

## HIGHLIGHTS OF PRESCRIBING INFORMATION

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

Exjade® (deferasirox) Tablets for oral suspension  
Initial U.S. Approval: 2005

### RECENT MAJOR CHANGES

Warnings and Precautions, Hepatic Dysfunction and Failure (5.3) 12/2007  
Warnings and Precautions, Gastrointestinal (5.6) 10/2008

### INDICATIONS AND USAGE

Exjade is an iron chelating agent indicated for the treatment of chronic iron overload due to blood transfusions in patients 2 years of age and older. (1)

### DOSAGE AND ADMINISTRATION

- Recommended initial daily dose is 20 mg/kg body weight, taken on an empty stomach at least 30 minutes before food. (2.1)
- Calculate dose to the nearest whole tablet. (2.1)
- Do not chew or swallow the tablets whole. (2.1)
- Disperse the tablets by stirring in an appropriate amount of water, orange juice, or apple juice. (2.1)

### DOSAGE FORMS AND STRENGTHS

Tablets for oral suspension: 125 mg, 250 mg, 500 mg. (3)

### CONTRAINDICATIONS

None. (4)

### WARNINGS AND PRECAUTIONS

- Cases of acute renal failure, some with a fatal outcome, have been reported in the postmarketing use of Exjade. Assess serum creatinine at baseline. Monitor serum creatinine and urine protein monthly. (5.1)
- There have been postmarketing reports of cytopenias in patients treated with Exjade. Some of these patients died. Monitor blood counts regularly. (5.2)

- There have been postmarketing reports of hepatic failure, some with a fatal outcome, in patients treated with Exjade. Monitor liver function tests monthly. (5.3)
- Serious hypersensitivity reactions have been reported. If reactions are severe, discontinue Exjade and institute appropriate medical intervention. (5.4)
- Conduct auditory testing and ophthalmic testing before starting treatment with Exjade and thereafter every 12 months. (5.5)
- Gastrointestinal irritation (ulcer, bleeding) may occur during Exjade treatment. Use caution in patients who are taking Exjade in combination with drugs that have known ulcerogenic or hemorrhagic potential, such as NSAIDs, corticosteroids, oral bisphosphonates, or anticoagulants. (5.6)

### ADVERSE REACTIONS

The most frequently occurring adverse reactions are diarrhea, vomiting, nausea, headache, abdominal pain, pyrexia, cough, and increases in serum creatinine. (6.1)

To report SUSPECTED ADVERSE REACTIONS, contact Novartis Pharmaceuticals Corporation at 1-888-669-6682 or FDA at 1-800-FDA-1088 or [www.fda.gov/medwatch](http://www.fda.gov/medwatch)

### DRUG INTERACTIONS

- Do not take Exjade with aluminum-containing antacid preparations. (7)
- Use caution when Exjade is administered with drugs metabolized by CYP3A4. (7)

### USE IN SPECIFIC POPULATIONS

Use Exjade with caution in elderly patients due to the greater frequency of decreased hepatic, renal, or cardiac function. (8.5)

See 17 for PATIENT COUNSELING INFORMATION

Revised: October 2008

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## **FULL PRESCRIBING INFORMATION**

### **1 INDICATIONS AND USAGE**

Exjade (deferasirox) is indicated for the treatment of chronic iron overload due to blood transfusions (transfusional hemosiderosis) in patients 2 years of age and older.

### **2 DOSAGE AND ADMINISTRATION**

#### **2.1 Dosing Information**

The recommended initial daily dose of Exjade is 20 mg/kg body weight.

Take Exjade once daily on an empty stomach at least 30 minutes before food, preferably at the same time each day. Do not chew tablets or swallow them whole. Do not take Exjade with aluminum-containing antacid products. Calculate doses (mg/kg per day) to the nearest whole tablet. Completely disperse tablets by stirring in water, orange juice, or apple juice until a fine suspension is obtained. Disperse doses of <1 g in 3.5 ounces of liquid and doses of  $\geq 1$  g in 7.0 ounces of liquid. After swallowing the suspension, resuspend any residue in a small volume of liquid and swallow.

Individualize the decision to remove accumulated iron based on anticipated clinical benefit and risks of Exjade therapy. In patients who are in need of iron chelation therapy, it is recommended that therapy with Exjade (deferasirox) be started when a patient has evidence of chronic iron overload, such as the transfusion of approximately 100 mL/kg of packed red blood cells (approximately 20 units for a 40-kg patient) and a serum ferritin consistently >1000 mcg/L.

