

SUMMARY OF PRODUCT CHARACTERISTICS

1. NAME OF THE MEDICINAL PRODUCT

Miglustat Bluefish 100 mg hard capsules

2. QUALITATIVE AND QUANTITATIVE COMPOSITION

Each hard capsule contains 100 mg miglustat.

For the full list of excipients, see section 6.1.

3. PHARMACEUTICAL FORM

Capsule, hard.

White hard gelatin capsules, size 4, filled with a homogenous, white to off-white granulate.

The average length of the capsules is 14.3 mm.

4. CLINICAL PARTICULARS

4.1 Therapeutic indications

Miglustat Bluefish is indicated for the oral treatment of adult patients with mild to moderate type 1 Gaucher disease. Miglustat Bluefish may be used only in the treatment of patients for whom enzyme replacement therapy is unsuitable (see sections 4.4 and 5.1).

Miglustat Bluefish is indicated for the treatment of progressive neurological manifestations in adult patients and paediatric patients with Niemann-Pick type C disease (see sections 4.4, and 5.1).

4.2 Posology and method of administration

Therapy should be directed by physicians who are knowledgeable in the management of Gaucher disease or Niemann-Pick type C disease, as appropriate.

Posology

Dosage in type 1 Gaucher disease

Adult

The recommended starting dose for the treatment of adult patients with type 1 Gaucher disease is 100 mg three times a day.

Temporary dose reduction to 100 mg once or twice a day may be necessary in some patients because of diarrhoea.

Paediatric population

The efficacy of Miglustat Bluefish in children and adolescents aged 0-17 years with type 1 Gaucher disease has not been established. No data are available.

Dosage in Niemann-Pick type C disease

Adult

The recommended dose for the treatment of adult patients with Niemann-Pick type C disease is 200 mg three times a day.

Paediatric population

The recommended dose for the treatment of adolescent patients (12 years of age and above) with Niemann-Pick type C disease is 200 mg three times a day.

Dosing in patients under the age of 12 years should be adjusted on the basis of body surface area as illustrated below:

Body surface area (m ²)	Recommended dose
> 1.25	200 mg three times a day
> 0.88 - 1.25	200 mg twice a day
> 0.73 - 0.88	100 mg three times a day
> 0.47 - 0.73	100 mg twice a day
≤ 0.47	100 mg once a day

Temporary dose reduction may be necessary in some patients because of diarrhoea.

The benefit to the patient of treatment with Miglustat Bluefish should be evaluated on a regular basis (see section 4.4).

There is limited experience with the use of Miglustat Bluefish in Niemann-Pick type C disease patients under the age of 4 years.

Special populations

Elderly

There is no experience with the use of Miglustat Bluefish in patients over the age of 70.

Renal impairment

Pharmacokinetic data indicate increased systemic exposure to miglustat in patients with renal impairment. In patients with an adjusted creatinine clearance of 50–70 ml/min/1.73 m², administration should commence at a dose of 100 mg twice daily in patients with type 1 Gaucher disease and at a dose of 200 mg twice daily (adjusted for body surface area in patients below the age of 12) in patients with Niemann-Pick type C disease.

In patients with an adjusted creatinine clearance of 30–50 ml/min/1.73 m², administration should commence at a dose of 100 mg once daily in patients with type 1 Gaucher disease and at a dose of 100 mg twice daily (adjusted for body surface area in patients below the age of 12) in patients with Niemann-Pick type C disease. Use in patients with severe renal impairment (creatinine clearance < 30 ml/min/1.73 m²) is not recommended (see sections 4.4 and 5.2).

Hepatic impairment

Miglustat Bluefish has not been evaluated in patients with hepatic impairment.

Method of administration

Miglustat Bluefish can be taken with or without food.

4.3 Contraindications

Hypersensitivity to the active substance or to any of the excipients listed in section 6.1.

4.4 Special warnings and precautions for use

Tremor

Approximately 37% of patients in clinical trials in type 1 Gaucher disease, and 58% of patients in a clinical trial in Niemann-Pick type C disease reported tremor on treatment. In type 1 Gaucher disease, these tremors were described as an exaggerated physiological tremor of the hands. Tremor usually began within the first month of treatment, and in many cases resolved after 1 to 3 months of continued treatment. Dose reduction may ameliorate the tremor, usually within days, but discontinuation of treatment may sometimes be required.

