

PRODUCT MONOGRAPH

^{Pr}ratio-SUMATRIPTAN

(Sumatriptan Succinate Tablets)

25 mg, 50 mg and 100 mg Sumatriptan

5-HT₁ Receptor Agonist

Migraine Therapy

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(Sumatriptan Succinate Tablets)

25 mg, 50 mg and 100 mg Sumatriptan

THERAPEUTIC CLASSIFICATION

Migraine Therapy

PHARMACOLOGIC CLASSIFICATION

5-HT₁ Receptor Agonist

CLINICAL PHARMACOLOGY

Sumatriptan succinate has been shown to be effective in relieving migraine headache. It is an agonist for a vascular 5-hydroxytryptamine_{1D} (5-HT_{1D}) receptor subtype (a member of the 5-HT₁ family), and has only weak affinity for 5-HT_{1A} receptors and no significant activity (as measured using standard radioligand binding assays) or pharmacological activity at 5-HT₂, 5-HT₃, 5-HT₄, 5-HT_{5A}, or 5-HT₇ receptor subtypes, or at alpha₁-, alpha₂-, or beta-adrenergic; dopamine, or dopamine₂; muscarinic; or benzodiazepine receptors.

The therapeutic activity of sumatriptan succinate in migraine is generally attributed to its agonist activity at 5-HT_{1B}/5-HT_{1D} receptors. Two current theories have been proposed to explain the efficacy of 5-HT₁ receptor agonists in migraine. One theory suggests that activation of 5-HT₁ receptors located on intracranial blood vessels, including those on the arteriovenous anastomoses, leads to vasoconstriction, which is believed to be correlated with the relief of migraine headache. The other hypothesis suggests that activation of 5-HT₁ receptors on perivascular fibres of the trigeminal system results in the inhibition of pro-inflammatory neuropeptide release. These theories are not mutually exclusive.

Experimental data from animal studies shows that sumatriptan succinate also activates 5-HT₁ receptors on peripheral terminals of the trigeminal nerve which innervates cranial blood vessels. This causes the inhibition of neuropeptide release. It is thought that such an action may contribute to the anti-migraine

action of sumatriptan succinate in humans.

Cardiovascular Effects

In vitro studies in human isolated epicardial coronary arteries suggest that the predominant contractile effect of 5-HT is mediated via 5-HT₂ receptors. However, 5-HT₁ receptors also contribute to some degree to the contractile effect seen. Transient increases in systolic and diastolic blood pressure (up to 20 mmHg) of rapid onset (within minutes), have occurred after intravenous administration of up to 64 µg/kg (3.2 mg for 50 kg subject) to healthy volunteers. These changes were not dose related and returned to normal within 10-15 minutes. Following oral administration of 200 mg or intranasal administration of 40 mg, however, mean peak increases in blood pressure were smaller and of slower onset than after intravenous or subcutaneous administration.

Pharmacokinetics

Pharmacokinetic parameters following oral administration is shown in Table 1. Sumatriptan succinate is rapidly absorbed after oral administration. The low oral bioavailability is primarily due to metabolism (hepatic and pre-systemic) and partly due to incomplete absorption. The oral absorption of sumatriptan succinate is not significantly affected either during migraine attacks or by food. Inter-patient and intra-patient variability was noted in most pharmacokinetic parameters assessed.

Table 1: Summary of Pharmacokinetic Parameters

Parameter	Oral
Bioavailability	14%
C _{max} (ng/mL)	100 mg: 50 - 60 ng/mL 25 mg: 18 ng/mL
T _{max}	100 mg: 0.5 - 5 hr*
T _{1/2}	2 hr (1.9-2.2 hr)
Protein Binding	14-21%
Volume of Distribution	170L
Total Plasma Clearance	1160 mL/min
Renal Plasma Clearance	260 mL/min

*70% to 80% of C_{max} values were attained within 30-45 minutes of dosing.

In vitro studies with human microsomes suggest that sumatriptan succinate is metabolized by monoamine oxidase (MAO), predominantly the A isoenzyme. In studies conducted in a limited number of patients, MAO inhibitors reduce sumatriptan succinate clearance, significantly increasing systemic exposure.

Non-renal clearance of sumatriptan succinate accounts for about 80% of the total clearance. The major metabolite, the indole acetic acid analogue of sumatriptan succinate is mainly excreted in the urine where it is present as a free acid (35%) and the glucuronide conjugate (11%). It has no known 5-HT₁ or 5-HT₂ activity. Minor metabolites have not been identified.

No differences have been observed between the pharmacokinetic parameters in healthy elderly volunteers compared with younger volunteers (less than 65 years old).

Significant relief begins about 30 minutes following oral administration.

Bioequivalence Studies

A Two-Way Crossover, Single Dose, Fasting, comparative bioavailability study of Sumatriptan 100 mg tablets was performed *versus* GlaxoSmithKline, IMITREX 100 mg Tablets. Bioavailability data were measured and the results are summarized in the following table:

Table 2
SUMMARY TABLE OF THE COMPARATIVE BIOAVAILABILITY DATA
FOR SINGLE DOSE STUDIES

Sumatriptan Succinate
(1 x 100 mg)
From measured data
Uncorrected for Potency
Geometric Mean

Arithmetic Mean (CV%)

PARAMETER	TEST SUMATRIPTAN	REFERENCE Imitrex ^{®**}	% RATIO OF GEOMETRIC MEANS	90% CONFIDENCE INTERVAL
AUC (ng.h/mL)	194.98 200.55 (24.01)	188.28 194.40 (26.88)	103.56	97.84 - 109.61
AUC _{refTmax} (ng.h/mL)	40.98 56.24 (70.48)	43.35 52.24 (57.85)	94.52	
AUC ₁ (ng.h/mL)	207.30 212.38 (22.63)	199.93 205.37 (25.45)	103.69	97.82 - 109.91
C _{max} (ng/mL)	43.47 46.21 (34.11)	42.06 43.68 (28.09)	103.37	92.81 - 115.12
T _{max} [*] (h)	2.29 (86.71)	2.23 (59.44)	----	
T _{1/2} [*] (h)	2.42 (20.03)	2.32 (16.81)	----	

* Expressed as the arithmetic mean (CV%) only.

** Imitrex[®] manufactured by GlaxoSmithKline Inc. and purchased in Canada.

CLINICAL STUDIES

Migraine

The efficacy of sumatriptan succinate tablets for the treatment of migraine was established in four multicentre, randomized, placebo-controlled studies. Patients enrolled and treated in these studies were primarily female (84%), Caucasian (98%) and with a mean age of 40 years (range of 18 to 65 years). Patients were instructed to treat a moderate to severe headache. In Study 2, up to three doses were permitted to treat a single attack within a 24 hour period, non-responders could take a second dose at two hours, while any recurrence of migraine could be treated with a third dose. Study 1, 3 and 4 were designed to allow for the treatment of up to three attacks.