#### **2.2 Dose Modifications**

After commencing initial therapy, monitor serum ferritin every month and adjust the dose of Exjade if necessary every 3-6 months based on serum ferritin trends. Make dose adjustments in steps of 5 or 10 mg/kg and tailor adjustments to the individual patient's response and therapeutic goals (maintenance or reduction of body iron burden). If the serum ferritin falls consistently below 500 mcg/L, consider temporarily interrupting therapy with Exjade. Do not exceed Exjade doses of 30 mg/kg per day since there is limited experience with doses above this level.

The risk of toxicity of Exjade may be increased when inappropriately high doses are given in patients with low iron burden or with serum ferritin levels that are only slightly elevated. The safety and efficacy of Exjade when administered with other iron chelation therapy have not been established.

### **3 DOSAGE FORMS AND STRENGTHS**

#### **125 mg tablets**

Off-white, round, flat tablet with beveled edge and imprinted with "J" and "125" on one side and "NVR" on the other.

#### **250 mg tablets**

Off-white, round, flat tablet with beveled edge and imprinted with "J" and "250" on one side and "NVR" on the other.

#### **500 mg tablets**

Off-white, round, flat tablet with beveled edge and imprinted with "J" and "500" on one side and "NVR" on the other.

## 4 CONTRAINDICATIONS

Use of Exjade (deferasirox) is contraindicated in patients with hypersensitivity to deferasirox or to any other component of Exjade.

## 5 WARNINGS AND PRECAUTIONS

### 5.1 Renal

Cases of acute renal failure, some with a fatal outcome, have been reported following the postmarketing use of Exjade (deferasirox). Most of the fatalities occurred in patients with multiple comorbidities and who were in advanced stages of their hematological disorders. Give particular attention to monitoring serum creatinine in patients who: are at increased risk of complications, have preexisting renal conditions, are elderly, have comorbid conditions, or are receiving medicinal products that depress renal function.

Assess serum creatinine in duplicate before initiating therapy to establish a reliable pretreatment baseline, due to variations in measurements. Monitor serum creatinine monthly thereafter. In patients with additional renal risk factors (see above), monitor serum creatinine weekly during the first month after initiation or modification of therapy and monthly thereafter.

Consider dose reduction, interruption, or discontinuation for increases in serum creatinine. If there is a progressive increase in serum creatinine beyond the age-appropriate upper limit of normal, interrupt Exjade use. Once the creatinine has returned to within the normal range, therapy with Exjade may be reinitiated at a lower dose followed by gradual dose escalation, if the clinical benefit is expected to outweigh potential risks.

For adult patients, reduce the daily dose of Exjade by 10 mg/kg if a rise in serum creatinine to >33% above the average of the pretreatment measurements is seen at 2 consecutive visits, and cannot be attributed to other causes. For pediatric patients, reduce the dose by 10 mg/kg if serum creatinine levels rise above the age-appropriate upper limit of normal at 2 consecutive visits.

In the clinical studies, for increases of serum creatinine on 2 consecutive measures (>33% in patients >15 years of age or >33% and greater than the age-appropriate upper limit of normal in patients <15 years of age), the daily dose of Exjade was reduced by 10 mg/kg. Patients with baseline serum creatinine above the upper limit of normal were excluded from clinical studies.

In the clinical studies, Exjade-treated patients experienced dose-dependent increases in serum creatinine. These increases occurred at a greater frequency compared to deferoxamine-treated patients (38% vs. 14%, respectively, in Study 1 and 36% vs 22%, respectively, in Study 3). Most of the creatinine elevations remained within the normal range [*see Adverse Reactions (6.1)*]. There have also been reports of renal tubulopathy in patients treated with Exjade.

In clinical studies, urine protein was measured monthly. Intermittent proteinuria (urine protein/creatinine ratio >0.6 mg/mg) occurred in 18.6% of Exjade-treated patients compared to 7.2% of deferoxamine-treated patients in Study 1. Although no patients were discontinued from Exjade in clinical studies up to 1 year due to proteinuria, monthly monitoring is recommended. The mechanism and clinical significance of the proteinuria are uncertain.

### 5.2 Cytopenias

There have been postmarketing reports (both spontaneous and from clinical trials) of cytopenias, including agranulocytosis, neutropenia and thrombocytopenia, in patients treated with Exjade. Some of these patients died. The relationship of these episodes to treatment with Exjade is uncertain. Most of these patients had preexisting hematologic disorders that are frequently associated with bone marrow failure [*See Adverse Reactions (6.2)*]. In line with the standard clinical management of such hematological

disorders, monitor blood counts regularly. Consider interrupting treatment with Exjade in patients who develop unexplained cytopenia. Reintroduction of therapy with Exjade may be considered, once the cause of the cytopenia has been elucidated.