Gastrointestinal disturbances

Gastrointestinal events, mainly diarrhoea, have been observed in more than 80% of patients, either at the outset of treatment or intermittently during treatment (see section 4.8). The mechanism is most likely inhibition of intestinal disaccharidases such as sucrase-isomaltase in the gastrointestinal tract leading to reduced absorption of dietary disaccharides. In clinical practice, miglustat-induced gastrointestinal events have been observed to respond to individualised diet modification (for example reduction of sucrose, lactose and other carbohydrate intake), to taking miglustat between meals, and/or to anti-diarrhoeal medicinal products such as loperamide. In some patients, temporary dose reduction may be necessary. Patients with chronic diarrhoea or other persistent gastrointestinal events that do not respond to these interventions should be investigated according to clinical practice. Miglustat Bluefish has not been evaluated in patients with a history of significant gastrointestinal disease, including inflammatory bowel disease.

Effects on spermatogenesis

Reliable contraceptive methods should be maintained while male patients are taking Miglustat Bluefish and for 3 months following discontinuation. Miglustat Bluefish should be discontinued and reliable contraception be used for the next 3 months before attempting to conceive (see sections 4.6 and 5.3). Studies in the rat have shown that miglustat adversely affects spermatogenesis and sperm parameters, and reduces fertility (see sections 4.6 and 5.3).

Special populations

Due to limited experience, Miglustat Bluefish should be used with caution in patients with renal or hepatic impairment. There is a close relationship between renal function and clearance of miglustat, and exposure to miglustat is markedly increased in patients with severe renal impairment (see section 5.2). At present, there is insufficient clinical experience in these patients to provide dosing recommendations. Use of Miglustat Bluefish in patients with severe renal impairment (creatinine clearance < 30 ml/min/1.73 m²) is not recommended.

Type 1 Gaucher disease

Although no direct comparisons with Enzyme Replacement Therapy (ERT) have been performed in treatment-naïve patients with type 1 Gaucher disease, there is no evidence of Miglustat Bluefish having an efficacy or safety advantage over ERT. ERT is the standard of care for patients who require treatment for type 1 Gaucher disease (see section 5.1). The efficacy and safety of Miglustat Bluefish has not been specifically evaluated in patients with severe Gaucher disease.

Regular monitoring of vitamin B₁₂ level is recommended because of the high prevalence of vitamin B₁₂ deficiency in patients with type 1 Gaucher disease.

Cases of peripheral neuropathy have been reported in patients treated with miglustat with or without concurrent conditions such as vitamin B₁₂ deficiency and monoclonal gammopathy. Peripheral neuropathy seems to be more common in patients with type 1 Gaucher disease compared to the general population. All patients should undergo baseline and repeat neurological evaluation.

In patients with type 1 Gaucher disease, monitoring of platelet counts is recommended. Mild reductions in platelet counts without association with bleeding were observed in patients with type 1 Gaucher disease who were switched from ERT to miglustat.

Niemann-Pick type C disease

The benefit of treatment with Miglustat Bluefish for neurological manifestations in patients with Niemann-Pick type C disease should be evaluated on a regular basis, e.g. every 6 months; continuation of therapy should be re-appraised after at least 1 year of treatment with Miglustat Bluefish.

Mild reductions in platelet counts without association to bleeding were observed in some patients with Niemann-Pick type C disease treated with miglustat. In patients included in the clinical trial, 40%-50% of patients had platelet counts below the lower limit of normal at baseline. Monitoring of platelet counts is recommended in these patients.

Paediatric population

Reduced growth has been reported in some paediatric patients with Niemann-Pick type C disease in the early phase of treatment with miglustat where the initial reduced weight gain may be accompanied or followed by reduced height gain. Growth should be monitored in paediatric and adolescent patients during treatment with Miglustat Bluefish; the benefit/risk balance should be re-assessed on an individual basis for continuation of therapy.