Headache relief at two hours was statistically significantly greater for all sumatriptan succinate groups when compared to placebo (see Table 3).

Table 3: Percentage of Patients with Headache Relief (0/1)¹ at 2 Hours Post Oral Dose for the Treatment of Migraine

Study	Placebo (%)	25 mg (%)	50 mg (%)	100 mg (%)
Study 1	27 (n=212)	-	-	67* (n=313)
Study 2	19 (n=84)	-	-	50* (n=149)
Study 3	23 (n=154)	-	49 (n=331)	-
Study 4	28 (n=98)	47** (n=303)	61* (n=302)	61* (n=298)

¹Headache relief is defined as a reduction in headache severity from grade 3 or 2 (severe or moderate) to grade 1 or 0 (mild or no pain)

- = not evaluated

* p<0.001 vs. placebo

** p=0.001 vs. placebo

In study 4, the 50mg (p=0.002) and 100mg (p=0.003) groups had significantly more patients experience headache relief compared to the 25mg group at 2 hours.

For patients with migraine-associated nausea, photophobia, phonophobia at baseline, there was a decrease incidence of these symptoms following administration of sumatriptan succinate tablets compared to placebo.

Menstrually-Associated Migraine

Two multicentre, randomized, placebo-controlled studies evaluated sumatriptan succinate 50mg and 100mg tablets administered during the mild phase of a menstrually-associated migraine attack. A total of 816 subjects with a mean age of 37 (18-65 years of age), with at least a 1-year history of migraine, and a 6-month history of regularly occurring MAM, were enrolled and treated. MAM was defined as any migraine beginning on Day-2, to +4 with day 1 = the first day of flow. patients were instructed to treat a single, mild, moderate or severe headache within one hour of mild pain onset.

A statistically significantly higher proportion of patients following sumatriptan succinate 50 mg and 100 mg achieved pain-free status at 2 hours post-dose compared with placebo in the treatment of menstrually-associated migraine (see Table 4).

Table 4: Percentage of Patients with Complete Headache Pain Relief¹ at 2 hours Post Oral Dose for the treatment of Menstrually-associated Migraine

Study	Placebo (%)	50 mg (%)	100 mg (%)
Study 1	22 (n=132)	51* (n=138)	58* (n=133)
Study 2	29 (n=118)	51* (n=116)	61* (n=115)

¹ Complete Headache Pain Relief is defined as grade 1 (mild pain) reduced to grade 0 (no pain)

* p<0.001 vs. placebo

For patients with migraine-associated nausea, photophobia, phonophobia at baseline, there was a decrease incidence of these symptoms following administration of sumatriptan succinate compared to placebo.

INDICATIONS AND CLINICAL USES

ratio-SUMATRIPTAN (sumatriptan succinate) is indicated for the acute treatment of migraine attacks with or without aura.

ratio-SUMATRIPTAN is not for use in the management of hemiplegic, basilar, or ophthalmoplegic migraine (see **CONTRAINDICATIONS**). Safety and efficacy have not been established for cluster headache which is present in an older, predominantly male population.

CONTRAINDICATIONS

ratio-SUMATRIPTAN (sumatriptan succinate) is contraindicated in patients with history, symptoms, or signs of ischemic cardiac, cerebrovascular, or peripheral vascular syndromes, valvular heart disease or cardiac arrhythmias (especially tachycardias). In addition, patients with other significant underlying cardiovascular diseases (e.g., atherosclerotic disease, congenital heart disease) should not receive ratio-SUMATRIPTAN. Ischemic cardiac syndromes include, but are not limited to, angina pectoris; of any type (e.g., stable angina of effort and vasospastic forms of angina such as the Prinzmetal's variant), all forms of myocardial infarction, and silent myocardial ischemia. Cerebrovascular syndromes include, but are not limited to, strokes of any type as well as transient ischemic attacks (TIAs). Peripheral vascular disease includes, but is not limited to, ischemic bowel disease, or Raynaud's syndrome (see WARNINGS).

Because ratio-SUMATRIPTAN may increase blood pressure, it is contraindicated in patients with

uncontrolled or severe hypertension.

Concurrent administration of MAO inhibitors or use within 2 weeks of discontinuation of MAO inhibitor therapy is contraindicated (see CLINICAL PHARMACOLOGY and PRECAUTIONS: DRUG INTERACTIONS).

Ergot-containing drugs have been reported to cause prolonged vasospastic reactions. Because ratio-SUMATRIPTAN may also cause coronary vasospasm and these effects may be additive, the use of ratio-SUMATRIPTAN within 24 hours before or after treatment with other 5-HT₁ receptor agonists, or ergotamine-containing drugs or their derivatives (e.g. dihydroergotamine, methysergide) is contraindicated.

ratio-SUMATRIPTAN should not be administered to patients with severe hepatic impairment.

ratio-SUMATRIPTAN is contraindicated in patients with hemiplegic, basilar, or ophthalmoplegic migraine.

ratio-SUMATRIPTAN is contraindicated in patients with hypersensitivity to sumatriptan succinate or any of the ingredients of the formulations.

WARNINGS

ratio-SUMATRIPTAN (sumatriptan succinate) should only be used where a clear diagnosis of migraine has been established.

Risk of Myocardial Ischemia and/or Infarction and Other Adverse Cardiac Events: Sumatriptan succinate has been associated with transient chest and/or neck pain and tightness which may resemble angina pectoris. In rare cases, the symptoms have been identified as being the likely result of coronary vasospasm or myocardial ischemia. Rare cases of serious coronary events or arrhythmia have occurred following use of sumatriptan succinate ratio-SUMATRIPTAN should not be given to patients who have documented ischemic or vasospastic coronary artery disease (CAD) (see CONTRAINDICATIONS). It is strongly recommended that ratio-SUMATRIPTAN not be given to patients in whom unrecognized CAD is predicted by the presence of risk factors (e.g., hypertension, hypercholesterolemia, smoking, obesity, diabetes, strong family history of CAD, female who is surgically or physiologically postmenopausal, or male who is over 40 years of age)

unless a cardiovascular evaluation provides satisfactory clinical evidence that the patient is reasonably free of coronary artery and ischemic myocardial disease or other significant underlying cardiovascular disease. The sensitivity of cardiac diagnostic procedures to detect cardiovascular disease or predisposition to coronary artery vasospasm is unknown. If, during the cardiovascular evaluation, the patient's medical history or electrocardiographic investigations reveal findings indicative of, or consistent with, coronary artery vasospasm or myocardial ischemia, ratio-SUMATRIPTAN should not be administered (see CONTRAINDICATIONS).

