

PRODUCT MONOGRAPH

**PrLIPIDIL MICRO®
(fenofibrate, micronized formulation)**

Capsules 200 mg

Lipid Metabolism Regulator

Fournier Pharma Inc.
8401 Trans-Canada Highway
Saint-Laurent, Quebec
H4S 1Z1

Date of Preparation:
April 10, 1990

Date of Previous Revision:
November 7, 2007

Submission Control No.: 147053

Date of Revision:
July 15, 2011

® Lipidil Micro: Registered Trademark Fournier Industrie et Santé S.A. Dijon France; Licensed use by Fournier Pharma Inc., Saint-Laurent, Quebec, H4S 1Z1

PRODUCT MONOGRAPH

NAME OF DRUG

^{Pr}LIPIDIL MICRO[®]
(fenofibrate, micronized formulation)
capsules 200 mg

PHARMACOLOGICAL CLASSIFICATION

Lipid metabolism regulator

ACTIONS AND CLINICAL PHARMACOLOGY

LIPIDIL MICRO[®] (fenofibrate) lowers elevated serum lipids by decreasing the low density lipoprotein (LDL) fraction rich in cholesterol and the very low density lipoprotein (VLDL) fraction rich in triglycerides. In addition, fenofibrate increases the high density lipoprotein (HDL) cholesterol fraction.

Fenofibrate appears to have a greater depressant effect on the very low density lipoproteins (VLDL) than on the low density lipoproteins (LDL). Therapeutic doses of fenofibrate produce variable elevations of HDL cholesterol, a reduction in the content of the total low density lipoproteins cholesterol, and a substantial reduction in the triglyceride content of very low density lipoproteins.

The mechanism of action of fenofibrate has not been definitively established. Work carried out to date suggests that fenofibrate:

- enhances the liver elimination of cholesterol as bile salts;
- inhibits the biosynthesis of triglycerides and enhances the catabolism of VLDL by increasing the activity of lipoprotein lipase;
- has an inhibitory effect on the biosynthesis of cholesterol by modulating the activity of HMG-CoA reductase.

After oral administration with food, fenofibrate is rapidly hydrolysed to fenofibric acid, the active metabolite.

Fenofibrate's absorption is low and variable when the product is administered under fasting conditions. Fenofibrate's absorption is increased when the compound is given with food. In man it is mainly excreted through the kidney. Half-life is about 20 hours. In patients with severe renal failure, significant accumulation was observed with a large increase in half-life. Therefore, the dose of fenofibrate may need to be reduced, depending on the rate of creatinine clearance.

The long half-life of fenofibrate led Laboratoires Fournier to develop a once daily formulation. The micronized formulation of fenofibrate (LIPIDIL MICRO) offers in the order of 33% greater bioavailability than the non-micronized fenofibrate formulation. Thus a 200 mg capsule of LIPIDIL MICRO achieves equivalent plasma levels to a single dose of three 100 mg capsules of standard fenofibrate (LIPIDIL) and a 67 mg capsule of LIPIDIL MICRO achieves equivalent plasma levels to a 100 mg capsule of standard fenofibrate (LIPIDIL). In comparison with non-micronized fenofibrate formulation, the absorption of micronized fenofibrate is less influenced by fat content of the diet.

INDICATIONS AND CLINICAL USE

LIPIDIL MICRO (fenofibrate, micronized formulation) is indicated as an adjunct to diet and other therapeutic measures for:

1. Treatment of patients with hypercholesterolemia, Fredrickson classification Types IIa and IIb mixed hyperlipidemias, to regulate lipid levels (reduce serum triglycerides and LDL cholesterol levels and increase HDL cholesterol).
2. Treatment of adult patients with very high serum triglyceride levels, Fredrickson classification Type IV and Type V hyperlipidemias, who are at a high risk of sequelae and complications (i.e., pancreatitis) from their hyperlipidemia.

LIPIDIL MICRO alone may not be adequate therapy in some patients with familial combined hyperlipidemia with Type IIb and Type IV hyperlipoproteinemia.

Initial therapy for hyperlipidemia should include a specific diet (at least equivalent to the American Heart Association (AHA) Step I diet), weight reduction, and an exercise program; and for patients with diabetes mellitus, good diabetic control.

CONTRAINDICATIONS

1. Hepatic or severe renal dysfunction (creatinine clearance <20 ml/minute), including primary biliary cirrhosis.
2. Pre-existing gallbladder disease (see **WARNINGS**).
3. Hypersensitivity to fenofibrate, any component of this medication or other drugs of the fibrate class.
4. The drug should not be used during pregnancy and breast feeding.
5. Known photoallergy or phototoxic reaction during treatment with fibrates or ketoprofen.
6. LIPIDIL MICRO (fenofibrate, micronized formulation) is not indicated for the treatment of Type I hyperlipoproteinemia.

WARNINGS

1. **Fenofibrate and HMG-CoA Reductase Inhibitors (Statins):** The concomitant administration of fenofibrate and statins should be avoided unless the benefit for further alteration in lipid levels is likely to outweigh the increased risk of this combination.

The concomitant administration of fenofibrate with Pravastatin (40 mg) once daily for 10 days, in healthy adults, increased the mean C_{max} and AUC values for pravastatin by 36% (range: from a 69% decrease to a 321% increase) and 28% (range: from a 54% decrease to a 128% increase), respectively. Co-administration of fenofibrate with Pravastatin also increased the mean C_{max} and AUC of the major metabolites, 3-alpha-hydroxy-isopravastatin by 55% (range: from a 32% decrease to a 314% increase) and 39% (range: from a 24% decrease to a 261% increase), respectively.

The combined use of fibric acid derivatives and HMG-CoA reductase inhibitors has been associated, in the absence of a marked pharmacokinetic action, in numerous case reports, with rhabdomyolysis, markedly elevated creatine kinase (CK) levels and myoglobinuria, leading to a high proportion of cases to acute renal failure.

This combination therapy must not be used in patients with predisposing factors for myopathy (pre-existing myopathy, age >70 years, renal impairment, hepatic impairment, severe infection, surgery and trauma, frailty, hypothyroidism or electrolyte imbalance, personal or family history of hereditary muscular disorders, previous history of muscle toxicity with another HMG-CoA reductase inhibitor, concomitant use of a fibrate, niacin or ezetimibe, alcohol abuse, excessive physical exercise, diabetes with hepatic fatty change situations where an increase in plasma levels of active ingredient may occur).

For information on a specific HMG-CoA reductase inhibitor, consult a respective Product Monograph.

The use of fibrates alone, including LIPIDIL MICRO, may occasionally be associated with myositis, myopathy or rhabdomyolysis. Patients receiving LIPIDIL MICRO and complaining of muscle pain, tenderness, or weakness should have prompt medical evaluation for myopathy, including serum creatine kinase level determination. If myopathy and or myositis is suspected or diagnosed, LIPIDIL MICRO therapy should be stopped.

2. **Liver function:** Abnormal liver function tests have been observed occasionally during fenofibrate administration, including elevations of transaminases, and decreases or, rarely, increases in alkaline phosphatase. From 5 placebo-controlled trials of 2 to 6 months' duration, increases up to >3 times the upper limit of normal occurred in 2.9% (14/477) of patients taking fenofibrate versus 0.5% (2/386) of those treated with placebo. In the DAIS study (3 years duration), increases up to 3 times the upper limit of normal occurred in 1.9% (4/207) of patients taking fenofibrate versus 0% of those treated with placebo (0/211). Follow-up measurements, performed either at the end of treatment or during continued treatment, showed that transaminase values generally returned to normal limits. Therefore regular periodic liver function tests (AST, ALT and GGT) in addition to other baseline tests are recommended every 3 months for the first 12 months and at least yearly thereafter. LIPIDIL MICRO (fenofibrate, micronized formulation) should be discontinued if abnormalities persist and/ or AST and ALT levels increase to more than 3 times the upper limit of normal.
3. **Cholelithiasis:** Fenofibrate may increase cholesterol excretion into the bile, and may lead to cholelithiasis. If cholelithiasis is suspected, gallbladder studies are indicated. LIPIDIL MICRO therapy should be discontinued if gallstones are found.
4. **Haematologic changes:** Mild hemoglobin, haematocrit and white blood cell decreases have been observed occasionally in patients following initiation of fenofibrate therapy. However, these levels stabilize during long-term administration. Periodic blood counts are recommended during the first 12 months of fenofibrate administration.

PRECAUTIONS

1. **Initial therapy:** Before instituting fenofibrate therapy, laboratory tests should be conducted to ensure that lipid levels are consistently abnormal. Attempts should be made to control serum lipids with appropriate diet, exercise and weight loss in obese patients. Secondary causes of hypercholesterolemia, such as uncontrolled type 2 diabetes mellitus, hypothyroidism, nephrotic syndrome, dysproteinemia, obstructive liver disease, pharmacological treatment and excessive alcohol intake should be adequately treated before fenofibrate therapy is initiated. In patients at high risk, consideration should be given to the control of other risk factors such as smoking, use of preparations containing estrogen and inadequately controlled hypertension.
2. **Long-term therapy:** Because long-term administration of fenofibrate is recommended, the potential risks and benefits should be carefully weighed. Adequate pretreatment laboratory studies should be performed to ensure that patients have elevated serum cholesterol and/or triglycerides or low HDL-cholesterol levels. Response to therapy should be monitored by

determination of serum lipid values (e.g. total cholesterol, LDL-C, triglycerides). If a significant serum lipid response is not obtained in 3 months, LIPIDIL MICRO should be discontinued.