Miglustat Bluefish contains sodium:

This medicinal product contains less than 1 mmol sodium (23 mg) per hard capsule, that is to say essentially 'sodium-free'

4.5 Interaction with other medicinal products and other forms of interaction

Limited data suggest that co-administration of miglustat and enzyme replacement with imiglucerase in patients with type 1 Gaucher disease may result in decreased exposure to miglustat (approximate reductions of 22% in C_{max} and 14% in AUC were observed in a small parallel-group study). This study also indicated that miglustat has no or limited effect on the pharmacokinetics of imiglucerase.

4.6 Fertility, pregnancy and lactation

Pregnancy

There are no adequate data from the use of miglustat in pregnant women. Studies in animals have shown maternal and embryo-foetal toxicity, including decreased embryo-foetal survival (see section 5.3). The potential risk for humans is unknown. Miglustat crosses the placenta and should not be used during pregnancy.

Breast-feeding

It is not known if miglustat is secreted in breast milk. Miglustat Bluefish should not be taken during breast-feeding.

Fertility

Studies in the rat have shown that miglustat adversely affects sperm parameters (motility and morphology) thereby reducing fertility (see sections 4.4 and 5.3).

Contraception in males and females

Contraceptive measures should be used by women of child-bearing potential. Reliable contraceptive methods should be maintained while male patients are taking Miglustat Bluefish and for 3 months following discontinuation (see sections 4.4 and 5.3).

4.7 Effects on ability to drive and use machines

Miglustat Bluefish has negligible influence on the ability to drive and use machines. Dizziness has been reported as a common adverse reaction, and patients suffering from dizziness should not drive or use machines.

4.8 Undesirable effects

Summary of the safety profile

The most common adverse reactions reported in clinical studies with miglustat were diarrhoea, flatulence, abdominal pain, weight loss and tremor (see section 4.4). The most common serious adverse reaction reported with miglustat treatment in clinical studies was peripheral neuropathy (see section 4.4).

In 11 clinical trials in different indications 247 patients were treated with miglustat at dosages of 50-200 mg t.i.d. for an average duration of 2.1 years. Of these patients, 132 had type 1 Gaucher disease, and 40 had Niemann-Pick type C disease. Adverse reactions were generally of mild to moderate severity and occurred with similar frequency across indications and dosages tested.

Tabulated list of adverse reactions

Adverse reactions from clinical trials and spontaneous reporting, occurring in > 1% of patients, are listed below by system organ class and frequency (very common: $\geq 1/10$, common: $\geq 1/100$ to $< 1/10$, uncommon: $\geq 1/1,000$ to $< 1/100$, rare: $\geq 1/10,000$ to $< 1/1,000$, very rare: $< 1/10,000$). Within each frequency grouping, adverse reactions are presented in order of decreasing seriousness.

Blood and lymphatic disorders

Common: Thrombocytopenia

Metabolism and nutrition disorders

Very common: Weight loss, decreased appetite

Psychiatric disorders

Common: Depression, insomnia, libido decreased

Nervous system disorders

Very common: Tremor

Common: Peripheral neuropathy, ataxia, amnesia, paraesthesia, hypoaesthesia, headache, dizziness

Gastrointestinal disorders

Very common: Diarrhoea, flatulence, abdominal pain

Common: Nausea, vomiting, abdominal distension/discomfort, constipation, dyspepsia

Musculoskeletal and connective tissue disorders

Common: Muscle spasms, muscle weakness

General disorders and administration site conditions

Common: Fatigue, asthenia, chills and malaise

Investigations

Common: Nerve conduction studies abnormal

Description of selected adverse reactions

Weight loss has been reported in 55% of patients. The greatest prevalence was observed between 6 and 12 months.

Miglustat has been studied in indications where certain events reported as adverse reactions, such as neurological and neuropsychological symptoms/signs, cognitive dysfunction and thrombocytopenia could also be due to the underlying conditions.

Reporting of suspected adverse reactions

Reporting suspected adverse reactions after authorisation of the medicinal product is important. It allows continued monitoring of the benefit/risk balance of the medicinal product. Healthcare professionals are asked to report any suspected adverse reactions via the national reporting system listed in

[To be completed nationally]

4.9 Overdose

Symptoms

No acute symptoms of overdose have been identified. Miglustat has been administered at doses of up to 3000 mg/day for up to six months in HIV positive patients during clinical trials. Adverse events observed included granulocytopenia, dizziness and paraesthesia. Leukopenia and neutropenia have also been observed in a similar group of patients receiving 800 mg/day or higher dose.

