

Name of Medicine

AGGRASTAT[®]

tirofiban hydrochloride

50mL Vial

Presentation

Concentrate: (0.25 mg/mL) 50mL glass vial containing 12.5mg of tirofiban (as 14.05mg tirofiban hydrochloride monohydrate) in 50mL of iso-osmotic citrate buffer solution.

Therapeutic Class

AGGRASTAT (tirofiban hydrochloride, MSD), a non-peptide antagonist of the platelet GP IIb/IIIa receptor, is a platelet aggregation inhibitor.

Indications

AGGRASTAT, in combination with heparin, is indicated for patients with unstable angina or non-Q-wave myocardial infarction to prevent cardiac ischaemic events.

Dosage and Administration

The vial of AGGRASTAT (concentrate) must be diluted prior to administration (see Instructions for Use).

AGGRASTAT is for intravenous use only using sterile equipment. AGGRASTAT may be co-administered with heparin through the same line.

AGGRASTAT is recommended for use with a calibrated infusion device. Care should be taken to avoid a prolonged loading infusion. Care should also be taken in calculating the bolus dose and infusion rates based on patient weight.

In clinical studies patients received aspirin, unless contraindicated.

Unstable Angina Pectoris or Non-Q-Wave Myocardial Infarction:

AGGRASTAT should be administered intravenously, in combination with heparin, at the initial infusion rate of 0.4mcg/kg/min for 30 minutes. Upon completion of the initial infusion, AGGRASTAT should be continued at a maintenance infusion rate of 0.1 mcg/kg/min.

The table below is provided as a guide to dosage adjustment by weight.

Patient Weight (kg)	Most Patients		Severe Renal Insufficiency	
	30 Min Loading Infusion Rate (mL/hr)	Maintenance Infusion Rate (mL/hr)	30 Min Loading Infusion Rate (mL/hr)	Maintenance Infusion Rate (mL/hr)
30-37	16	4	8	2
38-45	20	5	10	3
46-54	24	6	12	3
55-62	28	7	14	4

	Most Patients		Severe Renal Insufficiency	
63-70	32	8	16	4
71-79	36	9	18	5
80-87	40	10	20	5
88-95	44	11	22	6
96-104	48	12	24	6
105-112	52	13	26	7
113-120	56	14	28	7
121-128	60	15	30	8
129-137	64	16	32	8
138-145	68	17	34	9
146-153	72	18	36	9

In the study that demonstrated efficacy, AGGRASTAT in combination with heparin was generally continued for a minimum of 48 hours and up to 108 hours on average, patients received AGGRASTAT for 71.3 hours. This infusion can be continued through angiography and should be continued up to 12 to 24 hours post-angioplasty/atherectomy. Arterial sheaths should be removed when the patient's activated clotting time is <180 seconds or 2-6 hours following cessation of heparin.

Patients With Severe Renal Insufficiency

As specified in the above dosing tables, the dosage of AGGRASTAT should be decreased by 50% in patients with severe renal insufficiency (creatinine clearance <30 mL/min). (See Warnings and Precautions, *Severe Renal Insufficiency* and Actions, *Pharmacokinetics, Characteristics in Patients, Renal Insufficiency*.)

Other Patient Populations

No dosage adjustment is recommended for elderly patients (see Use in the Elderly) or female patients.

Instructions for Use

Parenteral medicine products should be inspected visually for particulate matter and discoloration prior to use, whenever solution and container permit.

The vial of AGGRASTAT (concentrate) must be diluted prior to administration.

Directions for Preparation of AGGRASTAT Solution for Infusion from Concentrate

1. Withdraw 50 mL from a 250 mL bag of sterile 0.9% saline or 5% dextrose in water and replace it with 50 mL of AGGRASTAT (from one 50 mL vial) to achieve a concentration of 50 mcg/mL. Mix well before administration.
2. Administer according to the appropriate dosage adjustments by weight above.
3. Any unused intravenous solution should be discarded.

AGGRASTAT may be administered in the same intravenous line as atropine sulphate, dobutamine, dopamine, epinephrine HCl, furosemide, lidocaine, midazolam HCl, morphine sulphate, nitroglycerin, potassium chloride, propranolol HCl, and PEPCIDINE[®] (famotidine) injection. AGGRASTAT should not be administered in the same intravenous line as diazepam.

Contraindications

- AGGRASTAT is contraindicated in patients who are hypersensitive to any component of the product.