For patients with risk factors predictive of CAD, who are considered to have a satisfactory cardiovascular evaluation, the first dose of ratio-SUMATRIPTAN should be administered in the setting of a physician's office or similar medically staffed and equipped facility. Because cardiac ischemia can occur in the absence of clinical symptoms, consideration should be given to obtaining electrocardiograms in patients with risk factors during the interval immediately following ratio-SUMATRIPTAN administration on the first occasion of use. However, an absence of drug-induced cardiovascular effects on the occasion of the initial dose does not preclude the possibility of such effects occurring with subsequent administrations.

Intermittent long term users of sumatriptan succinate who have or acquire risk factors predictive of CAD, as described above, should receive periodic interval cardiovascular evaluations over the course of treatment.

If symptoms consistent with angina occur after the use of ratio-SUMATRIPTAN, ECG evaluation should be carried out to look for ischemic changes.

The systematic approach described above is intended to reduce the likelihood that patients with unrecognized cardiovascular disease will be inadvertently exposed to ratio-SUMATRIPTAN

Cardiac Events and Fatalities Associated with 5-HT₁-Agonists: ratio-SUMATRIPTAN can cause coronary artery vasospasm. Serious adverse cardiac events, including acute myocardial infarction, life threatening disturbances of cardiac rhythm, and death have been reported within a few hours following the administration of 5-HT₁ agonists. Considering the extent of use of 5-HT₁ agonists in patients with migraine, the incidence of these events is extremely low. The fact that some of these events have occurred in patients with no prior cardiac disease history and with documented absence of CAD, and the close proximity of the events to sumatriptan succinate use support the conclusion that some of these cases were

caused by the drug. In many cases, however, where there has been known underlying coronary artery disease, the relationship is uncertain.

Premarketing Experience With Sumatriptan Succinate: Of 6348 patients with migraine who participated in premarketing controlled and uncontrolled clinical trials of oral sumatriptan succinate two experienced clinical adverse events shortly after receiving oral sumatriptan succinate that may have reflected coronary vasospasm. Neither of these adverse events was associated with a serious clinical outcome.

Postmarketing Experience With Sumatriptan Succinate: Serious cardiovascular events, some resulting in death, have been reported in association with the use of sumatriptan succinate tablets. The uncontrolled nature of postmarketing surveillance, however, makes it impossible to determine definitively the proportion of the reported cases that were actually caused by sumatriptan succinate or to reliably assess causation in individual cases. On clinical grounds, the longer the latency between the administration of sumatriptan succinate and the onset of the clinical event, the less likely the association is to be causative. Accordingly, interest has focused on events beginning within 1 hour of the administration of sumatriptan succinate.

Cardiac events that have been observed to have onset within 1 hour of sumatriptan succinate administration include: coronary artery vasospasm, transient ischemia, myocardial infarction, ventricular tachycardia and ventricular fibrillation, cardiac arrest, and death.

Some of these events occurred in patients who had no findings of CAD and appear to represent consequences of coronary artery vasospasm. However, among reports from the USA of serious cardiac events occurring within 1 hour of sumatriptan succinate administration, almost all of the patients had risk factors predictive of CAD and the presence of significant underlying CAD was established in most cases (see **CONTRAINDICATIONS**).

Cerebrovascular Events and Fatalities with 5-HT₁ Agonists: Cerebral hemorrhage, subarachnoid hemorrhage, stroke, and other cerebrovascular events have been reported in patients treated with oral sumatriptan succinate and some have resulted in fatalities. The relationship of sumatriptan succinate to these events is uncertain. In a number of cases, it appears possible that the cerebrovascular events were primary, sumatriptan succinate having been administered in the incorrect belief that the symptoms experienced were a consequence of migraine when they were not. Sumatriptan succinate should not be administered if the headache being experienced is atypical for the patient. It should also be noted that patients with migraine may be at increased risk of certain cerebrovascular events (e.g., stroke,

hemorrhage, TIA). If a patient does not respond to the first dose, the opportunity should be taken to review the diagnosis before a second dose is given.

Special Cardiovascular Pharmacology Studies: In subjects (n=10) with suspected coronary artery disease undergoing angiography, a 5-HT₁ agonist at a subcutaneous dose of 1.5 mg produced an 8% increase in aortic blood pressure, an 18% increase in pulmonary artery blood pressure, and an 8% increase in systemic vascular resistance. In addition, mild chest pain or tightness was reported by four subjects. Clinically significant increases in blood pressure were experienced by three of the subjects (two of whom also had chest pain/discomfort). Diagnostic angiogram results revealed that 9 subjects had normal coronary arteries and 1 had insignificant coronary artery disease.

In an additional study with this same drug, migraine patients (n=35) free of cardiovascular disease were subjected to assessments of myocardial perfusion by positron emission tomography while receiving a subcutaneous 1.5 mg dose in the absence of a migraine attack. Reduced coronary vasodilatory reserve (~10%), increase in coronary resistance (~20%), and decrease in hyperemic myocardial blood flow (~10%) were noted. The relevance of these findings to the use of the recommended oral doses of this 5-HT₁ agonist is not known.

Similar studies have not been done with sumatriptan succinate. However, owing to the common pharmacodynamic actions of 5-HT₁ agonists, the possibility of cardiovascular effects of the nature described above should be considered for any agent of this pharmacological class.

Hypersensitivity: Rare hypersensitivity (anaphylaxis/anaphylactoid) reactions may occur in patients receiving 5-HT₁ agonists; such as ratio-SUMATRIPTAN. Such reactions can be life threatening or fatal. In general, hypersensitivity reactions to drugs are more likely to occur in individuals with a history of sensitivity to multiple allergens (see **CONTRAINDICATIONS**). Owing to the possibility of cross-reactive hypersensitivity reactions, ratio-SUMATRIPTAN should not be used in patients having a history of hypersensitivity to chemically-related 5-HT₁ receptor agonists. There have been reports of patients with known hypersensitivity to sulphonamides exhibiting an allergic reaction following administration of sumatriptan succinate. Reactions ranged from cutaneous hypersensitivity to anaphylaxis.

Other Vasospasm Related Events: 5-HT₁ agonists may cause vasospastic reactions other than coronary artery vasospasm. Extensive post-market experience has shown the use of sumatriptan succinate to be associated with rare occurrences of peripheral vascular ischemia and colonic ischemia with abdominal pain and bloody diarrhea.

Increase in Blood Pressure: Significant elevation in blood pressure, including hypertensive crisis, has been reported on rare occasions in patients with and without a history of hypertension. ratio-SUMATRIPTAN is contraindicated in patients with uncontrolled or severe hypertension (see **CONTRAINDICATIONS**). In patients with controlled hypertension, ratio-SUMATRIPTAN should be administered with caution, as transient increases in blood pressure and peripheral vascular resistance have been observed in a small portion of patients.

