis, and dietary protein restriction are recommended.

1.2 Maintenance therapy for chronic hyperammonemia in patients with NAGS deficiency

Carbaglu® is indicated for maintenance therapy in pediatric and adult patients for chronic hyperammonemia due to the deficiency of the hepatic enzyme N-acetylglutamate synthase (NAGS). During maintenance therapy, the concomitant use of other ammonia lowering therapies and protein restriction may be reduced or discontinued based on plasma ammonia levels.

2. DOSAGE AND ADMINISTRATION

Carbaglu® treatment should be initiated by a physician experienced in metabolic disorders.

2.1 Adult Dosage and Administration

The recommended initial dose for acute hyperammonemia is 100 mg/kg/day to 250 mg/kg/day.

Concomitant administration of other ammonia lowering therapies is recommended. Dosing should be titrated based on individual patient plasma ammonia levels and clinical symptoms.

The recommended maintenance dose should be titrated to target normal plasma ammonia level for age. Based on limited data in 22 patients receiving maintenance treatment with Carbaglu® in a retrospective case series, maintenance doses were usually less than 100 mg/kg/day. The total daily dose should be divided into 2 to 4 doses and rounded to the nearest 100 mg (i.e., half of a Carbaglu® Tablet).

2.2 Preparation for Oral Administration in Adults

Carbaglu® tablets should not be swallowed whole or crushed. Disperse Carbaglu® tablets in water immediately before use.

Each 200 mg tablet should be dispersed in a minimum of 2.5 mL of water and taken immediately.

Carbaglu® tablets do not dissolve completely in water and undissolved particles of the tablet may remain in the mixing container. To ensure complete delivery of the dose, the mixing container should be rinsed with additional volumes of water and the contents swallowed immediately. **USE IN OTHER FOODS AND LIQUIDS HAS NOT BEEN STUDIED CLINICALLY AND IS THEREFORE NOT RECOMMENDED.**

2.3 Preparation for Nasogastric Tube Administration in Adults

For patients who have a nasogastric tube in place, Carbaglu® should be administered as follows:

- Mix each 200 mg tablet in a minimum of 2.5 mL of water. Shake gently to allow for quick dispersal.

- Administer the dispersion immediately through the nasogastric tube
- Flush with additional water to clear the nasogastric tube.

2.4 Pediatric Dosage and Administration

The recommended initial dose for acute hyperammonemia is 100 mg/kg/day to 250 mg/kg/day.

Concomitant administration of other ammonia lowering therapies is recommended. Dosing should be titrated based on individual patient plasma ammonia levels and clinical symptoms.

The recommended maintenance dose should be titrated to target normal plasma ammonia level for age. Based on limited data in 22 patients receiving maintenance treatment with Carbaglu® in a retrospective case series, maintenance doses were usually less than 100 mg/kg/day.

The total daily dose should be divided into 2 to 4 doses.

2.5 Preparation for Oral Administration Using an Oral Syringe in Pediatrics

For administration via oral syringe, Carbaglu® should be administered as follows:

- Mix each 200 mg tablet in 2.5 mL of water to yield a concentration of 80 mg/mL in a mixing container. Shake gently to allow for quick dispersal.
- Draw up the appropriate volume of dispersion in an oral syringe and administer immediately. Discard the unused portion.
- Refill the oral syringe with a minimum volume of water (1-2 mL) and administer immediately.

2.6 Preparation for Nasogastric Tube Administration in Pediatrics

For patients who have a nasogastric tube in place, Carbaglu® should be administered as follows:

- Mix each 200 mg tablet in 2.5 mL of water to yield a concentration of 80 mg/mL in a mixing container. Shake gently to allow for quick dispersal.
- Draw up the appropriate volume of dispersion and administer immediately through a nasogastric tube. Discard the unused portion.
- Flush with additional water to clear the nasogastric tube.

USE IN OTHER FOODS AND LIQUIDS HAS NOT BEEN STUDIED CLINICALLY AND IS THEREFORE NOT RECOMMENDED

3. DOSAGE FORMS AND STRENGTHS

Carbaglu® is a white and elongated 200 mg tablet, scored and coded “C” on one side.

4. CONTRAINDICATIONS

None

5. WARNINGS AND PRECAUTIONS

5.1 Hyperammonemia

Any episode of acute symptomatic hyperammonemia should be treated as a life-threatening emergency. Treatment of hyperammonemia may require dialysis, preferably hemodialysis, to remove a large burden of ammonia. Uncontrolled hyperammonemia can rapidly result in brain injury/damage or death, and prompt use of all therapies necessary to reduce plasma ammonia levels is essential.