Management

In case of overdose general medical care is recommended.

5. PHARMACOLOGICAL PROPERTIES

5.1 Pharmacodynamic properties

Pharmacotherapeutic group: Other alimentary tract and metabolism products, ATC code: A16AX06

Type 1 Gaucher disease

Gaucher disease is an inherited metabolic disorder caused by a failure to degrade glucosylceramide resulting in lysosomal storage of this material and widespread pathology. Miglustat is an inhibitor of glucosylceramide synthase, the enzyme responsible for the first step in the synthesis of most glycolipids. *In vitro*, glucosylceramide synthase is inhibited by miglustat with an IC_{50} of 20-37 μ M. In addition, inhibitory action on a non-lysosomal glycosylceramidase has been demonstrated experimentally *in vitro*. The inhibitory action on glucosylceramide synthase forms the rationale for substrate reduction therapy in Gaucher disease.

The pivotal trial of miglustat was conducted in patients unable or unwilling to receive ERT. Reasons for not receiving ERT included the burden of intravenous infusions and difficulties in venous access. Twenty-eight patients with mild to moderate type 1 Gaucher disease were enrolled in this 12-month non-comparative study, and 22 patients completed the study. At 12 months, there was a mean reduction in liver organ volume of 12.1% and a mean reduction in spleen volume of 19.0%. A mean increase in haemoglobin concentration of 0.26 g/dl and a mean platelet count increase of $8.29 \times 10^9/l$ were observed. Eighteen patients then continued to receive miglustat under an optional extended treatment protocol. Clinical benefit has been assessed at 24 and 36 months in 13 patients. After 3 years of continuous miglustat treatment, mean reductions in liver and spleen organ volume were 17.5% and 29.6%, respectively. There was a mean increase of $22.2 \times 10^9/l$ in platelet count, and a mean increase of 0.95 g/dl in haemoglobin concentration.

A second open, controlled study randomised 36 patients who had received a minimum of 2 years of treatment with ERT, into three treatment groups: continuation with imiglucerase, imiglucerase in combination with miglustat, or switch to miglustat. This study was conducted over a 6-month randomised comparison period followed by 18 months extension where all patients received miglustat monotherapy. In the first 6 months in patients who were switched to miglustat, liver and spleen organ volumes and haemoglobin levels were unchanged. In some patients there were reductions in platelet count and increases in chitotriosidase activity indicating that miglustat monotherapy may not maintain the same control of disease activity in all patients. 29 patients continued in the extension period. When compared to the measurements at 6 months, disease control was unchanged after 18 and 24 months of miglustat monotherapy (20 and 6 patients, respectively). No patient showed rapid deterioration of type 1 Gaucher disease following the switch to miglustat monotherapy.

A total daily dose of 300 mg miglustat administered in three divided doses was used in the above two studies. An additional monotherapy study was performed in 18 patients at a total daily dose of 150 mg, and results indicate reduced efficacy compared to a total daily dose of 300 mg.

An open-label, non comparative, 2-year study enrolled 42 patients with type 1 Gaucher disease, who had received a minimum of 3 years of ERT and who fulfilled criteria of stable disease for at least 2 years. The patients were switched to monotherapy with miglustat 100 mg t.i.d. Liver volume (primary efficacy variable) was unchanged from baseline to the end of treatment. Six patients had miglustat treatment prematurely discontinued for potential disease worsening, as defined in the study. Thirteen patients discontinued treatment due to an adverse event. Small mean reductions in haemoglobin [-0.95 g/dL (95% CI: -1.38 , -0.53)] and platelet count [$-44.1 \times 10^9/L$ (95% CI: -57.6 , -30.7)] were observed between baseline and end of study. Twenty-one patients completed 24 months of miglustat treatment. Of these, 18 patients at baseline were within established therapeutic goals for liver and spleen volume, haemoglobin levels, and platelet counts, and 16 patients remained within all these therapeutic goals at Month 24.