PRECAUTIONS

Cluster Headache: There is insufficient information on the efficacy and safety of sumatriptan succinate in the treatment of cluster headache, which is present in an older, predominantly male population. The need for prolonged use and the demand for repeated medication in this condition renders the dosing information inapplicable for cluster headache.

Cardiovascular: Discomfort in the chest, neck, throat and jaw (including pain, pressure, heaviness and tightness) has been reported after administration of sumatriptan succinate. Because 5-HT₁ agonists may cause coronary artery vasospasm, patients who experience signs or symptoms suggestive of angina following ratio-SUMATRIPTAN should be evaluated for the presence of CAD or a predisposition to variant angina before receiving additional doses, and should be monitored electrocardiographically if dosing is resumed and similar symptoms recur. Similarly, patients who experience other symptoms or signs suggestive of decreased arterial flow, such as ischemic bowel syndrome or Raynaud's syndrome following ratio-SUMATRIPTAN should be evaluated for atherosclerosis or, predisposition to vasospasm (see **CONTRAINDICATIONS AND WARNINGS**).

Neurological Conditions: Care should be taken to exclude other potentially serious neurologic conditions before treating headache in patients not previously diagnosed with migraine headache or who experience a headache that is atypical for them. There have been rare reports where patients received 5-HT₁ agonists for severe headaches that were subsequently shown to have been secondary to an evolving neurologic lesion. For newly diagnosed patients or patients presenting with atypical symptoms, the diagnosis of migraine should be reconsidered if no response is seen after the first dose of ratio-SUMATRIPTAN.

Seizures: Caution should be observed if ratio-SUMATRIPTAN is to be used in patients with a history of epilepsy or structural brain lesions which lower the convulsion threshold.

Psychomotor Impairment: Patients should be cautioned that drowsiness may occur as a result of treatment with ratio-SUMATRIPTAN. They should be advised not to perform skilled tasks (e.g. driving or operating machinery) if drowsiness occurs.

Renal Impairment: The effects of renal impairment on the efficacy and safety of sumatriptan succinate have not been evaluated. Therefore ratio-SUMATRIPTAN is not recommended in this patient population.

Hepatic Impairment: The effect of hepatic impairment on the efficacy and safety of sumatriptan succinate has not been evaluated, however, the pharmacokinetic profile of sumatriptan succinate in patients with moderate¹ hepatic impairment shows that these patients, following an oral dose of 50 mg, have much higher plasma sumatriptan succinate concentrations than healthy subjects (Table 5). Therefore, an oral dose of 25 mg may be considered in patients with hepatic impairment.

Table 5: Pharmacokinetic Parameters After Oral Administration of Sumatriptan Succinate 50 mg to Healthy Volunteers and Moderately Hepatically Impaired Patients

Parameter	Mean Ratio (hepatic impaired/healthy) n=8	90% CI	p-value
AUC _∞	181%	130 to 252%	0.009*
C _{max}	176%	129 to 240%	0.007*

*Statistically significant

Drug Interactions: Single dose pharmacokinetic drug interaction studies have not shown evidence of interactions with propranolol, flunarizine, pizotifen or alcohol. Multiple dose interaction studies have not been performed.

Ergot-Containing Drugs: Ergot-containing drugs have been reported to cause prolonged vasospastic reactions. Because there is a theoretical basis for these effects being additive, ergot-containing or ergot-type medications (like dihydroergotamine or methysergide) are contraindicated within 24 hours of ratio-SUMATRIPTAN administration (see **CONTRAINDICATIONS**).

MAO Inhibitors: In studies conducted in a limited number of patients, MAO inhibitors reduce sumatriptan succinate clearance, significantly increasing systemic exposure. Therefore, the use of ratio-

¹Assessed by aminopyrine breath test (>0.2-0.4 scaling units).

SUMATRIPTAN in patients receiving MAO inhibitors is contraindicated (see **CONTRAINDICATIONS**, and **CLINICAL PHARMACOLOGY**).

Other Serotonergic Drugs: Rare postmarketing reports describe patients with weakness, hyperreflexia, and incoordination following the combined use of a selective serotonin reuptake inhibitor (SSRI) and 5-HT₁ agonists. If concomitant treatment with ratio-SUMATRIPTAN and an SSRI (e.g., fluoxetine, fluvoxamine, paroxetine, sertraline), tricyclic antidepressant, or other drug with serotonergic activity is clinically warranted, appropriate observation of the patient for acute and long-term adverse events is advised.

Other 5-HT₁ agonists: The administration of sumatriptan succinate with other 5-HT₁ agonists has not been evaluated in migraine patients. As an increased risk of coronary vasospasm is a theoretical possibility with co-administration of 5-HT₁ agonists, use of these drugs within 24 hours of each other is contraindicated.

Drug/Laboratory Test Interactions: Sumatriptan succinate is not known to interfere with commonly employed clinical laboratory tests.

Use in Elderly (>65 years): Experience of the use of sumatriptan succinate in patients aged over 65 years is limited. Therefore the use of ratio-SUMATRIPTAN in patients over 65 years is not recommended.

Use in Children (<18 years): The safety and efficacy of sumatriptan succinate in children has not been established and its use in this age group is not recommended.

Use in Pregnancy: Reproduction studies, performed in rats, have not revealed any evidence of impaired fertility, teratogenicity, or post-natal development due to sumatriptan succinate. Reproduction studies, performed in rabbits by the oral route, have shown increased incidence of variations in cervico-thoracic blood vessel configuration in the foetuses. These effects were only seen at the highest dose tested, which affected weight gain in the dams, and at which blood levels were in excess of 50 times those seen in humans after therapeutic doses. A direct association with sumatriptan succinate treatment is considered unlikely but cannot be excluded. Therefore, the use of ratio-SUMATRIPTAN is not recommended in pregnancy.

In a rat fertility study, oral doses of sumatriptan succinate resulting in plasma levels approximately 150 times those seen in humans after a 6 mg subcutaneous dose and approximately 200 times those seen in humans after a 100 mg oral dose were associated with a reduction in the success of insemination. This

effect did not occur during a subcutaneous study where maximum plasma levels achieved approximately 100 times those in humans; by the subcutaneous route and approximately 150 times those in humans by the oral route.

Lactation: Sumatriptan succinate is excreted in human breast milk. Therefore, caution is advised when administering ratio-SUMATRIPTAN to nursing women. Infant exposure can be mimised by avoiding breast feeding for 24 hours after treatment.