Management of hyperammonemia due to NAGS deficiency should be done in coordination with medical personnel experienced in metabolic disorders.

Ongoing monitoring of plasma ammonia levels, neurological status, laboratory tests and clinical responses in patients receiving Carbaglu® is crucial to assess patient response to treatment.

5.2 Therapeutic Monitoring

Plasma ammonia levels should be maintained within normal range for age via individual dose adjustment.

5.3 Nutritional Management

Since hyperammonemia is the result of protein catabolism, complete protein restriction is recommended to be maintained for 24 to 48 hours and caloric supplementation should be maximized to reverse catabolism and nitrogen turnover.

6. ADVERSE REACTIONS

6.1 Retrospective Case Series Experience

The most common adverse reactions (occurring in $\geq 13\%$ of patients), regardless of causality, are: Infections, vomiting, abdominal pain, pyrexia, tonsillitis, anemia, ear infection, diarrhea, nasopharyngitis and headache.

Table 1 summarizes adverse reactions occurring in 2 or more patients treated with Carbaglu® in the retrospective case series. Because these reactions were reported retrospectively, it is not always possible to reliably estimate their frequency or establish a causal relationship to drug exposure.

Table 1: Adverse Reactions Reported in ≥ 2 Patients in the Retrospective Case Series treated with Carbaglu®

System Organ Class Preferred Term	Number of Patients (N)(%)
TOTAL	23 (100)
Blood and lymphatic system disorders	
Anemia	3 (13)
Ear and labyrinth disorders	
Ear infection	3 (13)
Gastrointestinal disorders	
Abdominal pain	4 (17)
Diarrhea	3 (13)
Vomiting	6 (26)
Dysgeusia	2 (9)
General disorders and administration site conditions	
Asthenia	2 (9)
Hyperhidrosis	2 (9)
Pyrexia	4 (17)
Infections and infestations	
Infections	3 (13)
Influenza	2 (9)
Nasopharyngitis	3 (13)
Pneumonia	2 (9)
Tonsillitis	4 (17)

System Organ Class Preferred Term	Number of Patients (N)(%)
Investigations	
Hemoglobin decreased	3 (13)
Weight decreased	2 (9)
Metabolism and nutrition disorders	
Anorexia	2 (9)
Nervous system disorders	
Headache	3 (13)
Somnolence	2 (9)
Skin and subcutaneous tissue disorders	
Rash	2 (9)

7. DRUG INTERACTIONS

No drug interaction studies have been conducted

8. USE IN SPECIFIC POPULATIONS

8.1 Pregnancy

Pregnancy Category C

There are no adequate and well controlled studies or available human data with Carbaglu® in pregnant women. Decreased survival and growth occurred in offspring born to animals that received carglumic acid at doses similar to the maximum recommended starting human dose during pregnancy and lactation. Because untreated N-acetylglutamate synthase (NAGS) deficiency results in irreversible neurologic damage and death, women with NAGS must remain on treatment throughout pregnancy. In embryo-fetal developmental toxicity studies, pregnant rats and rabbits received oral carglumic acid during organogenesis at doses up to 1.3 times the maximum recommended human starting dose based on body surface area (mg/m²). Actual doses were 500 and 2000 mg/kg/day (rats) and 250 and 1000 mg/kg/day (rabbits). The high doses resulted in maternal toxicity in both rats and rabbits. No effects on embryo-fetal development were observed in either species.

In a peri- and post-natal developmental study, female rats received oral carglumic acid from organogenesis through day 21 post-partum at doses up to 1.3 times the maximum recommended starting human dose based on body surface area (mg/m²). Actual doses were 500 and 2000 mg/kg/day. A reduction in offspring survival was seen at the high dose and a reduction in offspring growth was seen at both doses.

8.3 Nursing Mothers

It is not known whether Carbaglu® is excreted in human milk. Carglumic acid is excreted in rat milk, and an increase in mortality and impairment of body weight gain occurred in neonatal rats nursed by mothers receiving carglumic acid. Because many drugs are excreted in human milk and because of the potential for serious adverse reactions in nursing infants from Carbaglu®, human milk-feeding is not recommended. Treatment is continuous and life-long for NAGS deficiency patients.

8.4 Pediatric Use

The efficacy of Carbaglu® for the treatment of hyperammonemia in patients with NAGS deficiency from birth to adulthood was evaluated in a retrospective review of the clinical course of 23 NAGS deficiency patients who all began Carbaglu® treatment during infancy or childhood. There are no apparent differences in clinical response between adults and pediatric NAGS deficiency patients treated with Carbaglu®, however, data are limited.