### **5.3 Hepatic Dysfunction and Failure**

In Study 1, 4 patients discontinued Exjade because of hepatic abnormalities (drug-induced hepatitis in 2 patients and increased serum transaminases in 2 additional patients). There have been postmarketing reports of hepatic failure, some with a fatal outcome, in patients treated with Exjade. Most of these events occurred in patients greater than 55 years of age. Most reports of hepatic failure involved patients with significant comorbidities, including liver cirrhosis and multiorgan failure. Monitor liver function tests monthly during Exjade treatment and consider dose modifications or interruption for severe or persistent elevations.

### **5.4 Hypersensitivity**

Serious hypersensitivity reactions (such as anaphylaxis and angioedema) have been reported in patients receiving Exjade, with the onset of the reaction occurring in the majority of cases within the first month of treatment [*See Adverse Reactions (6.2)*]. If reactions are severe, discontinue Exjade and institute appropriate medical intervention.

Skin rashes may occur during Exjade (deferasirox) treatment. For rashes of mild to moderate severity, Exjade may be continued without dose adjustment, since the rash often resolves spontaneously. In severe cases, Exjade may be interrupted. Reintroduction at a lower dose with escalation may be considered in combination with a short period of oral steroid administration.

### **5.5 Special Senses**

Auditory disturbances (high frequency hearing loss, decreased hearing), and ocular disturbances (lens opacities, cataracts, elevations in intraocular pressure, and retinal disorders) have been reported at a frequency of <1% with Exjade therapy in the clinical studies. Auditory and ophthalmic testing (including slit lamp examinations and dilated funduscopy) are recommended before starting Exjade treatment and thereafter at regular intervals (every 12 months). If disturbances are noted, consider dose reduction or interruption.

### **5.6 Gastrointestinal**

Gastrointestinal (GI) irritation may occur during Exjade treatment. Upper GI ulceration and hemorrhage have been reported in patients, including children and adolescents, receiving Exjade [*See Adverse Reactions (6.1)*]. Physicians and patients should remain alert for signs and symptoms of GI ulceration and hemorrhage during Exjade therapy and promptly initiate additional evaluation and treatment if a serious GI adverse event is suspected. Use caution when administering Exjade in combination with drugs that have ulcerogenic or hemorrhagic potential, such as non-steroidal anti-inflammatory drugs (NSAIDs), corticosteroids, oral bisphosphonates, or anticoagulants.

### **5.7 Laboratory Tests**

Measure serum ferritin monthly to assess response to therapy and to evaluate for the possibility of overchelation of iron. If the serum ferritin falls consistently below 500 mcg/L, consider temporarily interrupting therapy with Exjade [*See Dosage and Administration (2.2)*].

In the clinical studies, the correlation coefficient between the serum ferritin and LIC was 0.63. Therefore, changes in serum ferritin levels may not always reliably reflect changes in LIC.

Perform laboratory monitoring of renal and hepatic function [*See Warnings and Precautions (5.1, 5.3)*].

## 6 ADVERSE REACTIONS

### 6.1 Clinical Trials Experience

A total of 700 adult and pediatric patients were treated with Exjade (deferasirox) for 48 weeks in premarketing studies. These included 469 patients with  $\beta$ -thalassemia, 99 with rare anemias, and 132 with sickle cell disease. Of these patients, 45% were male, 70% were Caucasian and 292 patients were <16 years of age. In the sickle cell disease population, 89% of patients were Black. Median treatment duration among these sickle cell patients was 51 weeks. Of the 700 patients treated, 469 (403  $\beta$ -thalassemia and 66 rare anemias) were entered into extensions of the original clinical protocols. In ongoing extension studies, median durations of treatment were 88-205 weeks.

The most frequently occurring adverse reactions in the therapeutic studies of Exjade were diarrhea, vomiting, nausea, abdominal pain, and increases in serum creatinine. Gastrointestinal symptoms, increases in serum creatinine, and skin rash were dose related.

Table 1 displays adverse reactions occurring in >5% of Exjade-treated  $\beta$ -thalassemia patients (Study 1) and sickle cell disease patients (Study 3) with a suspected relationship to study drug. Abdominal pain, nausea, vomiting, diarrhea, and skin rashes were the most frequent adverse reactions reported with a suspected relationship to Exjade.

**Table 1. Adverse Reactions Occurring in >5% of Exjade-treated Patients in Study 1 and Study 3\***

Preferred Term	Study 1 ( $\beta$ -Thalassemia)		Study 3 (Sickle Cell Disease)	
	EXJADE N=296 n (%)	Deferoxamine N=290 n (%)	EXJADE N=132 n (%)	Deferoxamine N=63 n (%)
Abdominal Pain**	63 (21.3)	41 (14.1)	37 (28.0)	9 (14.3)
Diarrhea	35 (11.8)	21 (7.2)	26 (19.7)	3 (4.8)
Creatinine Increased***	33 (11.1)	0 (0)	9 (6.8)	0
Nausea	31 (10.5)	14 (4.8)	30 (22.7)	7 (11.1)
Vomiting	30 (10.1)	28 (9.7)	28 (21.2)	10 (15.9)
Rash	25 (8.4)	9 (3.1)	14 (10.6)	3 (4.8)

\*Adverse reaction frequencies are based on adverse events reported regardless of relationship to study drug.