3. **Skeletal muscle:** Treatment with drugs of the fibrate class has been associated on rare occasions with rhabdomyolysis or myositis, usually in patients with impaired renal function and in cases of hypoalbuminaemia. Myopathy should be considered in any patient with diffuse myalgias, myositis, muscle cramps, tenderness or weakness, and/or marked elevation of creatine phosphokinase levels.

Patients should be advised to promptly report unexplained muscle pain, tenderness or weakness, particularly if accompanied by malaise or fever. CPK levels should be assessed in patients reporting these symptoms, and fenofibrate therapy should be discontinued if markedly elevated CPK levels (5 times the upper limit of normal) occur or myopathy is diagnosed.

Patient with pre-disposing factors for myopathy may be at an increased risk of developing rhabdomyolysis (See **WARNINGS**). For these patients, the putative benefits and risks of fenofibrate therapy should be carefully weighed.

4. **Reproduction studies:** Standard tests for teratology, fertility and peri-and post-natal effects in animals have shown a relative absence of risk; however, embryo-toxicity has occurred in animals at maternally toxic doses.
5. **Use in pregnancy:** Safety in pregnant women has not been established. Fenofibrate has been shown to be embryocidal in rats when given in doses 7 to 10 times the maximum recommended human dose (MRHD) and in rabbits when given in doses 9 times the MRHD (on the basis of mg/m² surface area). There are no adequate and well-controlled studies in pregnant women. Fenofibrate should not be used during pregnancy. (See **Contraindications**).
6. **Nursing mothers:** In the absence of information concerning the presence of fenofibrate in human breast milk, LIPIDIL MICRO should not be used by nursing mothers.

7. **Carcinogenicity:** In long-term animal toxicity and carcinogenicity studies fenofibrate has been shown to be tumorigenic for the liver in male rats at 12 times the human dose. At this dose level in male rats there was also an increase in benign Leydig cell tumors. Pancreatic acinar cell tumors were increased in male rats at 9 and 40 times the human dose. However, mice and female rats were unaffected at similar doses. Florid hepato-cellular peroxisome proliferation has been observed following fenofibrate administration to rats. Such changes have not been found in the human liver after up to 3.5 years of fenofibrate administration.
8. **Hepatobiliary disease:** In patients with a past history of jaundice or hepatic disorder, fenofibrate should be used with caution. Fenofibrate may increase cholesterol excretion into the bile, and may lead to cholelithiasis.
9. **Renal function:** In patients with hypoalbuminemia, e.g., nephrotic syndrome, and in patients with renal insufficiency, the dosage of fibrates must be reduced and renal function should be monitored regularly (see **PRECAUTIONS, Skeletal muscle** and **DOSAGE AND ADMINISTRATION**). Fenofibrate is not removed by hemodialysis and should not be used in dialysis patients.

Treatment should be interrupted in case of an increase in creatinine levels > 50% upper limit of normal. It is recommended that creatinine measurement may be considered during the first three months after initiation of treatment.

10. **Pancreatitis:** In common with some other fibrates, pancreatitis has been reported in patients taking fenofibrate. This occurrence may represent a failure of efficacy in patients with severe hypertriglyceridemia, a direct drug effect, or a secondary phenomenon mediated through biliary tract stone or sludge formation with obstruction of the common bile duct.
11. **Use in Elderly:** Fenofibrate is excreted by the kidney. Therefore, the risk of adverse reactions to LIPIDIL MICRO may be greater in the elderly patients with impaired renal function. Since elderly patients are more likely to have a decreased renal function, dose should be carefully selected (See **DOSAGE AND ADMINISTRATION**).

12. **Drug Interactions:**

General:

Fenofibrate is highly protein bound (>99%), mainly to albumin. Consideration should be given to the potential for displacement drug interactions with other highly protein-bound drugs.

Statins

No drug-drug interaction studies with fenofibrate and statins have been conducted in patients.

Pharmacokinetic interaction studies conducted with drugs in healthy subjects may not detect the possibility of a potential drug interaction in some patients due to differences in underlying disease and use of concomitant medications (See WARNINGS).

Pravastatin

Concomitant administration in 23 healthy adults of fenofibrate with pravastatin, 40 mg once daily for 10 days, has been shown to increase the mean C_{max} and AUC values for pravastatin by 36% (range: from a 69% decrease to a 321% increase) and 28% (range: from a 54% decrease to a 128% increase), respectively. Co-administration of fenofibrate with pravastatin also increased the mean C_{max} and AUC of the major metabolite, 3- α -hydroxy-iso-pravastatin by 55% (range: from a 32% decrease to a 314% increase) and 39% (range: from a 24% decrease to a 261% increase), respectively.

Atorvastatin

Concomitant administration of fenofibrate with atorvastatin (20 mg) once daily for 10 days resulted in a 14% decrease in the mean atorvastatin AUC value (range: from a 67% decrease to a 44% increase) in 22 healthy males. There was a 0% change in the atorvastatin mean C_{max} value (range: from a 60% decrease to a 136% increase). No significant pharmacokinetic interaction was observed in the mean fenofibric acid AUC (2.3% decrease, range: from a 39% decrease to a 40% increase) or in the mean C_{max} (3.8% decrease, range: from a 29% decrease to a 42% increase) when fenofibrate was co-administered with multiple doses of atorvastatin.

Simvastatin

In a 10-day trial, fenofibrate was taken once daily. On day 10, simvastatin 40 mg was added to the fenofibrate regimen. The mean AUC of simvastatin acid, the main active metabolite, decreased by 42% (range: from a 77% decrease to a 50% increase) in the presence of fenofibrate. Fenofibrate had no impact (0%) on the mean simvastatin acid C_{max} (range: from a 67% decrease to a 92% increase). The mean fenofibric acid C_{min} plasma levels increased by 14% (range: from a 7% decrease to a 48% increase) following the co-administration of simvastatin, indicating that fenofibric acid concentrations are not significantly affected by the addition of a 40 mg dose of simvastatin.

Rosuvastatin

Co-administration of fenofibrate (67 mg three times daily) and rosuvastatin (10 mg once daily) for seven days did not lead to a clinically significant change in the plasma concentrations of either drug.

Ezetimibe

The safety and effectiveness of ezetimibe and fibrate combination therapy have not been established, therefore co-administration is not recommended until use in patients has been studied.

Oral anticoagulants Caution should be exercised when oral anticoagulants are given in conjunction with LIPIDIL MICRO (fenofibrate, micronized formulation). The dosage of oral anticoagulant should be reduced to maintain the prothrombin time at the desired level to prevent bleeding complications. Careful monitoring of prothrombin time is therefore recommended until it has been definitely determined that the prothrombin level has been stabilized.

Statins and cyclosporine: Severe myositis and rhabdomyolysis have occurred when a statin or cyclosporine was administered in combination therapy with a fibrate. Therefore, the benefits and risks of using fenofibrate concomitantly with these drugs should be carefully considered.

Some severe cases of reversible renal function impairment have been reported during concomitant administration of fenofibrate and cyclosporin. The renal function of these patients must therefore be closely monitored and the treatment with fenofibrate stopped in the case of severe alteration of laboratory parameters.

Bile Acid Sequestrants

When a fibrate is used concurrently with cholestyramine or any other resin, an interval of at least 2 hours should be maintained between the administration of the two drugs, since the absorption of fibrates are impaired by cholestyramine.

Estrogens

Estrogens may lead to a rise in lipid levels. Prescribing fibrates in patients taking estrogens or estrogen-containing contraceptives must be considered clinically on an individual basis.

Rosiglitazone

Some epidemiologic studies and case reports suggest that markedly decreased HDL-C in some patients involve the interaction of rosiglitazone with fenofibrate or bezafibrate. Laboratory findings in some published case reports demonstrated that, in some cases, it is the combination of rosiglitazone and fenofibrate, and neither agent alone, that lowers HDL-C.

ADVERSE REACTIONS

In five placebo-controlled clinical trials, conducted in the U.S. and Europe, a total of 477 patients on fenofibrate and 386 patients on placebo were evaluated for adverse effects during 2 to 6 months of treatment.

Adverse events led to the withdrawal of treatment in 5.5% of patients (26/477) treated with fenofibrate, the most common symptoms being abnormal elevation in transaminases, skin reactions and digestive disorders. Of the placebo-treated patients, 2.6% (10/386) were discontinued due to adverse effects.

The most frequently reported adverse events include: gastrointestinal (epigastric distress, flatulence, abdominal pain, nausea, diarrhea, constipation), dermatologic (erythema, pruritus, urticaria), musculoskeletal (muscle pain and weakness, arthralgia), central nervous system (headache, dizziness, insomnia), miscellaneous (decreased libido, hair loss, weight loss).

Adverse events, regardless of their causality, reported in more than 1% of patients are shown in Table 1.