8.5 Geriatric Use

Carbaglu® has not been studied in the geriatric population. Therefore, the safety and effectiveness in geriatric patients have not been established

10. OVERDOSAGE

One patient treated with 650 mg/kg/day of carglumic acid developed symptoms characterized as a monosodium glutamate intoxication-like syndrome: tachycardia, profuse sweating, increased bronchial secretion, increased body temperature and restlessness. These symptoms resolved upon reduction of dose.

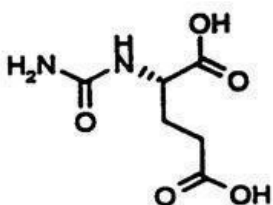
Repeated oral dosing of carglumic acid at 2000 mg/ kg/day was lethal to most neonatal rats within 2-3 days of treatment. In adult rats, a single oral administration of carglumic acid was not lethal at doses up to 2800 mg/kg (1.8 times the maximum recommended starting dose based on a body surface area comparison to adult humans).

11. DESCRIPTION

Carbaglu® tablets for oral administration contain 200 mg of carglumic acid. Carglumic acid, the active substance, is a Carbamoyl Phosphate Synthetase 1 (CPS 1) activator and is soluble in boiling water, slightly soluble in cold water, practically insoluble in organic solvents.

Chemically carglumic acid is N-carbamoyl-L-glutamic acid or (2S)-2-(carbamoylamino) pentanedioic acid, with a molecular weight of 190.16.

The structural formula is:



Molecular Formula: C₆H₁₀N₂O₅

The inactive ingredients of Carbaglu® are microcrystalline cellulose, sodium lauryl sulfate, hypromellose, croscarmellose sodium, silica colloidal anhydrous, sodium stearyl fumarate.

12. CLINICAL PHARMACOLOGY

12.1 Mechanism of Action

Carglumic acid is a synthetic structural analogue of N-acetylglutamate (NAG), which is an essential allosteric activator of carbamoyl phosphate synthetase 1 (CPS 1) in liver mitochondria.

CPS 1 is the first enzyme of the urea cycle, which converts ammonia into urea. NAG is the product of N-acetylglutamate synthase (NAGS), a mitochondrial enzyme. Carglumic acid acts as a replacement for NAG in NAGS deficiency patients by activating CPS 1.

12.2 Pharmacodynamics

In a retrospective review of the clinical course in 23 patients with NAGS deficiency, carglumic acid reduced plasma ammonia levels within 24 hours when administered with and without concomitant ammonia lowering therapies. No dose response relationship has been identified.

12.3 Pharmacokinetics

The pharmacokinetics of carglumic acid has been studied in healthy male volunteers using both radiolabeled and non-radiolabeled carglumic acid.

Absorption

The median T_{max} of Carbaglu® was 3 hours (range:2-4). Absolute bioavailability has not been determined.

Distribution

The apparent volume of distribution was 2657 L (range: 1616-5797). Protein binding has not been determined.

Metabolism

A proportion of carglumic acid may be metabolized by the intestinal bacterial flora. The likely end product of carglumic acid metabolism is carbon dioxide, eliminated through the lungs.

Elimination

Median values for the terminal half-life was 5.6 hours (range 4.3-9.5), the apparent total clearance was 5.7 L/min (range 3.0-9.7), the renal clearance was 290 mL/min (range 204-445), and the 24-hour urinary excretion was 4.5 % of the dose (range 3.5-7.5). Following administration of a single radiolabeled oral dose of 100 mg/kg of body weight, 9% of the dose was excreted unchanged in the urine and up to 60% of the dose was excreted unchanged in the feces.

Drug Interaction Studies

No drug interaction studies have been performed. Based on in-vitro studies, Carbaglu® is not an inducer of CYP1A1/2, CYP2B6, CYP2C, and CYP3A4/ 5 enzymes, and not an inhibitor of CYP1A2, CYP2A6, CYP2B6, CYP2C8, CYP2C9, CYP2C19, CYP2D6, CYP2E1, and CYP3A4/5 enzymes.

13 NONCLINICAL TOXICOLOGY

13.1 Carcinogenesis, Mutagenesis, Impairment of Fertility

Carcinogenicity studies have not been performed with carglumic acid.

Carglumic acid was negative in the Ames test, chromosomal aberration assay in human lymphocytes, and the in vivo micronucleus assay in rats.

There were no effects on fertility or reproductive performance in female rats at oral doses up to 2000 mg/kg/day (1.3 times the maximum recommended human starting dose based on body surface area). In a separate study, mating and fertility were unaffected in male rats at oral doses up to 1000 mg/kg/day (0.6 times the maximum recommended human starting dose based on body surface area).