\*\* Includes 'abdominal pain', 'abdominal pain lower', and 'abdominal pain upper' which were reported as adverse events.

\*\*\* Includes 'blood creatinine increased' and 'blood creatinine abnormal' which were reported as adverse events. Also see Table 2.

In Study 1, a total of 113 patients treated with Exjade had increases in serum creatinine >33% above baseline on 2 separate occasions (Table 2) and 25 patients required dose reductions. Increases in serum creatinine appeared to be dose related [See *Warnings and Precautions (5.1)*]. In this study, 17 patients developed elevations in SGPT/ALT levels >5 times the upper limit of normal at 2 consecutive visits. Of these, 2 patients had liver biopsy proven drug-induced hepatitis and both discontinued Exjade therapy [See *Warnings and Precautions (5.3)*]. An additional 2 patients, who did not have elevations in SGPT/ALT >5 times the upper limit of normal, discontinued Exjade because of increased SGPT/ALT. Increases in transaminases did not appear to be dose related. Adverse reactions that led to discontinuations included abnormal liver function tests (2 patients) and drug-induced hepatitis (2 patients), skin rash, glycosuria/proteinuria, Henoch Schönlein purpura, hyperactivity/insomnia, drug fever, and cataract (1 patient each).

In Study 3, a total of 48 patients treated with Exjade had increases in serum creatinine >33% above baseline on 2 separate occasions (Table 2) [See *Warnings and Precautions (5.1)*]. Of the patients who experienced creatinine increases in Study 3, 8 Exjade-treated patients required dose reductions. In this study, 5 patients in the Exjade group developed elevations in SGPT/ALT levels >5 times the upper limit of normal at 2 consecutive visits and 1 patient subsequently had Exjade permanently discontinued. Four

additional patients discontinued Exjade due to adverse reactions with a suspected relationship to study drug, including diarrhea, pancreatitis associated with gallstones, atypical tuberculosis, and skin rash.

**Table 2. Number (%) of Patients with Increases in Serum Creatinine or SGPT/ALT in Study 1 and Study 3**

Laboratory Parameter	Study 1 (β-Thalassemia)		Study 3 (Sickle Cell Disease)	
	EXJADE N=296 n (%)	Deferoxamine N=290 n (%)	EXJADE N=132 n (%)	Deferoxamine N=63 n (%)
<b>Serum Creatinine</b>				
Creatinine increase >33% and <ULN at 2 consecutive postbaseline visits	113 (38.2)	41 ( 14.1)	48 (36.4)	14 (22.2)
Creatinine increase >33% and >ULN at 2 consecutive postbaseline visits	7 (2.4)	1 (0.3)	3 (2.3)	2 (3.2)
<b>SGPT/ALT</b>				
SGPT/ALT >5 x ULN at 2 postbaseline visits	25 (8.4)	7 (2.4)	2 (1.5)	0
SGPT/ALT >5 x ULN at 2 consecutive postbaseline visits	17 (5.7)	5 (1.7)	5 (3.8)	0

In the population of more than 5,000 patients who have been treated with Exjade during clinical trials, adverse reactions occurring in 0.1% to 1% of patients included gastritis, edema, sleep disorder, pigmentation disorder, dizziness, anxiety, maculopathy, cholelithiasis, pyrexia, fatigue, pharyngolaryngeal pain, early cataract, hearing loss, gastrointestinal hemorrhage, gastric ulcer (including multiple ulcers), duodenal ulcer, and renal tubulopathy (Fanconi’s syndrome). Adverse reactions occurring in 0.01% to 0.1% of patients included optic neuritis and esophagitis. Adverse reactions which most frequently led to dose interruption or dose adjustment during clinical trials were rash, gastrointestinal disorders, infections, increased serum creatinine, and increased serum transaminases.

## 6.2 Postmarketing Experience

The following adverse reactions have been spontaneously reported during postapproval use of Exjade. Because these reactions are reported voluntarily from a population of uncertain size, in which patients may have received concomitant medication, it is not always possible to reliably estimate frequency or establish a causal relationship to drug exposure.

There have been reports of cytopenias, including agranulocytosis, neutropenia and thrombocytopenia, in patients treated with Exjade. Although most of these patients had preexisting hematologic disorders that are frequently associated with bone marrow failure, a contributory role for Exjade cannot be excluded. Cases of acute renal failure have been reported in the context of severe complications relating to the underlying disease. There have been postmarketing reports of hepatic failure, some with a fatal outcome, in patients treated with Exjade. Most of these events occurred in patients greater than 55 years of age. Most reports of hepatic failure involved patients with significant comorbidities, including liver cirrhosis and multiorgan failure [*See Warnings and Precautions (5.3)*].