Binding to Melanin Containing Tissues: In rats treated with a single subcutaneous dose (0.5 mg/kg) or oral dose (2 mg/kg) of radiolabeled sumatriptan succinate, the elimination half life of radioactivity from the eye was 15 and 23 days, respectively, suggesting that sumatriptan succinate and/or its metabolites bind to the melanin of the eye. Because there could be an accumulation in melanin rich tissues over time, this raises the possibility that sumatriptan succinate could cause toxicity in these tissues after extended use. However, no effects on the retina related to treatment with sumatriptan succinate were noted in any of the oral or subcutaneous toxicity studies. Although no systematic monitoring of ophthalmologic function was undertaken in clinical trials, and no specific recommendations for ophthalmologic monitoring are offered, prescribers should be aware of the possibility of long term ophthalmologic effects.

Laboratory Tests: No specific laboratory tests are recommended for monitoring patients prior to and/or after treatment with sumatriptan succinate.

ADVERSE REACTIONS

Serious cardiac events, including some that have been fatal, have occurred following the use of 5-HT₁ agonists. These events are extremely rare and most have been reported in patients with risk factors predictive of CAD. Events reported have included coronary artery vasospasm, transient myocardial ischemia, myocardial infarction, ventricular tachycardia, and ventricular fibrillation (see CONTRAINDICATIONS, WARNINGS, and PRECAUTIONS).

Experience in Controlled Clinical Trials with sumatriptan succinate

Typical 5-HT₁ Agonist Adverse Reactions: As with other 5-HT₁ agonists, sumatriptan succinate has been associated with sensations of heaviness, pressure, tightness or pain which may be intense. These may occur in any part of the body including the chest, throat, neck, jaw and upper limb.

Acute Safety. In placebo-controlled migraine trials, 3095 patients received at least one dose of oral sumatriptan succinate. Table 6 lists adverse events occurring at an incidence of 1% or more in any of the sumatriptan succinate dose groups and that occurred at a higher incidence than in the placebo groups.

Table 6: Treatment-Emergent Adverse Events in Oral Placebo-Controlled Clinical Trials Reported by at least 1% of Patients with Migraine

	Placebo	Sumatriptan succinate 25 mg	Sumatriptan succinate 50 mg	Sumatriptan succinate 100 mg**
Number of Patients	690	351	723	2021
Number of Migraine Attacks Treated	1187	945	1889	14750
<i>Symptoms of Potentially Cardiac Origin</i>				
• Chest Sensation*	0.6%	2.3%	2.6%	3.2%
• Neck/Throat/Jaw Sensations*	1.4%	2.3%	3.5%	5.2%
• Upper Limb Sensations*	1.2%	1.4%	2.5%	3.6%
• Palpitations	0.6%	0.3%	1.0%	1.1%
<i>Neurological</i>				
• Head/Face Sensations*	1.3%	2.3%	2.5%	4.7%
• Dizziness	2.5%	3.1%	3.3%	6.2%
• Headache	3.3%	4.0%	2.2%	3.3%
• Vertigo	0.6%	1.1%	1.1%	1.0%
• Drowsiness	1.6%	1.1%	1.2%	2.1%
• Tremor	0.4%	0.9%	0.4%	1.1%
<i>Gastrointestinal</i>				
• Nausea	5.8%	2.8%	4.4%	11.0%
• Hyposalivation	1.2%	1.4%	1.1%	1.2%
• Vomiting	2.9%	4.3%	1.1%	4.4%
• Gastrointestinal Discomfort & Pain	1.4%	1.1%	0.8%	2.0%
• Abdominal Discomfort & Pain	0.3%	NR	0.4%	1.2%
• Diarrhea	0.9%	0.3%	0.6%	1.1%
<i>Musculoskeletal</i>				
• Musculoskeletal Pain	0.7%	2.3%	0.4%	1.4%
• Muscle Pain	0.3%	0.9%	0.1%	1.0%
• Muscle Atrophy Weakness & Tiredness	NR	0.6%	0.4%	1.4%
<i>Ear, Nose & Throat</i>				
• Infections	0.6%	0.6%	1.1%	1.4%
• Nasal Signs & Symptoms	0.7%	1.4%	0.8%	1.0%
• Throat & Tonsil Symptoms	0.6%	NR	0.4%	2.3%
<i>Respiratory</i>				
• Viral Infection	0.3%	1.1%	0.1%	1.0%
<i>Non-Site Specific</i>				
• Limb Sensations*	0.4%	1.1%	0.4%	1.5%

	Placebo	Sumatriptan succinate 25 mg	Sumatriptan succinate 50 mg	Sumatriptan succinate 100 mg**
• Sensations* (body region unspecified)	4.5%	5.7%	8.0%	9.0%
• Malaise/Fatigue	5.1%	3.7%	2.6%	9.5%
• Sweating	0.4%	0.6%	0.6%	1.6%

* The term "sensations" encompasses adverse events described as pain and discomfort, pressure, heaviness, constriction, tightness, heat/burning sensation, paresthesia, numbness, tingling and strange sensations.

** Includes patients receiving up to 3 doses of 100 mg

NR = Not Reported

Sumatriptan succinate is generally well tolerated. Most of the events were transient in nature and resolved within 2 hours of oral administration.

Minor disturbances of liver function tests have occasionally been observed with sumatriptan succinate treatment. There is no evidence that clinically significant abnormalities occurred more frequently with sumatriptan succinate than with placebo.

Patients treated with sumatriptan succinate rarely exhibit visual disorders like flickering and diplopia. Additionally cases of nystagmus, scotoma and reduced vision have been observed. Very rarely a transient loss of vision has been reported. However, visual disorders may also occur during a migraine attack itself.

SYMPTOMS AND TREATMENT OF OVERDOSE

There have been some reports of overdosage with sumatriptan succinate. Doses up to 400 mg orally were not associated with side effects other than those mentioned.

If overdosage with sumatriptan succinate occurs, the patient should be monitored and standard supportive treatment applied as required. Toxicokinetics are not available.

The effect of hemodialysis or peritoneal dialysis on the serum concentration of sumatriptan succinate is unknown.

DOSAGE AND ADMINISTRATION

General:

ratio-SUMATRIPTAN (sumatriptan succinate) is indicated for the acute treatment of migraine headache

with or without aura. Sumatriptan succinate should not be used prophylactically. The safety of treating an average of more than four headaches in a 30 day period has not been established. Significant relief begins about 30 minutes following oral administration.

In addition to relieving the pain of migraine, sumatriptan succinate has also been shown to be effective in relieving associated symptoms of migraine (nausea, vomiting, phonophobia, photophobia). Sumatriptan succinate is equally effective when administered at any stage of a migraine attack. Long term (12-24 months) clinical studies with maximum recommended doses of sumatriptan succinate indicate that there is no evidence of the development of tachyphylaxis, or medication-induced (rebound) headache.

The minimal effective single adult dose of ratio-SUMATRIPTAN tablets is 25 mg. The maximum recommended single dose is 100 mg.

The optimal dose is a single 50 mg tablet. However, depending on individual patient's needs and response to treatment, some patients may require 100 mg.