Since inhibition of platelet aggregation increases the risk of bleeding, AGGRASTAT is contraindicated in patients with

- active internal bleeding
- a history of intracranial haemorrhage
- intracranial neoplasm
- arteriovenous malformation or aneurysm
- in patients who developed thrombocytopenia following prior exposure to AGGRASTAT.

Warnings and Precautions

AGGRASTAT should be used with caution in the following patients:

- recent (<1 year) bleeding, including a history of gastrointestinal bleeding, or genitourinary bleeding of clinical significance
- known coagulopathy, platelet disorder, or history of thrombocytopenia
- platelet count <150,000 cells/
- history of cerebrovascular disease within 1 year
- major surgical procedure or severe physical trauma within 1 month
- recent epidural procedure
- history, symptoms, or findings suggestive of aortic dissection
- severe uncontrolled hypertension (systolic blood pressure >180 mmHg and/or diastolic blood pressure >110 mmHg)
- acute pericarditis
- haemorrhagic retinopathy
- chronic haemodialysis

Bleeding Precautions

Because AGGRASTAT inhibits platelet aggregation, caution should be employed when it is used with other medicines that affect haemostasis. The safety of AGGRASTAT when used in combination with thrombolytic agents has not been established.

During therapy with AGGRASTAT, patients should be monitored for potential bleeding. When treatment of bleeding is required, discontinuation of the medicine should be considered. Consideration may also be given to transfusions.

Fatal bleedings have been reported (see Adverse Effects).

Femoral artery access site:

AGGRASTAT is associated with minor increases in bleeding rates particularly at the site of arterial access for femoral sheath placement. Care should be taken when attempting vascular access so that only the anterior wall of the femoral artery is punctured, avoiding a Seldinger (through and through) technique for obtaining sheath access. Care should be taken to obtain proper haemostasis after removal of the sheaths followed by close observation.

Laboratory Monitoring:

Platelet counts, and haemoglobin and haematocrit should be monitored prior to treatment, within 6 hours following the bolus or loading infusion, and at least daily thereafter during therapy with AGGRASTAT (or more frequently if there is evidence of significant decline). In patients who have previously received GP IIb/IIIa receptor antagonists, consideration should be given to earlier monitoring of platelet count. If the patient experiences a platelet

count decrease to <90,000 cells/, additional platelet counts should be performed to exclude pseudothrombocytopenia. If thrombocytopenia is confirmed, AGGRASTAT and heparin should be discontinued and the condition appropriately monitored and treated.

In addition, the activated partial thromboplastin time (APTT) should be determined before treatment and the anticoagulant effects of heparin should be carefully monitored by repeated determinations of APTT and the dose should be adjusted accordingly, (see also Dosage and Administration). Potentially life-threatening bleeding may occur especially when heparin is administered with other products affecting haemostasis, such as GP IIb/IIIa receptor antagonists.

Severe Renal Insufficiency

In clinical studies, patients with severe renal insufficiency (creatinine clearance <30 mL/min) demonstrated decreased plasma clearance of AGGRASTAT. The dosage of AGGRASTAT should be reduced in these patients (see Dosage and Administration).

Pregnancy

There are no adequate and well-controlled studies in pregnant women. AGGRASTAT should be used during pregnancy only if the potential benefit justifies the potential risk to the foetus.

Nursing Mothers

It is not known whether AGGRASTAT is excreted in human milk. Because many medicines are excreted in human milk, and because of the potential for adverse effects on the nursing infant, a decision should be made whether to discontinue nursing or discontinue the medicine, taking into account the importance of the medicine to the mother.

Paediatric Use

Safety and effectiveness in children have not been established.

Use in the Elderly

In clinical studies the efficacy of AGGRASTAT in the elderly (≥ 65 years) was comparable to that seen in younger patients (<65 years). Elderly patients receiving AGGRASTAT with heparin or heparin alone had a higher incidence of bleeding complications than younger patients. The incremental risk of bleeding in patients treated with AGGRASTAT in combination with heparin over the risk in patients treated with heparin alone was comparable regardless of age. The overall incidence of non-bleeding adverse events was higher in older patients (compared to younger patients); however, the incidence of non-bleeding adverse events in these patients was comparable between the AGGRASTAT with heparin and the heparin alone groups. No dose adjustment is recommended (see Dosage and Administration, *Other Patient Populations*).

Animal Toxicology

Acute Toxicity

The approximate LD₅₀ of AGGRASTAT given as a single intravenous dose to mice or rats was >5 mg/kg. The maximum dose of 5 mg/kg (22 times the maximum recommended daily human dose) was limited by compound solubility and maximum acceptable dosing volume. The approximate LD₅₀ of AGGRASTAT given as a single oral dose to mice was >500 mg/kg. No mortality, physical signs, or compound-related effects on body weight were observed in either the intravenous or oral studies.