Skin and subcutaneous tissue disorders: leukocytoclastic vasculitis, urticaria.

Immune system disorders: hypersensitivity reactions (including anaphylaxis and angioedema).

## 7 DRUG INTERACTIONS

The concomitant administration of Exjade and aluminum-containing antacid preparations has not been formally studied. Although deferasirox has a lower affinity for aluminum than for iron, do not administer Exjade with aluminum-containing antacid preparations.

In healthy volunteers, the concomitant administration of Exjade and midazolam (a CYP3A4 probe substrate) resulted in a decrease of midazolam peak concentration by 23 % and exposure by 17%. In the clinical setting, this effect may be more pronounced. Therefore, due to a possible decrease in CYP3A4 substrate concentration and potential loss of effectiveness, use caution when deferasirox is administered with drugs metabolized by CYP3A4 (e.g., cyclosporine, simvastatin, hormonal contraceptive agents).

In healthy volunteers, Exjade had no effect on the pharmacokinetics of digoxin. The effect of digoxin on Exjade pharmacokinetics has not been studied.

The concomitant administration of Exjade and vitamin C has not been formally studied. Doses of vitamin C up to 200 mg were allowed in clinical studies without negative consequences.

The interaction of Exjade with hydroxyurea has not been formally studied. No inhibition of deferasirox metabolism by hydroxyurea is expected based on the results of an *in-vitro* study.

Do not administer Exjade with other iron chelator therapies, as safety of such combinations has not been established.

The bioavailability (AUC) of deferasirox was variably increased when taken with a meal. Administer Exjade on an empty stomach 30 minutes before eating.

## 8 USE IN SPECIFIC POPULATIONS

### 8.1 Pregnancy

#### Pregnancy Category B

Reproduction studies have been performed in pregnant rats at oral doses up to 100 mg/kg per day (about 0.8 times the recommended human oral dose based on body surface area) and in pregnant rabbits at oral doses up to 50 mg/kg per day (about 0.8 times the recommended human oral dose based on body surface area). These studies have revealed no evidence of impaired fertility or harm to the fetus due to deferasirox. There are, however, no adequate and well-controlled studies in pregnant women. Because animal reproduction studies are not always predictive of human response, use deferasirox during pregnancy only if clearly needed.

### 8.3 Nursing Mothers

It is not known whether deferasirox is excreted in human milk. Deferasirox and its metabolites were excreted in breast milk of rats following a 10 mg/kg dose (about 0.08 times the recommended human oral dose based on body surface area). Because many drugs are excreted in human milk, exercise caution when using deferasirox in a nursing woman.

### 8.4 Pediatric Use

Of the 700 patients who received Exjade during clinical studies, 292 were pediatric patients 2 - <16 years of age with various congenital and acquired anemias, including 52 patients age 2 - <6 years, 121 patients age 6 - <12 years and 119 patients age 12 - <16 years. 70% of these patients had  $\beta$ -thalassemia. Children between the ages of 2 - <6 years have a systemic exposure to Exjade approximately 50% of that of adults [See *Clinical Pharmacology (12.3)*]. However, the safety and efficacy of Exjade in pediatric patients was similar to that of adult patients, and younger pediatric patients responded similarly to older pediatric

patients. The recommended starting dose and dosing modification are the same for children and adults [See *Clinical Studies (14)*, *Indications and Usage (1)*, and *Dosage and Administration (2.1)*].

During the 1-year study, the growth and development were within normal limits.

### 8.5 Geriatric Use

Exjade clinical studies did not include sufficient numbers of subjects age 65 and over to determine whether they respond differently, or have a different adverse event profile, from younger subjects. Thirty patients  $\geq 65$  years of age were included in clinical studies of Exjade. The majority of these patients had myelodysplastic syndrome (MDS) (n=27). In general, use caution in elderly patients due to the greater frequency of decreased hepatic, renal, or cardiac function, and of concomitant disease or other drug therapy.

### 8.6 Renal Impairment

Exjade has not been studied in patients with renal impairment.

### 8.7 Hepatic Impairment

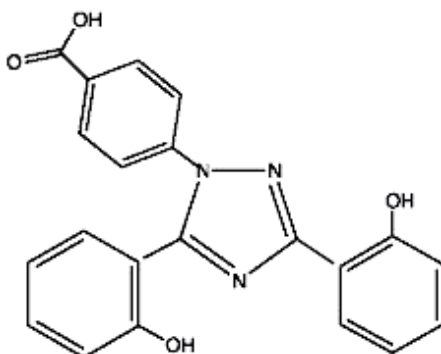
Exjade has not been studied in patients with hepatic impairment.