Clinical trials have shown that approximately 50 - 75% of patients have headache relief within two hours after oral dosing with 100 mg, and that a further 15 - 25% have headache relief by 4 hours. Comparator studies have shown similar efficacy rates with the 50 mg and 100 mg tablets. There is evidence that doses of 50 and 100 mg may provide greater effect than 25 mg.

If the migraine headache returns, or if a patient has a partial response to the initial dose, the dose may be repeated after 2 hours. Not more than 200 mg should be taken in any 24 hour period.

If a patient does not respond to the first dose of ratio-SUMATRIPTAN tablets, a second dose should not be taken for the same attack, as it is unlikely to be of clinical benefit. ratio-SUMATRIPTAN may be taken to treat subsequent migraine attacks.

The tablet should be swallowed whole with water, not crushed, chewed or split.

Hepatic Impairment:

In patients with mild or moderate hepatic impairment, plasma sumatriptan succinate concentrations up to two times those seen in healthy subjects have been observed. Therefore, a 25 mg dose (single tablet) may be considered in these patients (see **PRECAUTIONS**). Sumatriptan succinate should not be administered to patients with severe hepatic impairment (see **CONTRAINDICATIONS**).

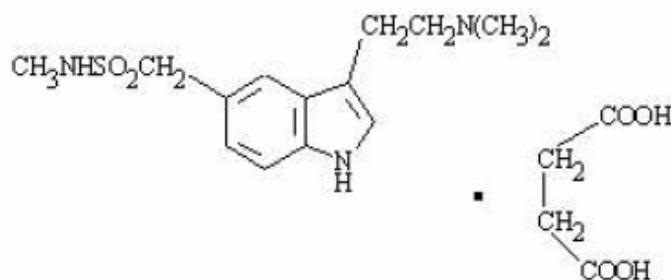
PHARMACEUTICAL INFORMATION

Drug Substance

Common Name: Sumatriptan succinate (USAN, BAN and INN)

Chemical Name: 3-[2-(dimethyl amino)ethyl]-N-methyl-1 H-indole-5-methane sulphonamide, butane-1,4-dioate (1:1)

Structural Formula:



Molecular formula: C₁₄H₂₁N₃O₂S·C₄H₆O₄

Molecular Weight: 413.5

Physical Characteristics: White to off-white powder with a melting point between 164.6 °C-165.5 °C.

Solubility: In water (4 °C) = 54 mg/mL
In water (20 °C) = 101 mg/mL
In saline (0.9% w/v, 4 °C) = 62 mg/mL
In saline (0.9% w/v, 20 °C) = 109 mg/mL

pH and pka: The pH of a 1% w/v solution of sumatriptan succinate in water is approximately 4.9.

pka, (succinic acid) = 4.21, 5.67

pka2 (3° amine group) = 9.63

pka3 (sulphonamide group) = > 12

Partition Coefficient (between n-octanol and water):

log P = 1.07 at a pH of 10.7

COMPOSITION

ratio-SUMATRIPTAN Tablets contain 25mg, 50 mg or 100 mg Sumatriptan (base) as the succinate salt. ratio-SUMATRIPTAN Tablets also contain (alphabetically): Carnauba wax, Colloidal Silicon Dioxide, Lactose Monohydrate, Magnesium Stearate, Microcrystalline Cellulose, Sodium Starch Glycolate, Sucrose, Talc, Titanium Dioxide and Triethyl Citrate. The 100 mg tablets also contain Red Iron Oxide.

STABILITY AND STORAGE RECOMMENDATIONS

ratio-SUMATRIPTAN Tablets should be stored between 15°C and 30°C.

AVAILABILITY OF DOSAGE FORMS

ratio-SUMATRIPTAN Tablets 25 mg are white to off-white, sugar coated round tablets, with “rph” on one side and “S53” on the other side.

ratio-SUMATRIPTAN Tablets 50 mg are white to off-white, sugar coated triangular tablets, with “rph” on one side and “S52” on the other side.

ratio-SUMATRIPTAN Tablets 100 mg are pink, sugar coated triangular tablets, with “rph” on one side and “S51” on the other side.

Each tablet contains 25 mg or 50 mg or 100 mg sumatriptan (base) as the succinate salt.

ratio-SUMATRIPTAN Tablets 25 mg, 50 mg and 100 mg are available in bottles of 100 tablets and blister packs of 30 tablets (5 x 6 tablets) in a box.

INFORMATION FOR THE CONSUMER
ratio-SUMATRIPTAN Tablets

Please read this leaflet carefully before you take ratio-SUMATRIPTAN Tablets. It provides a summary of the information available on your medicine. ***Please do not throw away this leaflet until you have finished your medicine. You may need to read it again.*** This leaflet does not contain all the information on ratio-SUMATRIPTAN Tablets. For further information or advice, ask your doctor or pharmacist.

Information about Your Medicine:

The name of your medicine is ratio-SUMATRIPTAN (sumatriptan succinate). It can be obtained only by prescription from your doctor. The decision to use ratio-SUMATRIPTAN is one that you and your doctor should make jointly, taking into account your individual preferences and medical circumstances. If you have risk factors for heart disease (such as high blood pressure, high cholesterol, obesity, diabetes, smoking, strong family history of heart disease, or you are postmenopausal or a male over 40), you should tell your doctor, who should evaluate you for heart disease in order to determine if ratio-SUMATRIPTAN is appropriate for you.

1. The Purpose of Your Medicine:

ratio-SUMATRIPTAN is intended to relieve your migraine headache and other associated symptoms of a migraine attack. ratio-SUMATRIPTAN should not be used continuously to prevent or reduce the number of attacks you experience. Use ratio-SUMATRIPTAN only to treat an actual migraine headache attack.

2. How Your Medicine Works:

Migraine headache is believed to be caused by a widening of the blood vessels in the head. ratio-SUMATRIPTAN narrows these vessels and relieves the symptoms of migraine headache.

3. Important Questions to Consider Before Taking ratio-SUMATRIPTAN

If the answer to any of the following questions is YES or if you do not know the answer, then please discuss with your doctor before you use ratio-SUMATRIPTAN.

- Are you pregnant? Do you think you might be pregnant? Are you trying to become pregnant? Are you using inadequate contraception? Are you breast-feeding?
- Do you have any chest pain, heart disease, shortness of breath, or irregular heart beats? Have you had a heart attack? Do you have angina?
- Do you have risk factors for heart disease (such as high blood pressure, high cholesterol, obesity, diabetes, smoking, strong family history of heart disease, or are you postmenopausal or a male

over 40)?