TABLE 1: Number (%) of Patients Reporting Adverse Events		
	Fenofibrate N= 477	Placebo N= 386
Body as a whole	68 (14.3%)	51 (13.2%)
Abdominal pain	12 (2.5%)	8 (2.1%)
Asthenia	14 (2.9%)	7 (1.8%)
Headache	15 (3.1%)	11 (2.8%)
Cardiovascular system	15 (3.1%)	13 (3.4%)
Digestive system	63 (13.2%)	47 (12.2%)
Diarrhoea	10 (2.1%)	13 (3.4%)
Nausea	12 (2.5%)	7 (1.8%)
Constipation	6 (1.3%)	3 (0.8%)
Dyspepsia	5 (1.0%)	6 (1.6%)
Flatulence	10 (2.1%)	10 (2.6%)
Endocrine system	1 (0.2%)	1 (0.3%)
Haemic & lymphatic system	3 (0.6%)	1 (0.3%)
Metabolic & nutritional disorders	18 (3.8%)	14 (3.6%)
ALT increase	12 (2.5%)	4 (1.0%)
AST increase	8 (1.7%)	1 (0.3%)
ALT/AST increase	9 (4.9%)	0
CPK increase	1 (0.2%)	5 (1.3%)
Creatinine increase	8 (1.7%)	1 (0.3%)
Musculo-skeletal system	31 (6.5%)	21 (5.4%)
Arthralgia	11 (2.3%)	11 (2.8%)
Myalgia	3 (0.6%)	4 (1.0%)
Nervous system	31 (6.5%)	11 (2.8%)
Dizziness	5 (1.0%)	4 (1.0%)
Respiratory system	34 (7.1%)	25 (6.5%)
Rhinitis	10 (2.1%)	4 (1.0%)
Skin and appendages	24 (5.0%)	12 (3.1%)
Rash	11 (2.3%)	3 (0.8%)
Pruritus	10 (2.1%)	3 (0.8%)
Special senses	14 (2.9%)	10 (2.6%)
Urogenital system	14 (2.9%)	9 (2.3%)

Safety was monitored for 3 years during the placebo-controlled DAIS study (See Clinical Studies) for both adverse events and laboratory anomalies. Fenofibrate was used safely in type 2 diabetic patients, as the overall incidence and severity of adverse events were comparable in fenofibrate and placebo groups. Table 2 below summarizes the incidence of adverse events, by body system, observed in both treatment groups.

TABLE 2 DAIS study: Incidence of adverse events (AEs) by system, experienced by type 2 diabetic patients during treatment with fenofibrate or placebo (ITT population)

Body System	Fenofibrate (N=207)		Placebo (N=211)	
	AEs	Patients	AEs	Patients
Total # pts. with at least 1 AE	Total AEs: 1710	201 (97.1%)	Total AEs: 1759	202 (95.7%)
Body as a whole	371 (21.7%)	136 (65.7%)	362 (20.6%)	146 (69.2%)
Cardiovascular	183 (10.7%)	84 (40.6%)	220 (12.5%)	96 (45.5%)
Digestive	196 (11.5%)	86 (41.6%)	194 (11.0%)	87 (41.2%)
Endocrine	11 (0.6%)	10 (4.8%)	19 (1.1%)	11 (5.2%)
Haemic/lymphatic	31 (1.8%)	19 (9.2%)	23 (1.3%)	15 (7.1%)
Metabolic/ nutritional	50 (2.9%)	32 (15.5%)	70 (4.9%)	41 (19.4%)
Musculo-skeletal	155 (9, 1%)	84 (40.6%)	180 (10.2%)	84 (39.8%)
CNS	103 (6.0%)	59 (28.5%)	98 (5.6%)	58 (27.5%)
Respiratory	301 (17.6%)	108 (52.2%)	279 (15.9%)	105 (49.8%)
Skin/appendage	107 (6.3%)	58 (28.0%)	107 (6.1%)	48 (22.8%)
Special senses	73 (4.3%)	44 (21.3%)	90 (5.1%)	50 (23.7%)
Urogenital	118 (6.9%)	55 (26.6%)	103 (5.9%)	46 (21.8%)
Other	11 (0.6%)	9 (4.4%)	14 (0.8%)	11 (5.2%)

In two open, non- controlled clinical studies conducted in Canada and Germany, a total of 375 patients on fenofibrate, microcoated formulation, were evaluated for adverse events. Listed in Table 3 are the adverse events possibly or probably related to fenofibrate, microcoated formulation and reported by more than 0.5% of the patients.

Table 3: Number (%) of patients reporting adverse events possibly or probably related to fenofibrate

Canadian and German multicenter studies (12-week treatment)	
Adverse Events	microcoated fenofibrate (n = 375)
Digestive system	
Gastrointestinal disorder	4 (1.1%)
Nausea	3 (0.8%)
Flatulence	2 (0.5%)
Diarrhea	2 (0.5%)
Liver function tests abnormal	2 (0.5%)
Dyspepsia	2 (0.5%)
Gastritis	2 (0.5%)
Constipation	2 (0.5%)
Body as a whole	
Abdominal pain	4 (1.1%)
Headache	2 (0.5%)
Asthenia	2 (0.5%)
Lab test abnormal	2 (0.5%)
Metabolic and Nutritional Disorders	
ALT increased (> 3 x UNL)	3 (0.8%)
AST increased (> 3 x UNL)	4 (1.1%)
Creatine kinase increased (> 5 x UNL)	1 (0.3%)
Nervous system	
Dizziness	2 (0.5%)
Libido decreased	2 (0.5%)

Some epidemiological studies and case reports support paradoxical HDL-C lowering with fenofibrate.

Other adverse events include the following:

Common: Vomiting.

Uncommon: Pancreatitis, venous thromboembolism (pulmonary embolism and deep vein thrombosis).

Rare: Alopecia, sexual asthenia, myositis, muscular cramps.

Very rare: Rhabdomyolysis, interstitial pneumopathies

Episodes of hepatitis have been reported. When symptoms indicative of hepatitis occur (e.g. jaundice), laboratory tests are to be conducted for verification and fenofibrate discontinued, if applicable (see **WARNINGS**).

Photosensitivity reactions, development of gallstones and cutaneous hypersensitivity with erythema and vesiculation or nodulation on parts of the skin exposed to sunlight or artificial UV light in individual cases (even after many months of uncomplicated use) have also been reported.

Laboratory tests:

In most trials, sporadic and transient increases in aminotransferase levels have been associated with the use of fenofibrate. The reported frequency of AST and ALT elevations was variable; in the clinical trials conducted in Canada and Germany elevations above three times the upper limit of normal were observed in 2.0 % of the patients (7/375) treated with fenofibrate, microcoated formulation. In two dose-ranging studies, the incidence of increases in transaminases (>3 x ULN) due to fenofibrate therapy appears to be dose related; 0.6% (1/157) (80mg tablet), 1.9% (3/158) (160mg tablet) and 4.0% (6/149) (240mg tablet). Values usually return to normal without interruption of treatment (See **PRECAUTIONS**). Reductions in alkaline phosphatase levels have also been observed.

Mild decreases in hemoglobin, hematocrit, and white blood cell counts have been observed occasionally in patients following initiation of fenofibrate therapy but these observations were without clinical significance. However, these levels stabilize during long-term administration. In addition, a decrease in haptoglobin concentration has been observed in some patients with Type IV hyperlipidemia during long-term use of fenofibrate. However, this decrease in haptoglobin was not associated with any other sign of blood dyscrasia and/or hemolysis.

The mean plasma levels of urea and creatinine showed increases, particularly during long-term fenofibrate treatment, most of them remaining within the limits of normal values.

Fenofibrate also has the potential to provoke CK elevations and changes in haematologic parameters which generally subside when the drug is discontinued (see **PRECAUTIONS**). In the clinical studies conducted in Canada and Germany, the reported frequency of CK elevations above five times the upper limit of normal was approximately 0.3% (2/375) of the patients treated with fenofibrate, microcoated formulation.

SYMPTOMS AND TREATMENT OF OVERDOSAGE

While there has been no reported case of overdosage, symptomatic and supportive measures should be taken. Fenofibrate is not dialysable because the main metabolite (fenofibric acid) is highly bound to plasma proteins.

DOSAGE AND ADMINISTRATION

Patients should be placed on a standard cholesterol-lowering diet (at least equivalent to the Adult Treatment Panel III (ATP III TLC diet)) before receiving LIPIDIL MICRO and should continue on this diet during treatment with LIPIDIL MICRO. If appropriate, a program of weight control and physical exercise should be implemented.

Prior to initiating therapy with LIPIDIL MICRO, secondary causes for elevations in plasma lipid levels should be excluded. A lipid profile should also be performed.

If a significant serum lipid response is not obtained in three months, LIPIDIL MICRO should be discontinued.

The recommended dose for LIPIDIL MICRO in adults is 200 mg daily administered as one 200 mg capsule taken with the main meal. The maximum recommended total daily dose is 200 mg.

In patients with renal insufficiency (creatinine clearance between 20 and 100 ml/mn), fenofibrate, micronized formulation, treatment should be initiated at the dose of 67 mg/day and increased progressively after evaluation of the tolerance and effects on the lipid parameters. Fenofibrate, micronized formulation, is not removed by hemodialysis and should not be used when the creatinine clearance is lower than 20 ml/mn.

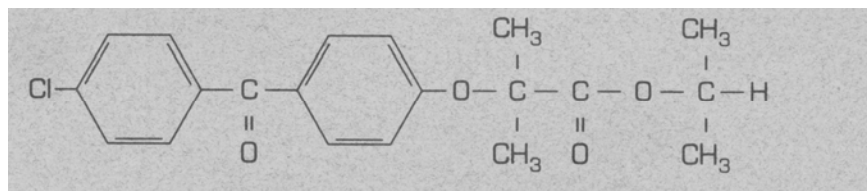
PHARMACEUTICAL INFORMATION

DRUG SUBSTANCE

Proper name: fenofibrate

Chemical name: 2-(4-(4-chlorobenzoyl) phenoxy)-2-methyl-propanoic acid
1-methylethyl ester.