## 10 OVERDOSAGE

Cases of overdose (2-3 times the prescribed dose for several weeks) have been reported. In one case, this resulted in hepatitis which resolved without long-term consequences after a dose interruption. Single doses up to 80 mg/kg/day in iron overloaded  $\beta$ -thalassemic patients have been tolerated with nausea and diarrhea noted. In healthy volunteers, single doses of up to 40 mg/kg/day were tolerated. There is no specific antidote for Exjade. In case of overdose, induce vomiting and employ gastric lavage.

## 11 DESCRIPTION

Exjade (deferasirox) is an iron chelating agent. Exjade tablets for oral suspension contain 125 mg, 250 mg, or 500 mg deferasirox. Deferasirox is designated chemically as 4-[3,5-Bis (2-hydroxyphenyl)-1H-1,2,4-triazol-1-yl]-benzoic acid and its structural formula is



Deferasirox is a white to slightly yellow powder. Its molecular formula is  $C_{21}H_{15}N_3O_4$  and its molecular weight is 373.4.

*Inactive Ingredients:* Lactose monohydrate (NF), crospovidone (NF), povidone (K30) (NF), sodium lauryl sulphate (NF), microcrystalline cellulose (NF), silicon dioxide (NF), and magnesium stearate (NF).

## 12 CLINICAL PHARMACOLOGY

### 12.1 Mechanism of Action

Exjade (deferasirox) is an orally active chelator that is selective for iron (as  $\text{Fe}^{3+}$ ). It is a tridentate ligand that binds iron with high affinity in a 2:1 ratio. Although deferasirox has very low affinity for zinc and copper there are variable decreases in the serum concentration of these trace metals after the administration of deferasirox. The clinical significance of these decreases is uncertain.

### 12.2 Pharmacodynamics

Pharmacodynamic effects tested in an iron balance metabolic study showed that deferasirox (10, 20 and 40 mg/kg per day) was able to induce a mean net iron excretion (0.119, 0.329 and 0.445 mg Fe/kg body weight per day, respectively) within the clinically relevant range (0.1-0.5 mg/kg per day). Iron excretion was predominantly fecal.

### 12.3 Pharmacokinetics

#### Absorption

Exjade is absorbed following oral administration with median times to maximum plasma concentration ( $t_{\text{max}}$ ) of about 1.5-4 hours. The  $C_{\text{max}}$  and AUC of deferasirox increase approximately linearly with dose after both single administration and under steady-state conditions. Exposure to deferasirox increased by an accumulation factor of 1.3-2.3 after multiple doses. The absolute bioavailability (AUC) of deferasirox tablets for oral suspension is 70% compared to an intravenous dose.

#### Distribution

Deferasirox is highly (~99%) protein bound almost exclusively to serum albumin. The percentage of deferasirox confined to the blood cells was 5% in humans. The volume of distribution at steady state ( $V_{\text{ss}}$ ) of deferasirox is  $14.37 \pm 2.69$  L in adults.

#### Metabolism

Glucuronidation is the main metabolic pathway for deferasirox, with subsequent biliary excretion. Deconjugation of glucuronidates in the intestine and subsequent reabsorption (enterohepatic recycling) is likely to occur. Deferasirox is mainly glucuronidated by UGT1A1 and to a lesser extent UGT1A3. CYP450-catalyzed (oxidative) metabolism of deferasirox appears to be minor in humans (about 8%).

#### Excretion

Deferasirox and metabolites are primarily (84% of the dose) excreted in the feces. Renal excretion of deferasirox and metabolites is minimal (8% of the administered dose). The mean elimination half-life ( $t_{1/2}$ ) ranged from 8-16 hours following oral administration.

#### Pharmacokinetics in Special Populations

**Pediatric:** Following oral administration of single or multiple doses, systemic exposure of adolescents and children to deferasirox was less than in adult patients. In children <6 years of age, systemic exposure was about 50% lower than in adults.

**Geriatric:** The pharmacokinetics of deferasirox have not been studied in geriatric patients (65 years of age or older).

**Gender:** Females have a moderately lower apparent clearance (by 17.5%) for deferasirox compared to males.

**Renal Insufficiency:** Deferasirox is minimally (8%) excreted via the kidney.

**Hepatic Impairment:** Deferasirox is principally excreted by glucuronidation and is minimally (8%) metabolized by oxidative cytochrome P450 enzymes. Exjade treatment has been initiated in patients with baseline liver transaminase levels up to 5 times the upper limit of the normal range. The pharmacokinetics of deferasirox were not influenced by such transaminase levels.