- Do you have high blood pressure?
- Have you ever had to stop taking this or any other medication because of an allergy or other problems? Are you allergic to sulpha-containing drugs?
- Are you taking any medications, including migraine medications such as other 5-HT₁ agonists or those containing ergotamine, dihydroergotamine, or methysergide?
- Have you ever experienced difficulty moving one side of your body when you have a headache?
- Have you ever had a stroke, transient ischemic attacks (TIAs), or Raynaud Syndrome?
- Are you over 65 years of age?
- Are you taking any medication for depression (lithium, monoamine oxidase inhibitors or selective serotonin reuptake inhibitors [SSRIs])?
- Have you had, or do you have, any disease of the liver or kidney?
- Have you had, or do you have, epilepsy or seizures?
- Is this headache different from your usual migraine attacks?
-

Remember, if you answered YES to any of the above questions, then discuss it with your doctor.

4. The Use of ratio-SUMATRIPTAN Tablets During Pregnancy:

Do not use ratio-SUMATRIPTAN Tablets if you are pregnant, think you might be pregnant, are trying to become pregnant, or are not using adequate contraception, unless you have discussed this with your doctor.

5. How to Use ratio-SUMATRIPTAN Tablets:

The label on the container of your medicine or the leaflet inside should tell you how often to take a dose and the amount you should take in each dose. If it does not or you are not sure, ask your doctor or pharmacist. DO NOT take more tablets, or take your medicine more often than you are told.

Do not take any ergotamine-containing preparation, ergot derivatives (such as dihydroergotamine, or methysergide), or another 5-HT₁ agonist within 24 hours of using ratio-SUMATRIPTAN.

ratio-SUMATRIPTAN can be taken at any time during your migraine headache.

Adults: Take as directed by your doctor. If the first tablet does not relieve your headache, do not take further doses of sumatriptan succinate for the same attack. You may take pain medication other than ergotamine-containing preparations for further pain relief. Sumatriptan succinate may be taken for subsequent attacks.

A second tablet may be taken if your symptoms come back. Do not take more than 200 mg in any 24 hour period.

ratio-SUMATRIPTAN may be taken with or without food. ***The tablet should be swallowed whole with water. It should not be crushed, chewed or split.***

6. *Side Effects to Watch for:*

Although the vast majority of those who have taken sumatriptan succinate have not experienced any significant side effects, some individuals have experienced problems.

- ▶ Some patients experience pain or tightness in the chest or throat when using sumatriptan succinate. If this happens to you, then discuss it with your doctor before using any more ratio-SUMATRIPTAN. If the chest pain is severe or does not go away, call your doctor immediately.
- ▶ If you have sudden and/or severe abdominal pain after taking ratio-SUMATRIPTAN, call your doctor immediately.
- ▶ Shortness of breath; wheeziness; heart throbbing; swelling of eyelids, face, or lips; or a skin rash, skin lumps, or hives happens rarely. If it happens to you, then tell your doctor immediately. Do not take any more ratio-SUMATRIPTAN unless your doctor tells you to do so.
- ▶ Some people may have feelings of tingling, heat, flushing (redness of face lasting a short time), heaviness or pressure after treatment with sumatriptan succinate. A few people may feel drowsy, dizzy, tired, or sick. Tell your doctor of these symptoms at your next visit.
- ▶ Drowsiness may occur as a result of ratio-SUMATRIPTAN. Do not drive or operate machinery until you are sure that you are not drowsy.
- ▶ If you feel unwell in any other way or have any symptoms that you do not understand or find distressing, you should contact your doctor immediately.

7. *What to Do If an Overdose Is Taken:*

If you have taken more medication than you have been told, contact either your doctor, hospital emergency department, or nearest poison control center immediately.

8. *Storing Your Medicine:*

Keep your medicine in a safe place where children cannot reach it. It may be harmful to children.

Keep your tablets in a cool, dry place (15°C to 30°C).

If your medication has expired (the expiration date is printed on the treatment pack), throw it away as instructed.

If your doctor decides to stop your treatment, do not keep any leftover medicine unless your doctor tells

you to. Throw away your medicine as instructed.

9. *What is in Your Medicine:*

ratio-SUMATRIPTAN Tablets contain 25 mg, 50 mg or 100 mg Sumatriptan (base) as the succinate salt. ratio-SUMATRIPTAN Tablets also contain (alphabetically): Carnauba wax, Colloidal Silicon Dioxide, Lactose Monohydrate, Magnesium Stearate, Microcrystalline Cellulose, Sodium Starch Glycolate, Sucrose, Talc, Titanium Dioxide and Triethyl Citrate. The 100 mg tablets also contain Red Iron Oxide.

10. *Class of Medicine:*

This medicine is one of a group of anti-migraine drugs.

11. *Who Distributes Your Medicine:*

ratiopharm inc.

Mirabel, Canada J7J 1P3

12. *Reminder:*

REMEMBER: This medicine is for you. Only a doctor can prescribe it for you. Never give it to someone else. It may harm them even if their symptoms appear to be similar to yours.

PHARMACOLOGY

ANIMAL PHARMACODYNAMICS

The action of sumatriptan has been studied in a range of isolated preparations in vitro, all known to contain different 5-HT receptor subtypes.

In Beagle dog isolated saphenous vein known to contain 5-HT₁ receptors, sumatriptan had a mean EC₅₀² of 302 nM, while 5-HT had an EC₅₀ of 44 nM.

In cat isolated saphenous vein, sumatriptan (concentrations of up to 10 µM) had no activity on 5-HT₁ receptors, suggesting that sumatriptan is a highly selective agonist at some, but not all, 5-HT₁ receptors. The contrasting action of sumatriptan at these receptor sites in the Beagle dog and cat isolated saphenous veins provides evidence that 5-HT₁ receptors are heterogeneous.

Sumatriptan displayed virtually no activity at 5-HT₂ receptors mediating contraction of the rabbit isolated aorta (concentrations up to 50 µM) and at 5-HT₃ receptors mediating depolarization of the rat isolated vagus nerve (concentrations up to 100 µM).

The selectivity of sumatriptan was further confirmed by studies in dog isolated saphenous vein, and in dog and primate isolated basilar artery. In these assays sumatriptan was resistant to the selective 5-HT₂ and 5-HT₃ receptor antagonists, ketanserin and MDL72222, respectively. Radioligand binding studies provide yet additional support for the high degree of specificity of sumatriptan. Sumatriptan was shown to have a high affinity for some 5-HT₁ binding sites, notably the 5-HT_{1D} subtype, and no significant affinity for other neurotransmitter binding sites such as, 5-HT_{1A}, 5-HT_{1C}, 5-HT₂, 5-HT₃, alpha₁, alpha₂, beta₁, dopamine D₁ and D₂, muscarinic and benzodiazepine receptors. In the human isolated basilar artery, methiothepin specifically and equally antagonized the contractile effects of both 5-HT and sumatriptan, suggesting that sumatriptan and 5-HT contract this artery by activating the same receptor type. This receptor appears to be identical to the 5-HT₁ receptor which mediates contraction of the dog isolated saphenous vein and cerebral blood vessels in both the dog and primate.