14. CLINICAL STUDIES

14.1 Responses of Patients with NAGS Deficiency to Acute and Chronic Treatment

The efficacy of Carbaglu® in the treatment of hyperammonemia due to NAGS deficiency was evaluated in a retrospective review of the clinical course of 23 NAGS deficiency patients who received Carbaglu® treatment for a median of 7.9 years (range 0.6 to 20.8 years).

The demographics characteristics of the patient population are shown in Table 2.

Table 2: Baseline Characteristics of the 23 NAGS deficiency patients

Patients N=23		
Gender	Male	14 (61%)
	Female	9 (39%)
Age at initiation of Carbaglu® therapy (years)	Mean (SD)	2 (4)
	Min-Max	0-13
Age groups at initiation of Carbaglu® therapy	<30 days	9 (39%)
	>30 days - 11 months	9 (39%)
	≥1 - 13 years	5 (22%)
NAGS gene mutations by DNA testing	homozygous	14 (61%)
	heterozygous	4 (17%)
	Not available	5 (22%)
Patients current treatment status	On-going	18 (78%)
	Discontinued	5 (22%)

The clinical observations in the 23 patient case series were retrospective, unblinded and uncontrolled and preclude any meaningful formal statistical analyses of the data. However, short-term efficacy was evaluated using mean and median change in plasma ammonia levels from baseline to days 1 to 3. Persistence of efficacy was evaluated using long-term mean and median change in plasma ammonia level. Table 3 summarizes the plasma ammonia levels at baseline, days 1 to 3 post-Carbaglu® treatment, and long-term Carbaglu® treatment for 13 evaluable patients. Of the 23 NAGS deficiency patients who received treatment with Carbaglu®, a subset of 13 patients who had both well documented plasma ammonia levels prior to Carbaglu® treatment and after long-term treatment with Carbaglu® were selected for analysis.

All 13 patients had abnormal ammonia levels at baseline. The overall mean baseline plasma ammonia level was 271 µmol/L. By day 3, normal plasma ammonia levels were attained in patients for whom data were available. Long-term efficacy was measured using the last reported plasma ammonia level for each of the 13 patients analyzed (median length of treatment was 6 years; range 1 to 16 years). The mean and median ammonia levels were 23 µmol/L and 24 µmol/L, respectively, after a mean treatment duration of 8 years.

Table 3: Plasma ammonia levels at baseline and after treatment with Carbaglu®

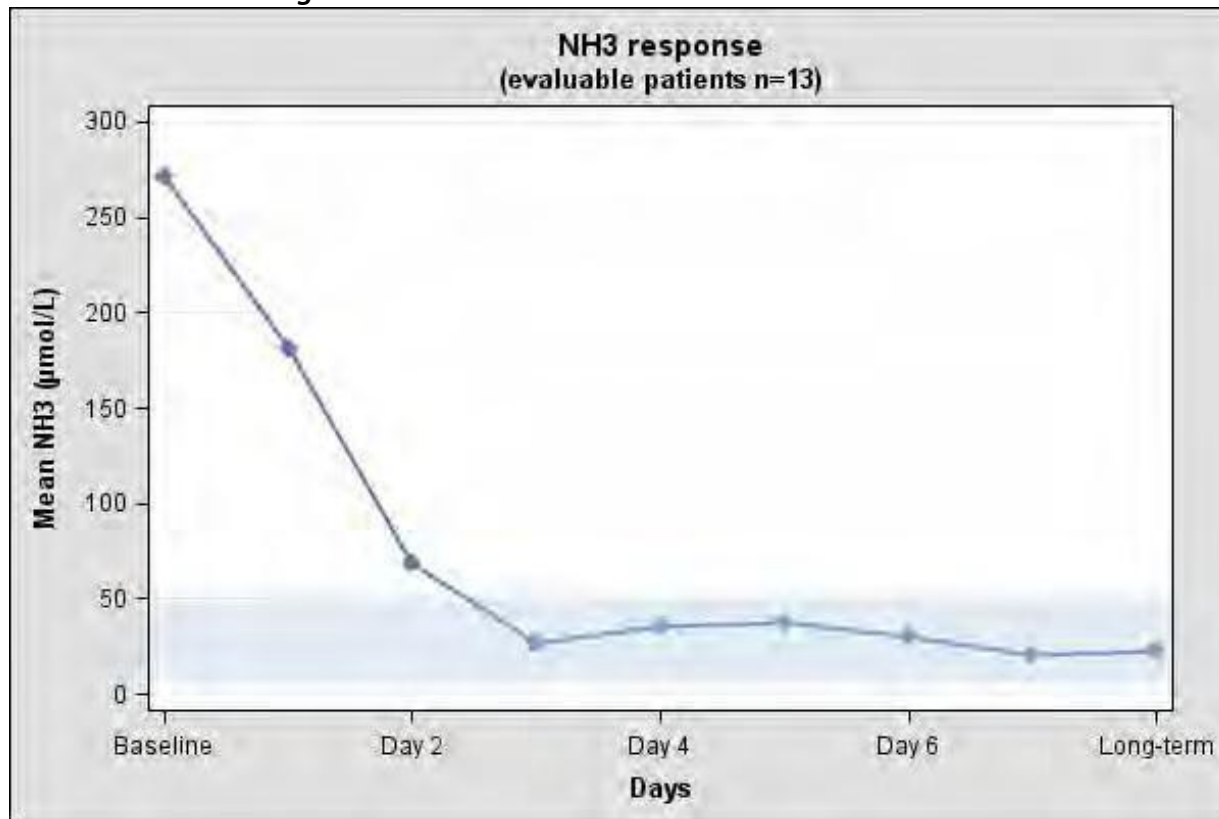
Timepoint	Statistics (N = 13*)	Ammonia** (μmol/L)
Baseline (prior to first treatment with Carbaglu®)	N	13
	Mean (SD)	271 (359)
	Median	157
	Range	72-1428
	Missing Data	0
Day 1	N	10
	Mean (SD)	181 (358)
	Median	65
	Range	25-1190
	Missing Data	3
Day 2	N	8
	Mean (SD)	69 (78)
	Median	44
	Range	11-255
	Missing Data	5
Day 3	N	5
	Mean (SD)	27 (11)
	Median	25
	Range	12-42
	Missing Data	8
Long-term Mean: 8 years Median: 6 years 1 to 16 years (last available value on Carbaglu® treatment)	N	13
	Mean (SD)	23 (7)
	Median	24
	Range	9-34
	Missing Data	0