Bone manifestations of type 1 Gaucher disease were evaluated in 3 open-label clinical studies in patients treated with miglustat 100 mg t.i.d. for up to 2 years ($n = 72$). In a pooled analysis of uncontrolled data, bone mineral density Z-scores at the lumbar spine and femoral neck increased by more than 0.1 units from baseline in 27 (57%) and 28 (65%) of the patients with longitudinal bone density measurements. There were no events of bone crisis, avascular necrosis or fracture during the treatment period.

Niemann-Pick type C disease

Niemann-Pick type C disease is a very rare, invariably progressive and eventually fatal neurodegenerative disorder characterised by impaired intracellular lipid trafficking. The neurological manifestations are considered secondary to the abnormal accumulation of glycosphingolipids in neuronal and glial cells.

Data to support safety and efficacy of miglustat in Niemann-Pick type C disease come from a prospective open-label clinical trial and a retrospective survey. The clinical trial included 29 adult and juvenile patients in a 12-month controlled period, followed by extension therapy for an average total duration of 3.9 years and up to 5.6 years. In addition 12 paediatric patients were enrolled in an uncontrolled substudy for an overall average duration of 3.1 years and up to 4.4 years. Among the 41 patients enrolled in the trial 14 patients were treated with miglustat for more than 3 years. The survey included a case series of 66 patients treated with miglustat outside of the clinical trial for a mean duration of 1.5 years. Both data sets included paediatric, adolescent and adult patients with an age range of 1 year to 43 years. The usual dose of miglustat in adult patients was 200 mg t.i.d., and was adjusted according to body surface area in paediatric patients.

Overall the data show that treatment with miglustat can reduce the progression of clinically relevant neurological symptoms in patients with Niemann-Pick type C disease.

The benefit of treatment with Miglustat Bluefish for neurological manifestations in patients with Niemann-Pick type C disease should be evaluated on a regular basis, e.g. every 6 months; continuation of therapy should be re-appraised after at least 1 year of treatment with Miglustat Bluefish, (see section 4.4).

5.2 Pharmacokinetic properties

Pharmacokinetic parameters of miglustat were assessed in healthy subjects, in a small number of patients with type 1 Gaucher disease, Fabry disease, HIV-infected patients, and in adults, adolescents and children with Niemann-Pick type C disease or type 3 Gaucher disease.

The kinetics of miglustat appear to be dose linear and time independent. In healthy subjects miglustat is rapidly absorbed. Maximum plasma concentrations are reached about 2 hours after dose. Absolute bioavailability has not been determined. Concomitant administration of food decreases the rate of absorption ($C_{\max}$ was decreased by 36% and $t_{\max}$ delayed 2 hours), but has no statistically significant effect on the extent of absorption of miglustat (AUC decreased by 14%).

The apparent volume of distribution of miglustat is 83 l. Miglustat does not bind to plasma proteins. Miglustat is mainly eliminated by renal excretion, with urinary recovery of unchanged drug accounting for 70-80% of the dose. Apparent oral clearance (CL/F) is 230 ± 39 ml/min. The average half-life is 6–7 hours.

Following administration of a single dose of 100 mg ^{14}C -miglustat to healthy volunteers, 83% of the radioactivity was recovered in urine and 12% in faeces. Several metabolites were identified in urine and faeces. The most abundant metabolite in urine was miglustat glucuronide accounting for 5% of the dose. The terminal half-life of radioactivity in plasma was 150 h suggesting the presence of one or more metabolites with very long half-life. The metabolite accounting for this has not been identified, but may accumulate and reach concentrations exceeding those of miglustat at steady state.

The pharmacokinetics of miglustat is similar in adult type 1 Gaucher disease patients and Niemann-Pick type C disease patients when compared to healthy subjects.

Paediatric population

Pharmacokinetic data were obtained in paediatric patients with type 3 Gaucher disease aged 3 to 15 years, and patients with Niemann-Pick type C disease aged 5–16 years. Dosing in children at 200 mg t.i.d. adjusted for body surface area resulted in $C_{\max}$ and AUC_{τ} values which were approximately two-fold those attained after 100 mg t.i.d. in type 1 Gaucher disease patients, consistent with the dose-linear pharmacokinetics of miglustat. At steady state, the concentration of miglustat in cerebrospinal fluid of six type 3 Gaucher disease patients was 31.4–67.2% of that in plasma.