Structural formula:



Molecular formula: C₂₀ H₂₁ O₄ Cl

Molecular weight: 360.83

Description: Fenofibrate is a crystalline, cream-colored, odourless and tasteless powder.

Melting point: 79 to 82°C.

Solubilities: Fenofibrate is practically insoluble in water, soluble in ethanol, freely soluble in acetone and chloroform.

COMPOSITION

LIPIDIL MICRO contains, in addition to fenofibrate, the following excipients: lactose, pregelatinized starch, magnesium stearate, sodium laurylsulfate, reticulated polyvinyl-pyrrolidone.

Utilizing an original and specific process of manufacturing, the size of the particles of fenofibrate contained in LIPIDIL MICRO is reduced, thus providing an increase in the effective surface area of particles to facilitate the dissolution rate and absorption.

STABILITY AND STORAGE RECOMMENDATIONS

Keep at room temperature (15-25°C). Avoid excessive humidity.

AVAILABILITY OF DOSAGE FORMS

LIPIDIL MICRO 200 mg Capsules: Each orange, hard gelatin capsule contains 200 mg micronized fenofibrate. Available in boxes of 30 capsules.

INFORMATION FOR THE CONSUMER

Full prescribing information is available to doctors and pharmacists on request.

LIPIDIL MICRO reduces blood cholesterol, in particular cholesterol associated with low and very low density lipoproteins (LDL and VLDL-cholesterol). LIPIDIL MICRO also reduces high triglyceride levels associated with hypercholesterolemia. Blood uric acid levels are also reduced by LIPIDIL MICRO treatment. The mechanism of action of LIPIDIL MICRO is not fully established.

LIPIDIL MICRO is only available on prescription. This medicine should only be used to supplement an appropriate diet recommended and followed up by your doctor for the long-term treatment of raised lipid levels; prescription of this medicine in no way replaces dietary treatment. In addition, depending on the situation, your doctor may recommend further physical exercise, weight loss or other measures.

Take exactly as instructed by your doctor. Do not change the dose without your doctor's advice. Consult your doctor before stopping treatment since to do so may result in an increase in your blood lipid levels.

DO NOT USE LIPIDIL MICRO IF:

- you suffer from liver or kidney disease ;
- you already have gallbladder problems ;
- you are allergic to fenofibrate or similar drug or if you are allergic to any of the ingredients in LIPIDIL MICRO capsules (See ***What Does LIPIDIL MICRO Contain?***)
- you are pregnant or breastfeeding; in the event of pregnancy during treatment, your doctor should be informed and LIPIDIL MICRO should be discontinued ;
- you have a photoallergy (skin sensitivity to sunlight or UV light) when taking a fibrate (a class of drugs used for lowering cholesterol, which includes LIPIDIL MICRO and gemfibrozil) or an anti-inflammatory drug called ketoprofen.

BEFORE STARTING TREATMENT WITH THIS MEDICINE, your doctor must know:

- if you have had an allergic reaction to (or poorly tolerated) LIPIDIL MICRO, any of its ingredients (See ***What Does LIPIDIL MICRO Contain?***), or any other lipid treatment;
- if you suffer from liver or kidney problems;
- if you have a gall bladder or gallstone problem;
- if you are pregnant, or intend to become pregnant, or are breast-feeding, or intend to breast feed;
- if you are taking any other medicines, prescription or not. Of particular concern are:
 - Statins (a class of drugs, which includes atorvastatin, pravastatin, simvastatin, etc., used to lower cholesterol)

- Ezetimibe (another type of cholesterol lowering agent)
- Oral anticoagulants (blood thinning agents, such as warfarin)
- Cyclosporine (a drug which may be taken following an organ transplant)
- Cholestyramine or similar drug (another type of cholesterol lowering agent)
- Estrogens (hormones which may be found in oral contraceptives or hormone replacement therapy)
- Rosiglitazone (a drug used to treat type 2 diabetes)

PROPER USE OF THE MEDICINE

- LIPIDIL MICRO should be taken with meals, as directed by your doctor.
- It is particularly important to follow this advice because LIPIDIL MICRO is less well absorbed and hence less effective when not taken with food.
- The usual recommended dose of LIPIDIL MICRO in adults is one 200 mg capsule.
- Never change the dose unless directed by your doctor.
- LIPIDIL MICRO is not recommended for use in children.
- The safety of using LIPIDIL MICRO in combination with a statin has not been extensively studied in patients. Therefore, the combined use of fenofibrate with a statin should be avoided unless recommended by your doctor.
- Tell your doctor about any health problem that occurs while you are taking LIPIDIL MICRO. If you need other medical treatment while taking LIPIDIL MICRO, let your doctor know that you are taking LIPIDIL MICRO.

SIDE EFFECTS

In addition to its intended action, any medicine may cause side effects.

Tell your doctor if you feel in any way unwell while taking LIPIDIL MICRO.

Some common side effects may include abdominal pains, constipation, diarrhea, nausea, headache, dizziness, skin reactions, and fatigue. This is not a complete list of side effects. If you experience any unexpected symptoms while taking LIPIDIL MICRO, contact your doctor or pharmacist.

Muscle pain or cramps, or muscle weakness, may indicate rare, but more serious, side effects. If you suffer any unexplained muscle pain, stop the drug and contact your doctor immediately.

Your doctor will ask you to have regular medical check-ups and appropriate laboratory tests. It is important to respect the dates proposed for these tests: we strongly recommend that you keep these appointments faithfully so that any abnormalities that may occur can be identified promptly.

WHAT DOES LIPIDIL MICRO CONTAIN

LIPIDIL MICRO contains, in addition to fenofibrate, the following nonmedicinal ingredients: lactose, pregelatinized starch, magnesium stearate, sodium laurylsulfate, reticulated polyvinyl-pyrrolidone.

THIS MEDICINE IS PRESCRIBED FOR A PARTICULAR HEALTH PROBLEM AND FOR YOUR PERSONAL USE. DO NOT GIVE IT TO OTHER PERSONS.

KEEP ALL MEDICINES OUT OF THE REACH OF CHILDREN.

IF YOU WANT FURTHER INFORMATION, ASK YOUR DOCTOR OR PHARMACIST.

® Lipidil Micro: Registered Trademark Fournier Industrie et Santé S.A. Dijon France; Licensed use by Fournier Pharma Inc., Saint-Laurent, Quebec, H4S 1Z1

Last revised: July 15, 2011

ANIMAL PHARMACOLOGY

The antilipidemic activity of fenofibrate was investigated in normal and hyperlipidemic rats. Fenofibrate significantly lowers total lipids, LDL and VLDL-cholesterol, and triglyceride levels. At the same time it has been found to variably increase HDL-cholesterol concentrations. Its effect is more pronounced in hyperlipidemic rats and those fed high fat diets than in normal rats and those fed standard diets. Studies comparing fenofibrate with clofibrate have found that fenofibrate is a potent cholesterol-lowering drug.

The pronounced hypolipidemic effect in hyperlipidemic animals suggests that fenofibrate reduces cholesterol by enhancing the rate of cholesterol elimination. In normocholesterolemic rats, the main effect of fenofibrate is an inhibition of cholesterol biosynthesis.

Fenofibrate has no anti-inflammatory, cardiovascular, respiratory, CNS, autonomic nervous system, or other basal metabolism activities.

PHARMACOKINETICS AND CLINICAL PHARMACOLOGY

PHARMACOKINETICS

In rats, dogs and man, fenofibrate is poorly absorbed from the gastrointestinal tract. This absorption is increased when the compound is administered in oil with food.

In man, a dose of 300 mg per day of non-micronized fenofibrate produced mean steady-state plasma drug concentrations ranging between 10 and 15 $\mu\text{g/ml}$ after 5 days of administration.

Fenofibrate is metabolized by hydrolysis to its active form, fenofibric acid. In man, fenofibric acid is eliminated conjugated with glucuronic acid. In rats this glucuroconjugation is very low and in dogs, practically non-existent. In these two species the main metabolic pathway is carbonyl reduction. The excretion in rats is principally a biliary excretion. In man, within 7 days after oral administration of fenofibrate with food, about 60 % is excreted in the urine and 25 % in the feces.

The elimination half-life of fenofibric acid is about 7-8 hours in rats and 24 hours in dogs. In man, the elimination half-life of fenofibric acid is about 20-24 hours. This value is not modified after multiple dosing. Very minor changes of pharmacokinetic parameters were observed in elderly subjects, but in patients with severe renal failure, significant accumulation was observed with a large increase of the half-life.

No sex related differences in pharmacokinetics and metabolism were observed in any species.

Fenofibric acid is extensively bound (> 99 %) to plasma proteins. This binding is not saturable.

Four specific pharmacokinetic studies were performed with LIPIDIL MICRO, (fenofibrate, micronized formulation) capsules 200 mg and one with LIPIDIL MICRO, capsules 67 mg.

A first single dose study in 18 healthy volunteers (9 M, 9 F) demonstrated that one capsule of LIPIDIL MICRO 200 mg was bioequivalent to one capsule containing 300 mg of non-micronized fenofibrate. In this balanced crossover study, the two formulations were administered immediately after a high-fat meal. The mean results are presented in the following table:

	AUC (mg.l ⁻¹ .h)	C _{max} (mg.l ⁻¹)	t _{max} (h)	t _{1/2} (h)
LIPIDIL MICRO (200 mg capsule)	176.7	11.0	5.9	15.4
LIPANTHYL 300 mg non-micronized fenofibrate	171.3	10.7	5.6	17.9
95 % confidence interval (Westlake)	14.1 %	15 %		

A second single dose study in 18 healthy male volunteers demonstrated that one LIPIDIL MICRO 200 mg capsule is bioequivalent to three LIPIDIL 100 mg capsules (non-micronized fenofibrate) taken simultaneously.