Chronic Toxicity

The toxic potential of tirofiban hydrochloride was evaluated in a series of continuous infusion intravenous toxicity studies of up to five weeks in rats and dogs. There were no findings that would preclude administration at the therapeutic dosage level for up to 108 hours.

Carcinogenesis

The carcinogenic potential of tirofiban hydrochloride has not been evaluated.

Mutagenesis

Tirofiban hydrochloride was negative in the microbial mutagenesis and V-79 mammalian cell mutagenesis assays. In addition, there was no evidence of direct genotoxicity in the *in vitro* alkaline elution and *in vitro* chromosomal aberration assays. Tirofiban was tested in these *in vitro* assays at concentrations up to 3 mM, approximately 20,000 times greater than the mean plasma level achieved in man at the recommended therapeutic dosage level. There was no induction of chromosomal aberrations in bone marrow cells of male mice after the administration of intravenous doses up to 5 mg/kg (22 times the maximum recommended daily human dose).

Reproduction

Fertility and reproductive performance were not affected in studies with male and female rats given intravenous doses of tirofiban hydrochloride up to 5 mg/kg/day. These dosages are approximately 22-fold higher than the maximum recommended daily dose in humans.

Development

Studies of developmental toxicity in rats and rabbits showed no evidence of maternal or foetal toxicity. In addition, a study of the potential developmental toxicity through sexual maturity of rats exposed *in utero* and during lactation showed no medicine-related effects on mortality, growth, development, and sexual maturation of the F₁ generation. In the developmental toxicity studies, dams were given tirofiban hydrochloride intravenously at doses up to 5 mg/kg/day (22 times the maximum recommended daily human dose).

Adverse Effects

The most common medicine-related adverse event reported during therapy with AGGRASTAT when used concomitantly with heparin and aspirin, was bleeding (usually reported by the investigators as oozing or mild). The incidences of major and minor bleeding using the TIMI** Criteria in the PRISM PLUS (Platelet Receptor Inhibition for Ischaemic Syndrome Management - Patients Limited by Unstable Signs and Symptoms) and RESTORE (Randomised Efficacy Study of Tirofiban for Outcomes and Restenosis) studies are shown below:

Bleeding	PRISM PLUS† (UAP/Non-Q-Wave MI Study)		RESTORE† (Angioplasty/Atherectomy Study)	
	AGGRASTAT+ Heparin (n=773) %	Heparin (n=797) %	AGGRASTAT+ Heparin (n=1071) %	Heparin (n=1070) %
Major Bleeding (TIMI Criteria)‡	1.4	0.8	2.2	1.6
Minor Bleeding (TIMI Criteria)§	10.5	8.0	12.0	6.3

Transfusions	4.0	2.8	4.3	2.5
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[†] Patients received aspirin unless contraindicated.

[‡] Haemoglobin drop of >50 g/L with or without an identified site, intracranial haemorrhage, or cardiac tamponade.

[§] Haemoglobin drop of >30 g/L with bleeding from a known site, spontaneous gross hematuria, hematemesis or hemoptysis.

There were no reports of intracranial bleeding in the PRISM PLUS study for AGGRASTAT in combination with heparin or in the control group (which received heparin). The incidence of intracranial bleeding in the RESTORE study was 0.1% for AGGRASTAT in combination with heparin and 0.3% for the control group (which received heparin). In the PRISM PLUS Study, the incidences of retroperitoneal bleeding reported for AGGRASTAT in combination with heparin, and for the control group were 0.0% and 0.1%, respectively. In the RESTORE Study, the incidences of retroperitoneal bleeding reported for AGGRASTAT in combination with heparin, and the control group were 0.6% and 0.3%, respectively.

Female patients and elderly patients receiving AGGRASTAT with heparin or heparin alone had a higher incidence of bleeding complications than male patients or younger patients, respectively. The incremental risk of bleeding in patients treated with AGGRASTAT in combination with heparin over the risk in patients treated with heparin alone was comparable regardless of age or gender. No dose adjustment is recommended for these populations (see Dosage and Administration, Other Patient Populations).

Patients treated with AGGRASTAT, with heparin, were more likely to experience decreases in platelet counts than the control group. These decreases were reversible upon discontinuation of AGGRASTAT. The percentage of patients with a decrease of platelets to <90,000 cells/mm³ was 1.5%. The percentage of patients with a decrease of platelets to <50,000 cells/mm³ was 0.3%. Platelet decreases have been observed in patients with no prior history of thrombocytopaenia upon readministration of GP IIb/IIIa receptor antagonists.