## 12.4 QT Prolongation

The effect of 20 and 40 mg/kg per day of deferasirox on the QT interval was evaluated in a single-dose, double-blind, randomized, placebo- and active-controlled (moxifloxacin 400 mg), parallel group study in 182 healthy male and female volunteers age 18-65 years. No evidence of prolongation of the QTc interval was observed in this study.

## 13 NONCLINICAL TOXICOLOGY

### 13.1 Carcinogenesis, Mutagenesis, Impairment of Fertility

A 104-week oral carcinogenicity study in Wistar rats showed no evidence of carcinogenicity from deferasirox at doses up to 60 mg/kg per day (about 0.48 times the recommended human oral dose based on body surface area). A 26-week oral carcinogenicity study in p53 (+/-) transgenic mice has shown no evidence of carcinogenicity from deferasirox at doses up to 200 mg/kg per day (about 0.81 times the recommended human oral dose based on body surface area) in males and 300 mg/kg per day (about 1.21 times the recommended human oral dose based on body surface area) in females.

Deferasirox was negative in the Ames test and chromosome aberration test with human peripheral blood lymphocytes. It was positive in 1 of 3 *in-vivo* oral rat micronucleus tests.

Deferasirox at oral doses up to 75 mg/kg per day (about 0.6 times the recommended human oral dose based on body surface area) was found to have no adverse effect on fertility and reproductive performance of male and female rats.

## 14 CLINICAL STUDIES

The primary efficacy study, Study 1, was a multicenter, open-label, randomized, active comparator control study to compare Exjade (deferasirox) and deferoxamine in patients with  $\beta$ -thalassemia and transfusional hemosiderosis. Patients  $\geq 2$  years of age were randomized in a 1:1 ratio to receive either oral Exjade at starting doses of 5, 10, 20 or 30 mg/kg once daily or subcutaneous Desferal (deferoxamine) at starting doses of 20 to 60 mg/kg for at least 5 days per week based on LIC (liver iron concentration) at baseline (2-3, >3-7, >7-14 and >14 mg Fe/g dry weight). Patients randomized to deferoxamine who had LIC values <7 mg Fe/g dry weight were permitted to continue on their prior deferoxamine dose, even though the dose may have been higher than specified in the protocol.

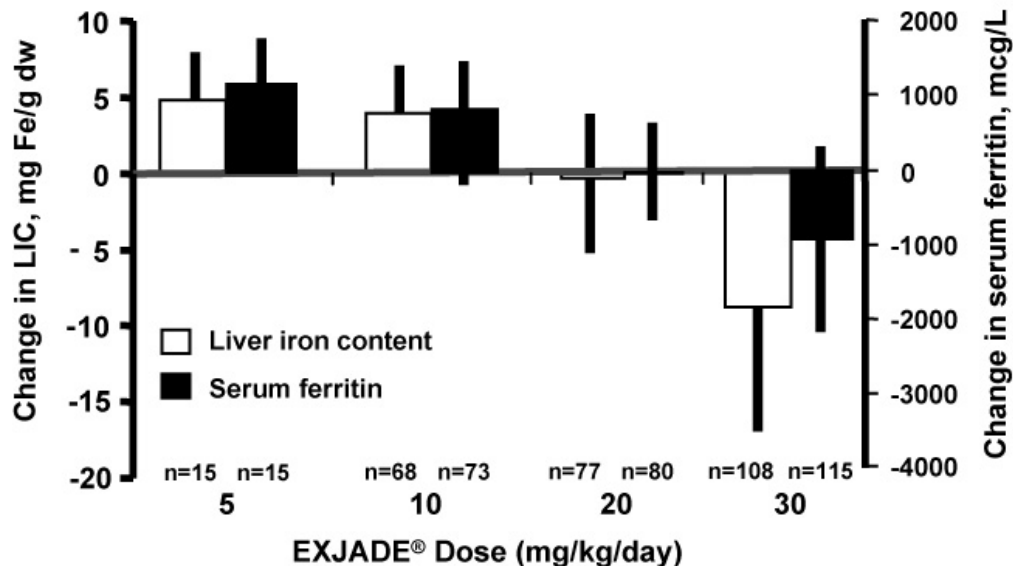
Patients were to have a liver biopsy at baseline and end of study (after 12 months) for LIC. The primary efficacy endpoint was defined as a reduction in LIC of  $\geq 3$  mg Fe/g dry weight for baseline values  $\geq 10$  mg Fe/g dry weight, reduction of baseline values between 7 and <10 to <7 mg Fe/g dry weight, or maintenance or reduction for baseline values <7 mg Fe/g dry weight.

A total of 586 patients were randomized and treated, 296 with Exjade and 290 with deferoxamine. The mean age was 17.1 years (range, 2-53 years); 52% were females and 88% were Caucasian. The primary efficacy population consisted of 553 patients (Exjade n=276; deferoxamine n=277) who had LIC evaluated at baseline and 12 months or discontinued due to an adverse event. The percentage of patients achieving the primary endpoint was 52.9% for Exjade and 66.4% for deferoxamine. The relative efficacy of Exjade to deferoxamine cannot be determined from this study.