The two formulations were administered immediately after a high-fat meal according to a balanced crossover design. The mean results are presented in the following table :

	AUC (mg.l⁻¹.h)	C_{max} (mg.l⁻¹)	t_{max} (h)	t_{1/2} (h)
LIPIDIL MICRO (200 mg capsule)	178.2	8.9	6	22.9
3 x LIPIDIL (100 mg capsules)	180.0	10.2	6	22.0
95 % confidence interval (Westlake)	12.9 %	31.4 %	-	12.4 %

In a third cross-over study, 18 healthy volunteers (8 F, 10 M) received either one LIPIDIL MICRO 200 mg capsule or three LIPIDIL 100 mg capsules once daily, during a low fat, low calorie meal, for 10 days.

The comparison of the pharmacokinetic parameters obtained at steady-state (Day 10) with the two formulations shows that the amount of fenofibrate absorbed is slightly higher with one LIPIDIL MICRO capsule 200 mg than with three 100 mg capsules of non-micronized fenofibrate (LIPIDIL) but also that the better absorption of LIPIDIL MICRO leads to a better homogeneity of the fenofibric acid plasma concentrations. This lower inter-subject variability with LIPIDIL MICRO is shown by the decrease of the coefficients of variation of AUC₀₋₂₄, C_{max} as well as C_{min} obtained on Day 10. The mean values obtained on Day 10 and their coefficients of variation (CV %) are presented in the following table:

	AUC₀₋₂₄ (mg.l⁻¹.h)	C_{max} (mg.l⁻¹)	C_{min} (mg.l⁻¹)	t_{max} (h)	t_{1/2} (h)
LIPIDIL MICRO (200 mg capsule)	154.1 (19 %)	10.8 (23 %)	3.9 (24 %)	4.6 (20 %)	26.1 (50 %)
3 x LIPIDIL (100 mg capsules)	119.4 (45 %)	8.6 (46 %)	3.2 (54 %)	5.6 (34 %)	23.5 (40 %)

In a fourth cross-over study, 5 healthy adult volunteers (male) received either one LIPIDIL MICRO 200 mg capsule or three LIPIDIL 100 mg capsules once daily, during a standard supper containing 40% lipids, for 10 days.

The comparison of the pharmacokinetic parameters obtained at steady-state (Day 10) with the two formulations shows that the amount of fenofibrate absorbed is slightly higher with three capsules of non-micronized fenofibrate (LIPIDIL) than with LIPIDIL MICRO capsules 200 mg. The mean values of pharmacokinetic parameters measured at Day 10 (CV %) are presented in the following table:

	AUC₀₋₂₄ (mg.l⁻¹.h)	C_{max} (mg.l⁻¹)	t_{max} (h)	t_{1/2} (h)
LIPIDIL MICRO (200 mg capsule)	335.5 (34 %)	20.1 (25 %)	9.2 (4 %)	15.1 (59 %)
3 x LIPIDIL (100 mg capsules)	409.0 (31 %)	25.5 (23 %)	7.0 (36 %)	15.3 (34 %)

The apparent discrepancy of the results of the two multiple-dose studies can be explained by the difference in fat content of the meals used in these studies and by the difference of particle size of fenofibrate in the two formulations.

The larger sized particles of fenofibrate contained in the non-micronized formulation (LIPIDIL) are indeed poorly absorbed in the presence of a low-fat meal whereas the smaller particles of LIPIDIL MICRO are already well absorbed.

Fenofibrate dissolves more easily in the presence of a larger amount of fat and food, this seems to affect the absorption of non-micronized fenofibrate more than that of micronized fenofibrate.

One specific pharmacokinetic study was performed with LIPIDIL MICRO, capsules 67 mg: 24 healthy male volunteers took part and completed this two-way, open randomized, cross-over study. Each volunteer received a single oral dose of each formulation with a standard breakfast and with a one week interval between doses.

Values obtained for the two formulations were as follows:

	C_{max} (mg.l⁻¹)	t_{max} (h)	AUC (mg.l⁻¹)	t 1/2 (h)	MRT (h)
LIPIDIL MICRO (capsules 67 mg)					
Mean	3.7	4.0*	62.1	19.7	25.2
sd	0.5	(2.0-7.0)	19.0	6.1	6.0
LIPIDIL (capsules 100 mg)					
Mean	4.0	4.0*	59.6	19.0	26.5
sd	0.9	(2.0-6.0)	21.8	5.8	6.3

* : Median (range)

sd: Standard deviation

In summary, under the conditions of the studies, the data show that biological equivalence was achieved between LIPIDIL MICRO and LIPIDIL.

CLINICAL PHARMACOLOGY

Action on lipid parameters

The oral administration of 300 mg/day of fenofibrate for one week significantly reduced the plasma cholesterol and triglyceride levels in normolipidemic subjects. However, no change in HDL cholesterol levels was observed.

The effects of fenofibrate 300 mg/day, clofibrate 1500 mg/day and placebo on plasma lipoprotein and biliary lipid composition were compared in a double-blind study involving 12 normolipidemic subjects. Each treatment lasted two weeks. Fenofibrate lowered plasma cholesterol by 17 %, triglycerides by 9 % and LDL cholesterol by 16 %.

Fenofibrate 400 mg/day was administered for one month to 18 patients with hyperlipoproteinemia who failed to achieve normal lipid levels with a lipid-lowering diet. Fenofibrate treatment significantly reduced the total plasma cholesterol concentrations by 14 %, plasma triglycerides by 49 % and VLDL triglycerides by 62 %. No significant change was observed in HDL cholesterol concentration. LDL-cholesterol was reduced in patients with Type IIa and IIb hyperlipoproteinemia and increased in Types IV and V. Lipoprotein-lipase activity was significantly increased.

In a double-blind study, two parallel groups of hyperlipidemic patients were treated with either 400 mg/day of fenofibrate (15 patients) or placebo (8 patients) for one month. Significant decreases in total cholesterol, triglycerides and Apo-B were observed in the fenofibrate treated group, along with a significant increase in HDL-cholesterol.

Uricosuric action

Fenofibrate decreased the plasma uric acid levels in normal as well as hyperuricemic subjects. In a study involving 10 normal male volunteers, single doses of 300 mg of fenofibrate were compared to benzbromarone. A uricosuric action was observed with both drugs. During a 14 day study in hyperlipidemic patients, a 28 % decrease in plasma uric acid concentration was observed less than four days after the onset of treatment with 300 mg/day of fenofibrate. This effect remained constant until the end of the study. An additional study conducted in healthy volunteers confirmed the rapid onset of the fenofibrate-induced hypouricemic effect and demonstrated the increased capability of the kidneys under these conditions to eliminate uric acid without damage to the proximal tubules.

Effect on lithogenic index

By virtue of structural similarity to other fibrates, fenofibrate might be suspected to increase the risk of gallstones as a result of increased cholesterol excretion via the bile.

Thus, five investigators have studied the biliary lithogenic index in fenofibrate-treated patients. In most studies, the lithogenic index was shown to be increased but the effect of fenofibrate was not marked and the degree of significance varied from one study to

another. The relative proportions of bile lipids were also affected by fenofibrate treatment.

It is not known how fenofibrate treatment modifies the lipid composition of the bile.

Human liver biopsies

Two specific studies have been conducted in hyperlipidemic patients to evaluate the potential hepatocellular toxicity of fenofibrate. Examination of biopsies from liver samples of 38 patients including 28 receiving LIPIDIL over a mean period of approximately 2 years did not show any difference between treated and untreated patients. Peroxisomes were relatively rare, and macroscopic light and electron-microscopic observations revealed no sign of treatment-associated cellular abnormality. A similar study, taking biopsies from 10 patients who had, on average, received LIPIDIL for 9 months, and comparing these with tissue from 13 hyperlipidemic patients who had only received dietary treatment did not show any morphological difference between the two groups or any significant difference in the number or in the size of peroxisomes.

CLINICAL EXPERIENCE

The activity of fenofibrate has been evaluated in more than 150 clinical trials performed in the U.S., Canada and Europe. The majority of these were conducted with non-micronized fenofibrate at a daily dose of 300 mg.

US studies

Two multicenter, double-blind, placebo-controlled studies were conducted in the U.S., one in patients with Type II hyperlipoproteinemia, the other in Type IV/V patients.

Type II study :

Two hundred and twenty seven (227) hypercholesterolemic patients (181 Type IIa and 46 Type IIb) were enrolled during 6 months. After the double-blind phase, the study became open and all patients were given fenofibrate for the ensuing 6 month period.

One hundred and sixteen (116) patients received fenofibrate (100 mg t.i.d.) and one hundred and eleven (111) received placebo. At the end of this first period, ninety-eight (98) of the one hundred and sixteen (116) who were given fenofibrate and ninety-four (94) of the one hundred and eleven (111) patients who were given placebo, entered the second 6 month open phase of fenofibrate treatment.