The most frequent medicine-related non-bleeding adverse effects reported with AGGRASTAT, administered concomitantly with heparin, occurring at an incidence of >1% were nausea (1.7%), fever (1.5%), and headache (1.1%); nausea, fever and headache occurred at an incidence of 1.4%, 1.1% and 1.2%, respectively, in the control group.

In clinical studies, the incidences of adverse events were generally similar among different races, patients with or without hypertension, patients with or without diabetes mellitus, and patients with or without hypercholesterolaemia.

The overall incidence of non-bleeding adverse events was higher in female patients (compared to male patients) and older patients (compared to younger patients). However, the incidences of non-bleeding adverse events in these patients were comparable between the AGGRASTAT with heparin and the heparin alone groups. (See above for bleeding adverse events).

The following additional adverse reactions have been reported in post-marketing experience:

Bleeding: intracranial bleeding, retroperitoneal bleeding, hemopericardium, pulmonary (alveolar) haemorrhage and spinal-epidural haematoma. Fatal bleedings have been reported rarely.

Body as a whole: Acute and/or severe decreases in platelet counts which may be

associated with chills, low-grade fever, or bleeding complications (see above).

Hypersensitivity: Severe allergic reactions including anaphylactic reactions. The reported cases have occurred during the first day of tirofiban infusion, during initial treatment, and during readministration of tirofiban. Some cases have been associated with severe thrombocytopenia (platelet counts < 10,000/).

Laboratory Test Findings

The most frequently observed laboratory adverse events in patients receiving AGGRASTAT concomitantly with heparin were related to bleeding. Decreases in haemoglobin and haematocrit, and platelet count were observed. Increases in the presence of urine and faecal occult blood were also observed.

Interactions

AGGRASTAT has been studied on a background of aspirin and heparin.

The use of AGGRASTAT, in combination with heparin and aspirin, has been associated with an increase in bleeding compared to heparin and aspirin alone (see Adverse Effects). Caution should be employed when AGGRASTAT is used with other medicines that affect haemostasis (e.g., warfarin) (see Warnings and Precautions, *Bleeding Precautions*).

AGGRASTAT has been used concomitantly in clinical studies with beta-blockers, calcium channel blockers, non-steroidal anti-inflammatory agents (NSAIDs) and nitrate preparations without evidence of clinically significant adverse interactions.

In a sub-set of patients (n=762) in the PRISM study (Platelet Receptor Inhibition for Ischaemic Syndrome Management), the plasma clearance of tirofiban in patients receiving one of the following medicines was compared to that in patients not receiving that medicine. There were no clinically significant interactions of these medicines on the plasma clearance of tirofiban: acebutolol, acetaminophen, alprazolam, amlodipine, aspirin preparations, atenolol, bromazepam, captopril, diazepam, digoxin, diltiazem, docusate sodium, enalapril, furosemide, glyburide, heparin, insulin, isosorbide, levothyroxine, lorazepam, lovastatin, metoclopramide, metoprolol, morphine, nifedipine, nitrate preparations, omeprazole, oxazepam, potassium chloride, propranolol, ranitidine, simvastatin, sucralfate and temazepam.

Overdosage

In clinical trials, inadvertent overdosage with tirofiban occurred in doses up to 5 times and 2 times the recommended dose for bolus administration and loading infusion, respectively. Inadvertent overdosage occurred in doses up to 9.8 times the 0.15 mcg/kg/min maintenance infusion rate.

The most frequently reported manifestation of overdosage was bleeding, primarily minor mucocutaneous bleeding events and minor bleeding at the sites of cardiac catheterisation (see Warnings and Precautions, *Bleeding Precautions*).

Overdosage of tirofiban should be treated by assessment of the patient's clinical condition and cessation or adjustment of the medicine infusion as appropriate.

AGGRASTAT can be removed by haemodialysis.

Actions

Platelet activation, adhesion and aggregation represent critical initiating steps in the formation of arterial thrombus overlying disrupted atherosclerotic plaque. Thrombus

formation is central to the pathophysiology of the acute coronary ischaemic syndromes of unstable angina and myocardial infarction, as well as to cardiac ischaemic complications following coronary angioplasty.

AGGRASTAT is a non-peptide antagonist of the GP IIb/IIIa receptor, the major platelet surface receptor involved in platelet aggregation. AGGRASTAT prevents binding of fibrinogen to GP IIb/IIIa, thereby blocking the cross-linking of platelets and platelet aggregation.