* 13/23 patients with complete short-term and long-term plasma ammonia documentation

** Mean ammonia normal range: 5 to 50 μmol/L

The mean plasma ammonia level at baseline and the decline that is observed after treatment with Carbaglu® in 13 evaluable patients with NAGS deficiency is illustrated in Figure 1.

Figure 1: Ammonia response for 13 evaluable NAGS deficiency patients at baseline and after treatment with Carbaglu®



16. HOW SUPPLIED/STORAGE AND HANDLING

How Supplied

Carbaglu® is a white and elongated tablet, scored and coded “C” on one side. Each tablet contains 200 mg of carglumic acid. Carbaglu® is available in 5 or 60 tablets in a polypropylene bottle with polyethylene cap and desiccant unit.

NDC 52276-312-05 Bottles of 5 tablets

NDC 52276-312-60 Bottles of 60 tablets

Storage

Before opening, store refrigerated at 2 – 8 °C (36 –46 °F).

After first opening of the container:

- Do not refrigerate, do not store above 30°C (86 °F).
- Keep the container tightly closed in order to protect from moisture.
- Write the date of opening on the tablet container.
- Do not use after the expiration date stated on the tablet container.
- Discard one month after first opening.

17. PATIENT COUNSELING INFORMATION

Physicians should inform patients and caregivers about the following instructions for safe use of Carbaglu®:

- Carbaglu® tablets should not be swallowed whole or crushed. Each tablet should be dispersed in a minimum of 2.5 mL of water. Carbaglu® tablets do not dissolve completely in water and undissolved particles of the tablet may remain in the mixing container. The mixing container should be rinsed with additional volumes of water and the contents swallowed immediately.
- Before opening, store in a refrigerator 2 to 8 °C (36 to 46 °F).
- Keep the container tightly closed in order to protect from moisture.
- After first opening of the container: do not refrigerate, do not store above 30 °C (86 °F).
- Write the date of opening on the tablet container. Discard one month after first opening.
- Do not use after the expiration date stated on the tablet container.

Physicians should also advise patients and caregivers that:

- When plasma ammonia levels have normalized, dietary protein intake can usually be increase with the goal of unrestricted protein intake.
- Human milk-feeding is not recommended.
- The most common adverse reactions are infections, vomiting, abdominal pain, pyrexia, tonsillitis, anemia, ear infection, diarrhea, nasopharyngitis, and headache.

Supplied by:

Orphan Europe SARL
Paris, France



RECORDATI GROUP

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Recordati Rare Diseases, Inc.
Lebanon, NJ 08833
USA



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Carbaglu
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