Fenofibrate reduced the mean plasma concentrations of total cholesterol and VLDL-cholesterol in both Type IIa and IIb patients. LDL-cholesterol concentration was substantially decreased in all Type IIa patients, whereas there was little change in the Type IIb patients in whom the pre-treatment LDL-cholesterol levels were relatively normal. The mean concentrations of HDL-cholesterol were increased in both types of patients. Plasma triglyceride levels were decreased in the hypertrigly-

ceridemic Type IIB patients. These effects were observed in the double-blind and open phases of the study (table 3).

Table 2: Effect of fenofibrate on percent change of lipoprotein lipids from baseline

Plasma Lipid Parameter	Double-Blind Phase n = 92	Open Phase n = 73	Double-Blind Phase n = 24	Open Phase n = 21
Total cholesterol	- 16 %	- 18 %	- 15 %	- 24 %
LDL-cholesterol	- 20 %	- 22 %	- 3 %	- 20 %
VLDL-cholesterol	- 34 %	- 38 %	- 53 %	- 64 %
Total triglyceride	- 34 %	- 30 %	- 41 %	- 51 %
HDL-cholesterol	+ 12 %	+ 8 %	+ 14 %	+ 11 %
LDL/HDL-cholesterol	- 27 %	- 25 %	- 14 %	- 26 %

N.B. p-values<0.01 for differences between fenofibrate and placebo groups for all parameters except LDL-cholesterol in type IIB. Inversely, placebo treatment induced no statistically significant changes in the lipid parameters.

Type IV/V study:

One hundred forty seven (147) patients entered the study and all were stabilized on a low-fat diet. Following a placebo baseline period, patients were stratified according to plasma triglyceride (TG) levels (group A, 350-499 mg/dl, group B, 500-1.500 mg/dl) and randomly assigned to treatment with either 100 mg fenofibrate or one placebo capsule three times a day with meals. Demographically, the treatment groups were similar. A dramatic reduction in total TG levels occurred in the fenofibrate-treated patients but not in the placebo-treated patients. This effect, seen in both group A (46 %) and group B (55 %) patients, reached near maximum reduction in only 2 weeks of treatment, and continued throughout the 8 week treatment period. In both groups, fenofibrate treatment also decreased very low-density lipoprotein (VLDL) TG, total cholesterol and VLDL cholesterol, and increased high-density lipoprotein (HDL) levels (table 4).

LDL cholesterol levels increased 45 % from baseline in group B but not in group A. It should be noted that baseline LDL cholesterol levels were considerably depressed in group B as compared with group A patients.

Table 3: Percent change in lipid/lipoprotein values (mg/dl) from baseline to end-point

	Group A		Group B	
	Fenofibrate	Placebo	Fenofibrate	Placebo
Total TG	- 46 %	- 1 %	- 55 %	+ 7 %
VLDL-TG	- 44 %	+ 3 %	- 51 %	+ 19 %
Cholesterol Total	- 9 %	+ 3 %	- 14 %	0 %
HDL	+ 20 %	+ 4 %	+ 23 %	+ 5 %
VLDL	- 45 %	+ 6 %	- 49 %	+ 11 %
LDL	+ 15 %*	+ 12 %	+ 45 %	- 4 %

Mean value rounded to nearest whole number.

* Not significantly different from placebo at $p < 0.05$. All other changes with fenofibrate were significantly different from placebo at p ranging from 0.05 to < 0.001

Canadian study

Seventeen (17) patients with hypercholesterolemia were included in this six month open study. The dosage of fenofibrate was 100 mg t.i.d. Twelve (12) patients had familial hypercholesterolemia with tendon xanthomas (FHx) and five (5) patients were suffering from various types of hyperlipidemia including two cases of mixed familial hyperlipidemia, one case of Type IV hyperlipidemia and two cases of familial dysbetalipoproteinemia (Type III). Ten (10) patients showed serum cholesterol levels greater than 400 mg/dl; severe atherosclerosis was present in four other patients.

Plasma cholesterol and triglyceride concentrations were measured monthly and VLDL-C, LDL-C and HDL-C concentrations were measured every three months. These results were compared to the values obtained during a period of diet control. In the 12 patients suffering from familial hypercholesterolemia with tendon xanthomas, fenofibrate was very effective in lowering both cholesterol (mean decrease 19.8 percent) and LDL-C (mean decrease of 20.4 percent) ($p < 0.0001$ in both cases). However, the drug had no effect on HDL-C. Ten of the 12 patients showed a response characterized by a significant decrease in serum cholesterol of 15 percent or more. A marked and significant effect was observed in three of the other five patients. This effect, apparent on both cholesterol (decreases ranging from 33.6 to 38.2 percent) and triglycerides (decreases ranging from 36.3 to 77.8 percent), was accompanied by a corresponding effect on VLDL-C and a significant increase in HDL-C. One case of mixed familial hyperlipidemia proved resistant to treatment and the treatment in one Type III patient had to be interrupted after 3 months because of deterioration of lipoprotein profile and digestive problems.

In nine hundred and seventy one (971) patients with hyper-cholesterolemia (Type IIa), fenofibrate decreased the levels of total cholesterol (-16 to -30 %), LDL-cholesterol (-20 to -33 %) and apoprotein B (-14 to -37 %). HDL-cholesterol levels were variably affected depending on initial levels (-15 to +28 %). In eight hundred and fifty four (854) patients with mixed hyperlipidemia (Type IIb), more variable decreases were observed in total (-3 to -36 %) and LDL-cholesterol levels (-11 to -29 %), as well as substantial decreases in triglyceride levels (-19 to -67 %). In five hundred and seven (507) patients with hypertriglyceridemia (Type IV), marked decreases of triglycerides (-30 to -70 %) and VLDL-triglycerides (-47 to -70 %) were obtained following fenofibrate treatment. Results observed in short-term trials were maintained over long-term treatment periods.

European studies

Non-micronized formulation (LIPIDIL)

Thirty-one (31) short-term studies of up to twelve (12) months duration, and six (6) long-term trials of up to six (6) years duration were conducted in Europe, involving two thousand four hundred and forty nine (2449) patients. In most studies, the recommended fenofibrate dose of 300 mg daily, administered in three equally divided doses, was used; occasionally, this dose was increased to 400 mg or 600 mg, or reduced to 200 mg daily depending on patient response.

Micronized formulation (LIPIDIL MICRO)

Specific clinical studies were performed with LIPIDIL MICRO.

The first clinical trial, a double blind comparative trial with LIPIDIL MICRO (one 200 mg capsule per day), LIPIDIL (100 mg three times daily) and matched placebo, of 3 months treatment duration, demonstrated comparable clinical response on all lipidic parameters with both the intent-to-treat and efficacy analysis.

The results of this study indicate that the fenofibrate treatments, 3 x 100 mg or 1 x 200 mg micronized, are significantly more active than the placebo on lipid parameters: cholesterol, triglycerides, LDL-cholesterol fraction and apolipoprotein B. The two treatments did not present any noticeable activity on the HDL-cholesterol or apolipoprotein A1 concentrations when they were subnormal at T0.

In the intent-to-treat analysis, the two treatments showed equivalent success levels of 73.4 % for 3 x 100 mg fenofibrate and 71.9 % for 1 x 200 mg micronized fenofibrate and significantly greater than that observed in the placebo group (14.8 %).

In the analysis of efficacy, the two treatments decreased the mean cholesterol concentrations by more than 15 % versus the placebo group and this difference was significant ($p < 0.0001$).

Concerning triglycerides, the difference between the means for each of the fenofibrate groups and the placebo group is greater than the comparison value (30 % of placebo).

The second clinical trial conducted in Germany was established to evaluate the general acceptability associated with efficacy on lipid parameters of LIPIDIL MICRO. From patients evaluated for efficacy, there were 45.1% patients with type IIa and 69.6 % patients with type IIb classified as good responders on total cholesterol at T₃. The total number of good responders for triglycerides (patients type IIb and IV) was 71.4% at T₃ and 77.7% at T₁₂. The treatment effect was consistent throughout the 12 months of the study.

After 3 months of treatment the mean value of total cholesterol was lowered in patients with type IIa from 311.4 mg/dl to 258.3 mg/dl with a mean decrease of 17 %. In patients with type IIb the mean value of total cholesterol lowered from 328.0 mg/dl to 266.5 mg/dl with a mean decrease of 18.6 %.

After 3 months of treatment the mean value of triglycerides was lowered in patients with type IIb from 254.8 mg/dl to 165.7 mg/dl with a mean decrease of 34.4 %. In patients with type IV the mean value of triglycerides was lowered from 383.8 mg/dl to 231.1 mg/dl with a mean decrease of 37.9 % after 3 months of treatment.

TOXICOLOGY

Acute toxicity

Results from studies in mice, rats, hamsters and dogs indicate a low toxicity for fenofibrate with the highest administered doses (3200 to 24000 mg/kg), resulting in no deaths over the 7-day observation period. Autopsy findings were negative.

Chronic toxicity studies

Rats with normal or high cholesterol diet were treated for 7 days by gavage with fenofibrate at 0, 3, 10, 30, 100 and 300 mg/kg/day or clofibrate at 20, 60, 200 and 600 mg/kg/day. SGOT levels were raised in treated rats but SGPT levels remained within the normal range for rats on normal diet and were only slightly elevated in rats on the high cholesterol diet. Dose-related hepatomegaly and proliferation of peroxisomes occurred, at doses above 30 mg/kg/day. In a second but similar study of drug metabolising enzymes, rats were treated daily by gavage for 7 days with fenofibrate at 0 or 100 mg/kg or clofibrate 200 mg/kg. The absence of significant change in the parameters measured suggests that the mechanisms resulting in hepatomegaly caused by both fibrates had little effect on cell organelles involved in drug metabolism and protein synthesis. In a third study in rats, oral doses of fenofibrate (0 to 1000 mg/kg) were given for 3 months. Depression of blood lipids was seen at all dose levels. SGOT and SGPT values were increased at 500 and 1000 mg/kg. Hepatomegaly was a consistent finding at all dose-levels reaching a maximum of 78 % increase in weight compared to controls but appeared to regress rapidly. There were no other significant findings in the histological examination.