Limited data in patients with Fabry disease and impaired renal function showed that CL/F decreases with decreasing renal function. While the numbers of subjects with mild and moderate renal impairment were very small, the data suggest an approximate decrease in CL/F of 40% and 60% respectively, in mild and moderate renal impairment (see section 4.2). Data in severe renal impairment are limited to two patients with creatinine clearance in the range 18 – 29 ml/min and cannot be extrapolated below this range. These data suggest a decrease in CL/F by at least 70% in patients with severe renal impairment. Over the range of data available, no significant relationships or trends were noted between miglustat pharmacokinetic parameters and demographic variables (age, BMI, gender or race).

There are no pharmacokinetic data available in patients with liver impairment or in the elderly (> 70 years).

5.3 Preclinical safety data

The main effects common to all species were weight loss and diarrhoea, and, at higher doses, damage to the gastrointestinal mucosa (erosions and ulceration). Further effects seen in animals at doses that result in exposure levels similar to or moderately higher than the clinical exposure level were: changes in lymphoid organs in all species tested, transaminase changes, vacuolation of thyroid and pancreas, cataracts, nephropathy and myocardial changes in rats. These findings were considered to be secondary to debilitation.

Administration of miglustat to male and female Sprague-Dawley rats by oral gavage for 2 years at dose levels of 30, 60 and 180 mg/kg/day resulted in an increased incidence of testicular interstitial cell (Leydig

cell) hyperplasia and adenomas in male rats at all dose levels. The systemic exposure at the lowest dose was below or comparable to that observed in humans (based on $AUC_{0-\infty}$) at the recommended human dose. A No Observed Effect Level (NOEL) was not established and the effect was not dose dependent. There was no drug-related increase in tumour incidence in male or female rats in any other organ. Mechanistic studies revealed a rat specific mechanism which is considered to be of low relevance for humans.

Administration of miglustat to male and female CD1 mice by oral gavage at dose levels of 210, 420 and 840/500 mg/kg/day (dose reduction after half a year) for 2 years resulted in an increased incidence of inflammatory and hyperplastic lesions in the large intestine in both sexes. Based on mg/kg/day and corrected for differences in faecal excretion, the doses corresponded to 8, 16 and 33/19 times the highest recommended human dose (200 mg t.i.d.). Carcinomas in the large intestine occurred occasionally at all doses with a statistically significant increase in the high dose group. A relevance of these findings to humans cannot be excluded. There was no drug-related increase in tumour incidence in any other organ.

Miglustat did not show any potential for mutagenic or clastogenic effects in the standard battery of genotoxicity tests.

Repeated-dose toxicity studies in rats showed seminiferous tubule degeneration and atrophy. Other studies revealed changes in sperm parameters (sperm concentration, motility and morphology) consistent with an observed reduction in fertility. These effects occurred at dose levels adjusted for body surface area similar to those in patients, but showed reversibility. Miglustat decreased embryo/foetal survival in rats and rabbits. Prolonged parturition was reported, post-implantation losses were increased, and an increased incidence of vascular anomalies occurred in rabbits. These effects may be partly related to maternal toxicity.

Changes in lactation were observed in female rats in a 1-year study. The mechanism for this effect is unknown.

6. PHARMACEUTICAL PARTICULARS

6.1 List of excipients

Capsule contents

Sodium starch glycolate type A

Povidone

Magnesium stearate

Capsule shell

Titanium dioxide (E171)

Gelatin

6.2 Incompatibilities

Not applicable.

6.3 Shelf life

4 years

6.4 Special precautions for storage

This medicinal product does not require any special storage conditions.

6.5 Nature and contents of container

Miglustat Bluefish are white hard gelatin capsules.

Miglustat Bluefish is available in pack sizes of 84 hard capsules in perforated Aclar-Alu (PVC/PE/PCTFE-Alu) blisters.

Not all pack sizes may be marketed.

6.6 Special precautions for disposal and other handling

No special requirements for disposal.

7. MARKETING AUTHORISATION HOLDER

<To be completed nationally>

8. MARKETING AUTHORISATION NUMBER(S)

<To be completed nationally>

9. DATE OF FIRST AUTHORISATION/RENEWAL OF THE AUTHORISATION

{DD/MM/YYYY} <To be completed nationally>

10. DATE OF REVISION OF THE TEXT

2023-07-07