In patients who had an LIC at baseline and at end of study, the mean change in LIC was -2.4 mg Fe/g dry weight in patients treated with Exjade and -2.9 mg Fe/g dry weight in patients treated with deferoxamine.

Reduction of LIC and serum ferritin was observed with Exjade doses of 20 to 30 mg/kg per day. Exjade doses below 20 mg/kg per day failed to provide consistent lowering of LIC and serum ferritin levels (Figure 1). Therefore, a starting dose of 20 mg/kg per day is recommended [See Dosage and Administration (2.1)].

**Figure 1. Changes in Liver Iron Concentration and Serum Ferritin Following EXJADE (5-30 mg/kg per day) in Study 1**



Study 2 was an open-label, noncomparative trial of efficacy and safety of Exjade given for 1 year to patients with chronic anemias and transfusional hemosiderosis. Similar to Study 1, patients received 5, 10, 20, or 30 mg/kg per day of Exjade based on baseline LIC.

A total of 184 patients were treated in this study: 85 patients with  $\beta$ -thalassemia and 99 patients with other congenital or acquired anemias (myelodysplastic syndromes, n=47; Diamond-Blackfan syndrome, n=30; other, n=22). 19% of patients were <16 years of age and 16% were  $\geq$ 65 years of age. There was a reduction in the absolute LIC from baseline to end of study (-4.2 mg Fe/g dry weight).

Study 3 was a multicenter, open-label, randomized trial of the safety and efficacy of Exjade relative to deferoxamine given for 1 year in patients with sickle cell disease and transfusional hemosiderosis. Patients were randomized to Exjade at doses of 5, 10, 20, or 30 mg/kg per day or subcutaneous deferoxamine at doses of 20-60 mg/kg per day for 5 days per week according to baseline LIC.

A total of 195 patients were treated in this study: 132 with Exjade and 63 with deferoxamine. 44% of patients were <16 years of age and 91% were Black. At end of study, the mean change in LIC (as measured by magnetic susceptibility by a superconducting quantum interference device) in the per protocol-1 (PP-1) population, which consisted of patients who had at least one postbaseline LIC assessment, was -1.3 mg Fe/g dry weight for patients receiving Exjade (n=113) and -0.7 mg Fe/g dry weight for patients receiving deferoxamine (n=54).

## 16 HOW SUPPLIED/STORAGE AND HANDLING

Exjade is provided as 125 mg, 250 mg, and 500 mg tablets for oral suspension.

### 125 mg

Off-white, round, flat tablet with beveled edge and imprinted with “J” and “125” on one side and “NVR” on the other.

Bottles of 30 tablets.....(NDC 0078-0468-15)

**250 mg**

Off-white, round, flat tablet with beveled edge and imprinted with “J” and “250” on one side and “NVR” on the other.

Bottles of 30 tablets.....(NDC 0078-0469-15)

**500 mg**

Off-white, round, flat tablet with beveled edge and imprinted with “J” and “500” on one side and “NVR” on the other.

Bottles of 30 tablets.....(NDC 0078-0470-15)

Store Exjade tablets at 25°C (77°F); excursions are permitted to 15–30°C (59–86°F) [see USP Controlled Room Temperature]. Protect from moisture.

**17 PATIENT COUNSELING INFORMATION**

**17.1 Dosing and Administration**

Advise patients to take Exjade once daily on an empty stomach at least 30 minutes prior to food, preferably at the same time every day. Instruct patients to completely disperse the tablets in water, orange juice, or apple juice, and drink the resulting suspension immediately. After the suspension has been swallowed, resuspend any residue in a small volume of the liquid and swallow. Advise patients not to chew or swallow the tablets whole.

**17.2 Other Information**

Advise patients who experience diarrhea or vomiting to maintain adequate hydration.

Caution patients not to take aluminum-containing antacids and Exjade simultaneously.

Because auditory and ocular disturbances have been reported with Exjade, conduct auditory testing and ophthalmic testing before starting Exjade treatment and thereafter at regular intervals [See *Warnings and Precautions* (5.5)].

Caution patients experiencing dizziness to avoid driving or operating machinery [See *Adverse Reactions* (6.1)].

Caution patients about the potential for the development of GI ulcers or bleeding when taking Exjade in combination with drugs that have ulcerogenic or hemorrhagic potential, such as NSAIDs, corticosteroids, oral bisphosphonates, or anticoagulants.

Caution patients about potential loss of effectiveness of drugs metabolized by CYP3A4 (e.g., cyclosporine, simvastatin, hormonal contraceptive agents) when Exjade is administered with these drugs.

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