A 7-month study in dogs with 50 and 100 mg/kg/day and a 24-month study with 25 mg/kg/day were carried out. None of the dogs died but there was substantial weight loss associated with cholelithiasis and some interstitial nephritis. No important changes were observed in the biological parameters. Livers were apparently normal.

Fenofibrate (0, 12, 50 or 500 mg/kg) or clofibrate (200 mg/kg) was administered via a banana preparation, during 12 months to Rhesus monkeys. No fenofibrate-related effect with regard to toxicity was noted in any of the test groups during the study. No evidence of compound-related histomorphologic alterations was present in the animals sacrificed. The Rhesus monkey resembles man where biopsy studies show no signs of peroxisome proliferation during up to 2 years of fenofibrate treatment.

Carcinogenicity studies

Five rodent feeding studies have shown that target organs for tumorigenic effects of fenofibrate are liver, pancreas and testis.

Mice showed increased liver weight with intrahepatic cholestasis and some degenerative changes but not liver tumors with 50 mg/kg/day for 22 months.

Dose-related increases in liver and kidney weight were seen in mice treated with 10 to 200 mg/kg/day of fenofibrate for 80 weeks.

Gross hepatomegaly associated with cholestasis was seen at the high dose level and in clofibrate (200 mg/kg/day) treated mice with occasional cholangitis and periportal fibrosis. Neoplastic lesions were confined to the liver with significant increases in hepatocellular carcinoma at the high dose of fenofibrate in both sexes. Hepatocellular adenomas were also increased in males. In clofibrate-treated mice there was an excess of hepatic adenomas in females but not in males.

Both fenofibrate and clofibrate were found to be associated with an increased incidence of hepatocellular hypertrophy, lobular dysplasia and Kupffer cell pigmentation in another long-term toxicity study (93 weeks) on mice. In both sexes the incidence of total hepatic neoplasms and carcinomas was significantly increased by the high dose of fenofibrate (200 mg/kg). At the intermediate dose (60 mg/kg) the combined tumor incidence was almost significant in males but not in females, while incidence of carcinomas was not significantly increased in males and absent in females. Also, clofibrate (400 mg/kg) significantly increased the total tumor incidence but not carcinomas in males; females were unaffected.

Rats which received fenofibrate (0, 10, 45 or 200 mg/kg/day) or clofibrate (200 mg/kg/day) mixed with their diet for a 2-year period showed no significant differences in mortality over the study period. Significant increases in incidences of hepatocellular carcinoma were found in the high dose fenofibrate group of animals of both sexes, in mid dose fenofibrate males, and in clofibrate treated males. Mid-dose fenofibrate males and clofibrate-treated males and females also showed significantly increased incidence of hepatocellular adenomas. Well differentiated pancreatic acinar cell carcinomas and adenomas were increased in a dose-related manner in the fenofibrate treated males, and higher incidences were also evident in the clofibrate males.

The chronic toxicity and carcinogenicity of fenofibrate was further studied in rats (0, 10 and 60 mg/kg/day) in order to compare treatment-related responses with those produced by clofibrate (400 mg/kg/day) and gemfibrozil (250 mg/kg/day) during 117 weeks of treatments. The absolute and relative weights of the liver were increased in all treatment groups except with 10 mg/kg fenofibrate. Although comparatively low, an incidence of hepatocellular carcinoma was observed in gemfibrozil-treated rats, and neoplastic nodules were also found in the livers of 50 % of the males which survived up to the termination of the study. Fewer neoplastic nodules were seen in the clofibrate-treated rats but these animals had a high incidence of hepatocellular carcinoma at termination. A significantly increased incidence of pancreatic acinar cell adenoma was seen in the 60 mg/kg fenofibrate males, while this increase in females was not significant. A significant increase in acinar adenoma and a slight increase in acinar carcinoma occurred with clofibrate (400 mg/kg) and some adenomas were seen in gemfibrozil-treated rats. There was some excess of benign interstitial cell tumors of the testis in all treatment groups except the group that received 10 mg/kg of fenofibrate.

Reproduction and teratology studies

There was no evidence of any increase in malformation frequency in mice, rabbits and rats after administration of fenofibrate compared to that seen in controls. Examination

of offspring from fenofibrate-treated dams and those having received clofibrate did not disclose any significant abnormalities when compared to offspring from the controls.

With the highest dose levels at which the mothers were adversely affected, there was evidence of embryotoxicity in rats and rabbits.

Genetic toxicity studies

Gene mutations : *In vitro* tests for mutagenicity with either fenofibrate or fenofibric acid in the presence or absence of activating rat or human microsomal enzyme preparations, have all given negative results. Thus, fenofibric acid was without effect on gene mutation frequency in bacteria (Ames), yeast and mouse lymphoma cells in culture.

In a second mouse lymphoma cell comparative study, there was no response to clofibrinic acid while some increased response to fenofibric acid at the highest concentration used was discounted due to poor relative growth. Similar activity was seen with gemfibrozil at toxic concentrations in the absence of metabolic activation. In conclusion, all three fibrates were found to be non-mutagenic on the protocol criteria, both in the absence and presence of metabolic activation.

Chromosome aberrations : Some trace of an increased but not significant incidence of aberrations was seen in an *in vitro* mouse lymphoma cell multiple end point assay.

Chromosome aberrations as such were not seen in a more recent comparative *in vitro* study with CHO cells when testing clofibrinic acid and gemfibrozil as well as fenofibric acid. However, clofibrinic acid did have a marginal effect in increasing sister chromatid exchange frequency.

The absence of excision repair in human originated HeLa cells incubated with a wide range of concentrations of fenofibric acid with or without S9, reaffirmed the essentially non-genotoxic nature of the product.

Direct effects on DNA : The ability to bind covalently to target organ DNA is a property common to chemical substances which act by direct initiation of the carcinogenic process at the nuclear level. This type of genotoxic activity can be studied *in vivo* by DNA assay in rodents treated with the radiolabelled drug.

Although binding of fenofibric and clofibrinic acids to proteins was readily observed, no binding to DNA was demonstrated after oral administration of C¹⁴-labelled fenofibric or clofibrinic acid. The data therefore exclude somatic mutations as responsible for the known hepatocarcinogenic activity of these fibrates in rodents.

In a second *in vivo* test the effects of fenofibric acid were compared with those of clofibrinic acid and gemfibrozil on DNA synthesis in mouse testicular tissue, as measured by the incorporation of ³H-thymidine. Any response is representative of changes in DNA synthesis in any testicular cells such as germ, Sertoli, Leydig or interstitial cells undergoing scheduled or unscheduled synthesis.

Both fenofibric acid and gemfibrozil caused modest increases in thymidine incorporation above control values. Clofibrate caused some inhibition of the incorporation of thymidine into DNA at the two lowest doses with a small increase at the highest. No positive control substance was used but it would be assumed that, for example, genotoxic alkylating agents might cause a decrease in incorporation due to an inhibition of DNA synthesis. Such inhibition or cell cycle delay is well known for such agents.

The increase in DNA synthesis as observed in mouse testicular tissue with fenofibric acid and gemfibrozil is difficult to evaluate in the absence of a positive control or historical data for this recently developed test, nevertheless such an effect might be anticipated of such agents which are known to cause peroxisome proliferation and which produce increased cell turnover. The occurrence of increased cell turnover would be in keeping with a non-genotoxic but promoting mode of such compounds in mice.

In a rat primary hepatocyte unscheduled DNA synthesis (UDS) assay *in vitro*, gemfibrozil, clofibric acid and fenofibric acid showed a negative response. None caused nuclear labelling significantly different from the control and no dose-related trends were evident.

Cell growth or malignant transformation *in vitro* : fenofibric acid was without effect on growth or malignant transformation of cultured mammalian cell lines.