Pharmacokinetics

Distribution

Tirofiban is not highly bound to plasma proteins and protein binding is concentration independent over the range of 0.01 to 25 mcg/mL. Unbound fraction in human plasma is 35%. The steady state volume of distribution of tirofiban ranges from 22 to 42 litres. Tirofiban crosses the placenta in rats and rabbits.

Metabolism

Profiling of ¹⁴C-labeled tirofiban in urine and faeces indicates that the radioactivity was accounted for mainly by unchanged tirofiban. Circulating plasma radioactivity is accounted for mainly by unchanged tirofiban (up to 10 hours postdose). These data suggest limited metabolism of tirofiban.

Elimination

Following an intravenous dose of ¹⁴C-labeled tirofiban in healthy subjects, 66% of radioactivity is recovered in the urine and 23% in the faeces. Total radioactivity recovery is about 91%. Both urinary and biliary excretion contribute significantly to the elimination of tirofiban.

In healthy subjects, the plasma clearance of tirofiban ranges from 213 to 314 mL/min. Renal clearance accounts for 39 to 69% of plasma clearance. Half-life ranges from 1.4 to 1.8 hours.

In patients with coronary artery disease, the plasma clearance of tirofiban ranges from 152 to 267 mL/min. Renal clearance accounts for 39% of plasma clearance. Half-life ranges from 1.9 to 2.2 hours.

Tirofiban is excreted in rat milk.

Characteristics in Patients

Gender

Plasma clearance of tirofiban in patients with coronary artery disease is similar in males and females.

Elderly

Plasma clearance of tirofiban is about 19 to 26% lower in elderly (>65 years) patients with coronary artery disease compared to younger (≤65 years) patients.

Race

No difference in plasma clearance was detected in patients of different races.

Hepatic Insufficiency

In patients with mild to moderate hepatic insufficiency, plasma clearance of tirofiban is not significantly different compared to healthy subjects.

Renal Insufficiency

Plasma clearance of tirofiban is lower to a clinically significant extent (>50%) in patients with creatinine clearance <30 mL/min, including patients requiring haemodialysis (see Dosage and Administration, *Patients with Severe Renal Insufficiency*). Tirofiban is removed by haemodialysis.

Pharmaceutical Precautions

Concentrate for Infusion

Store between 15-30°C. Do not freeze. Protect from light during storage.

Medicine Classification

Prescription medicine

Package Quantities

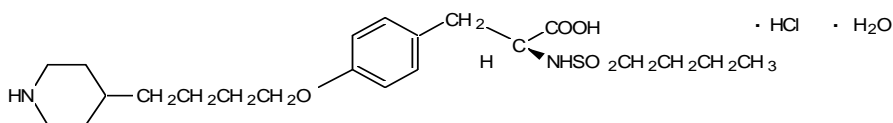
AGGRASTAT is available as single dose vials

Further Information

Chemistry

Tirofiban hydrochloride monohydrate, a non-peptide molecule, is chemically described as *N*-(butylsulfonyl)-*O*-[4-(4-piperidiny)butyl]-*L*-tyrosine monohydrochloride monohydrate.

Its empirical formula is $\bullet\text{HCl}\bullet$, and its structural formula is:



Tirofiban hydrochloride monohydrate is a white to off-white non-hygroscopic free-flowing powder, with a molecular weight of 495.08. It is very slightly soluble in water.

AGGRASTAT Concentrate for Infusion is a sterile concentrated solution for intravenous infusion after dilution and is supplied in a 50mL vial. Each mL of the solution contains 0.281mg of tirofiban hydrochloride monohydrate equivalent to 0.25 mg of tirofiban.

Composition

Active Ingredients

AGGRASTAT is supplied as an intravenous solution containing 0.25 mg/mL tirofiban free base.

Inactive Ingredients

Each mL of AGGRASTAT Concentrate for Infusion contains the following inactive ingredients: 0.16 mg citric acid anhydrous, 2.7 mg sodium citrate dihydrate and 8 mg sodium chloride. The pH ranges from 5.5 to 6.5 and may have been adjusted with hydrochloric acid and/or sodium hydroxide.

Name and Address

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Footnotes:

**Bovill, EG; et al: Haemorrhagic Events during Therapy with Recombinant Tissue-Type Plasminogen Activator, Heparin, and Aspirin for Acute Myocardial Infarction, Results of the Thrombolysis in Myocardial Infarction (TIMI), Phase II Trial, *Annals of Internal Medicine*, 115(4):256-265, 1991.