SELECTED BIBLIOGRAPHY

1. Avogaro P, Bittolo Bon G, Belussi F, Pontoglio E, Cassolato G. Variations in Lipids and Proteins of lipoproteins by Fenofibrate in some hyperlipoproteinaemic states. *Atherosclerosis* 1983; 47: 95-100.
2. Bergman von K, Leiss O. Effect of short-term treatment with bezafibrate and fenofibrate on biliary lipid metabolism in patients with hyperlipoproteinemia. *Eur J Clin Invest* 1984; 14: 150-154.
3. Blane GF, Bogaievsky Y, Bonnefous F. Fenofibrate : influence on circulating lipids and side-effects in medium and long-term clinical use. *Pharmacological control of hyperlipidaemia*, ed. JR. Prous Science Publishers 1986; 187-216.
4. Blane GF. Comparative toxicity and safety profile of fenofibrate and other fibric acid derivatives. *Am J Med* 1987; 83 (suppl 5B.): 26- 36.
5. Blane GF. Reviews of European clinical experience with fenofibrate. *Cardiology* 1989; 76 (suppl. 1): 1-13.
6. Blumke S, Schwartzkopff W, Lobeck H, Edmonson NA, Prentice DE, Blane GF. Influence of Fenofibrate on Cellular and Subcellular Liver Structure in Hyperlipidemic Patients. *Atherosclerosis* 1983; 46: 105-116.
7. Boissonnat P et al. The long-term effects of the lipid-lowering agent fenofibrate in hyperlipidemic heart transplant recipients. *Transplantation* 1994; 58(2): 245 – 247.
8. Bosello O, Cigolini M, Battaglia A, Olivetti R, Zancanaro C, Ferrari F, Micciolo R, Mantoan D. Influence of procetofen on serum lipids and on adipose tissue lipoprotein lipase activity in hyperlipidemic patients. *Curr Ther Res* 1983; 33 (2): 317-321.
9. Bridgman JF, Rosen SM, Thorp JM. Complications during clofibrate treatment of nephrotic-syndrome hyperlipoproteinaemia. *The Lancet* September 1972: 506 – 509.
10. Brodie RR, Chasseaud LF, Elsom FF, Franklin ER, Taylor T. The Metabolic Fate of the Hypolipidemic Agent Isopropyl-[4'-(p-chlorobenzoyl)-2-phenoxy-2-methyl] -propionate (LF 178) in Rats, Dogs and Man. *Arzneimittelforschung* 1979; 26: 896-901.
11. Brown WV, Dujovne CA, Farquhar JW, Feldman EB, Grundy SM, Knopp RH, Lasser NL, Mellies MJ, Palmer RH, Samuel P, Schonfeld G, Superko HR. Effects of fenofibrate on plasma lipids. Double-blind, multicenter study in patients with type IIa or IIb hyperlipidemia. *Arteriosclerosis* 1986; 6 (6): 670-678.

12. Brunova E, Valek J, Vondra K, Slabochova Z, Grafnetter D, Bruna J. Treatment of Hyperlipoproteinemia with Procetofen. *Curr Ther Res* 1982; 31 (1): 37-44.
13. Chicaud P., Demange J., Debry G. Long-term (18 months) effects of fenofibrate in young hypercholesterolemic subjects. *Presse Med.*, 1984,13: 417-419.
14. Daniken VA, Lutz WK, Schlatter C. Lack of covalent binding to rat liver DNA of the hypolipidemic drugs clofibrate and fenofibrate. *Toxicol Lett* 1981 ; 7 : 311-319. *JAMA* 1984; 251: 351-374.
15. Daubresse JC. A Comparison of Fenofibrate and Clofibrate Hypolipidemic Effects. *Acta Clin Belg* 1980; 35 (4): 227-232.
16. Desager JP, Harvengt C. Clinical pharmacokinetic study of procetofen, a new hypolipidemic drug, in volunteers. *Int J Clin Pharmacol Res* 1978; 16: 570-574.
17. Desager JP, Hulhoven R, Harvengt C. Uricosuric effect of fenofibrate in healthy volunteers. *J Clin Pharmacol* 1980; 20 (10): 560-564.
18. Drouin P, Mejean L, Lambert D, Wulfert E, Debry G. One-year Treatment with Fenofibrate (Procetofen) of Patients Affected by Primary Type II Hyperlipoproteinemia. Effects on Lipoprotein Lipids and Biochemical Tolerance. *Curr Ther Res* 1980; 28 (5): 728-733.
19. Drouin P, Mejean L, Sauvanet JP, Pointel JP, Gay G, Debry G. Etude de l'action hypolipidémiant de procétofène chez des malades porteurs d'une HLP du type IIa ou IIb. (Hypolipidemic effects of procetofene in patients with type IIa or IIb HLP). *Gaz Méd France* 1976; 83: 3848-3860.
20. Drouin P. Two-year Treatment with Procetofen (Fenofibrate) in Patients with Primary Type II Hyperlipoproteinemia. Effect on Lipoprotein Lipids and Biochemical Tolerance. *Clin Ter Cardiovasc* 1982; 2: 165-170.
21. Farnier M, Bonnefous F, Debbas N, Irvine A. Comparative Efficacy and Safety of Micronized Fenofibrate and Simvastatin in Patients With Primary Type IIa or IIb Hyperlipidemia. *Arch Intern Med* 1994; 154: 441-449.
22. Fromantin M, Gautier D, Bon R. Etude comparée du clofibrate et d'un nouvel hypolipidémiant : le Procétofène (propos du traitement de 38 malades). (Comparative Study of Clofibrate with a New Hypolipidemic Procetofene in 38 patients). *Gaz Méd France* 1976; 83: 1437-1466.
23. Fromantin M, Gautier D, Quatre JM, Bon R. Efficacité et tolérance du fénofibrate au cours de traitements long terme. *Thérapie* 1981; 36: 473-476.

24. Gariot P, Barrat TE, Mejean L, Pointel JP, Drouin P, Debry G. Fenofibrate and human liver. Lack of proliferation of peroxisomes. *Arch Toxicol* 1983; 53 (2): 151-163.
25. Gurrieri J, Le Lous M, Renson FJ, Tourne C, Voegelin H, Majoie B, Wulfert E. Experimental study of a new potent hypolipidemic drug, isopropyl-[4'-p-chlorobenzoyl-2-phenoxy-2-methyl]-propionate (LF178) *Arzneimittelforschung* 1976; 26 (5): 889-894.
26. Harvengt C, Heller F, Desager JP. Hypolipidemic and Hypouricemic Action of Fenofibrate in Various Types of Hyperlipoproteinemias. *Artery* 1980; 7 (1): 73-82.
27. Hunninghake DB. Treatment of hypertriglyceridemia with fenofibrate. *Practical Cardiology* 1989; 15 (2): 38-39.
28. Jacobson TA, Zimmerman FH. Fibrates in combination with statins in the management of dyslipidemia. *The Journal of Clinical Hypertension*. January 2006;8(1): 35 – 41.
29. Knopp RH, Brown WV, Dujovne CA, Farquhar JW, Feldman EB, Goldberg AC, Grundy SM, Lasser NL, Mellies MJ, Palmer RH, Samuel P, Schonfeld G, Superko HR. Effects of fenofibrate on plasma lipoproteins in hypercholesterolemia and combined hyperlipidemia. *Am J Med* 1987; 83 (suppl. 5B): 50-59.
30. Knopp RH. Review of the effects of fenofibrate on lipoproteins, apoproteins and bile saturation : US studies. *Cardiology* 1989; 76 (suppl. 1): 14-22 and 29-32.
31. Langer T, Levy R. Acute muscular syndrome associated with administration of clofibrate. *NEJM* October 1968; 279(16): 856-858.
32. Lauwers PL. Effect of Procetofene on Blood Lipids of Subjects with Essential Hyperlipidemia. *Curr Ther Res* 1979; 26: 30-38.
33. Lehtonen A, Viikari J. Effect of Procetofen on Serum Total Cholesterol, Triglycerides and High Density Lipoprotein-Cholesterol Concentrations in Hyperlipoproteinemia. *Int J Clin Pharmacol Ther Toxicol* 1981; 19 (12): 534-540.
34. Lethonen A and Viikari J. Fenofibrate and Cholestyramine in type II hyperlipoproteinemia. *Artery* 1982; 10 (5): 353-367.
35. Palmer RH. Effects of fenofibrate on bile lipids composition. *Arteriosclerosis* 1985; 5 (6): 631-638.
36. Podda M, Zuin M. Effects of fenofibrate on biliary lipids and bile acid pool size in patients type IV hyperlipoproteinemia. *Atherosclerosis* 1985; 55: 135-142.

37. Rossner S, Öro L. Fenofibrate Therapy of Hyperlipoproteinaemia. A dose-response. Study and a Comparison with Clofibrate. *Atherosclerosis* 1981; 38: 273-282.
38. Rouffy J, Sauvanet JP, Chanu B, Bakir R, Goy-Loeper J, Saya C, Pinaroli F. Evaluation long terme de l'activité hypolipémiante et de la tolérance du fénofibrate. Effet court terme du médicament sur les taux de lipides des lipoprotéines (HDL, LDL, VLDL) et apoprotéines B. (Fenofibrate : Hypolipidemic Activity and Safety in Long term Treatment. Effects of HDL, LDL, VLDL and Apoprotein B in Short-term Treatment). *Nouv Presse Méd* 1980; 9 (49): 3747-3751.
39. Rubba P, Falanga A, Postiglione A, Patti L, Mancini M. Increase in lipoprotein lipase activity after procetofen (fenofibrate) treatment in primary hyperlipoproteinemia. *Clin Ter Cardiovasc* 1982; 2: 177-179.
40. Saba P, Pagliai E, Scalabrino A, Galeone F, Giuntoli F, Guidi G, Morini S, Lavoratti G. The lipid-lowering effects of Procetofene (Lipanthyl) in hyperlipidaemic patients. A clinical investigation. *Clin Trials J* 1981; 18 (4): 262-271.
41. Schneider AG, Ditschuneit HH, Stange EF, Ditschuneit H. Regulation of 3-hydroxy-3-methylglutaryl coenzyme A reductase in freshly isolated human mononuclear cells by fenofibrate. 41st Meeting of the European Atherosclerosis Group, Stockholm June 2-3, 1984, ed by : L.A. CARLSON, A.G. OLSSON in : *Treatment of hyperlipoproteinemia*, Raven Press, New-York 1984: 181-184.
42. Viikari J, Solakivi-Jaakkola T, Lehtonen A. Effect of procetofen on apolipoprotein AI and B concentrations in hyperlipoproteinemia. *Int J Clin Pharmacol Ther Toxicol* 1982; 20 (8): 362-385.