Sumatriptan selectively reduced the extravasation of plasma proteins in the duramater of rats and guinea pigs, in response to trigeminal nerve stimulation.

²molar concentrations required to produce 50% of the maximum response.

Although an inhibitory effect on neurotransmitter release from trigeminal nerve endings is implicated, the action of sumatriptan would still predominantly involve a direct vasoconstrictive action on dural blood vessels, which could be expected to inhibit extravasation. In fact, such a vasoconstrictive action during a migraine attack could also increase the threshold for activating perivascular nerve afferents by reducing pressure on edematous pain-sensitive vessels within the cranium.

The major metabolite of sumatriptan in humans and other animal species, GR49336, has no pharmacological activity at 5-HT₁ receptors or other vascular 5-HT receptor subtypes.

Sumatriptan (1 to 1000 µg/kg, iv) produced a selective long-lasting and dose-dependent decrease in carotid arterial blood flow, *in vivo* (anesthetized Beagles), with little or no change in arterial blood pressure. The dose of sumatriptan producing 50% of its maximum vasoconstrictor action was 39 ± 8 µg/kg, iv. Maximal vasoconstrictor responses were achieved with intravenous doses between 300 to 1000 µg/kg.

The vasoconstrictor action of sumatriptan in the carotid arterial circulation of anesthetized Beagles is mediated by the activation of 5-HT₁ receptors since it was antagonized by methiothepin, a selective 5-HT₁ receptor blocker.

Sumatriptan (30 to 1000 µg/kg, iv) produced a dose-dependent reduction in the proportion of cardiac output passing through arteriovenous anastomoses (AVAs) in anesthetized cats.

At doses up to 1000 µg/kg iv, sumatriptan had little effect upon vascular resistance in a variety of other vascular beds. In contrast, the administration of ergotamine (30 µg/kg) caused marked increases in vasoconstriction in most vascular beds examined.

Sumatriptan did not modify efferent vagal activity by either a central action, or by interference with cholinergic neurotransmission from vagal nerve endings in the myocardium of anesthetized cats.

It had no antinociceptive effects in rodents, and is, therefore, unlikely that its effectiveness in alleviating migraine headache is due to a generalized analgesic action.

In conscious monkeys, at cumulative doses of up to 1000 µg/kg, there were no significant effects on arterial blood pressure, heart rate, ECG or respiratory rate that could be attributed to the intravenous administration of sumatriptan.

Sumatriptan up to 1 mg/kg had little or no effect upon either pulmonary artery or esophageal pressure in Beagle dogs. There was also little or no effect upon total peripheral resistance, and only a slight increase in cardiac output and stroke volume.

In the rat, sumatriptan (1 and 10 mg/kg, ip) caused a dose-related increase in the rate of gastric emptying, the magnitude of this effect being comparable with that obtained with metoclopramide at doses of 5 to 20 mg/kg, ip.

ANIMAL PHARMACOKINETICS

Absorption of radiolabelled drug-related material following single-dose oral administration of sumatriptan was both rapid and extensive in mice, rats, rabbits and dogs. Oral bioavailabilities of 37% in rat (5 mg/kg), 23% in rabbit (5 mg/kg) and 58% in dog (1 mg/kg) indicate that first-pass metabolism is moderate to high in these species. In dogs, this was supported by low metabolic clearance relative to hepatic blood flow. Following intravenous administration, the parent compound was rapidly eliminated from the plasma of mice, rats and rabbits ($t_{1/2} \leq 1.2$ h) and less rapidly in dogs ($t_{1/2} = 2.1$ h). Active tubular secretion of sumatriptan occurred in the kidneys of rats and rabbits but not in the dog, where clearance was primarily metabolic.

The repeat-dose pharmacokinetics of sumatriptan in the mouse, rat, rabbit and dog were generally consistent with the single-dose data. Plasma levels attained in these species showed that sumatriptan concentrations were linearly-related to oral doses up to 160 mg/kg in mice, 200 mg/kg in rats (subcutaneous doses up to 25 mg/kg), 400 mg/kg in rabbits and 100 mg/kg in dogs (subcutaneous doses up to 24 mg/kg).

Following intranasal administration to the rat or dog, plasma concentrations of sumatriptan peaked at approximately 30 minutes; in the monkey it peaked at 15 minutes. A second peak was observed in some animals at 90 to 120 minutes suggesting absorption of a swallowed portion of the dose.

The maximum concentrations of sumatriptan detected in plasma following oral or subcutaneous administration to dogs were 35- and 75-fold higher, respectively, than were measured in human plasma following standard therapeutic doses.

There was no evidence of accumulation or enzyme inhibition/induction in any of the species studied.

Radioactive drug-related material was widely distributed throughout the body following both oral and intravenous administration of radiolabelled sumatriptan. Transfer into the central nervous system was limited.

Drug-related material was cleared rapidly from all tissues with the exception of the eye in which it appeared to be bound to the melanin in the uveal tract.

The binding of sumatriptan to plasma proteins over the concentration range 10 to 1000 ng/mL was low, 21% or less, in all species studied. Erythrocyte-associated ¹⁴C-GR43175 was reversibly bound.

Placental transfer studies in rat and rabbit showed that in both species the fetuses were exposed to low levels of drug-related material. Sumatriptan and drug-related material were secreted into the milk of lactating rats and were present at higher concentrations than those seen in maternal plasma.

Following oral administration to the rabbit and dog, and intravenous administration to the dog, and intranasal administration to the rat and dog, the indole acetic acid derivative GR49336 was the major metabolite formed.

This metabolite was also a major component in the urine of rats after both oral and intravenous and intranasal administration and in rabbits after intravenous administration, indicating that oxidative deamination is the major metabolic pathway in all animal species studied.

Metabolism of the methylaminosulphonylmethyl side chain resulting in the formation of an N-demethylated derivative of sumatriptan was apparent in the urine of the mouse, rat, and rabbit but not in the dog.

The major route of excretion was via the urine in the mouse, rabbit and dog following oral and intravenous administration and in the rat following intravenous dosing only.

Following oral administration to rats, the major route of excretion of drug-related material was via the feces.

HUMAN PHARMACODYNAMICS

Administration of subcutaneous sumatriptan 6 mg twice daily for 5 days to healthy subjects caused slight

increases in mean systolic and diastolic blood pressures (6-8 mmHg) while heart rate decreased slightly (1-7 bpm).

Vasopressor effects were also evident following oral administration, with mean peak increases being somewhat smaller and of slower onset than after parenteral administration. A single oral dose of 200 mg sumatriptan caused significant increases in both systolic and diastolic blood pressures (16 mmHg and 5 mmHg, respectively); however, further dosing (200 mg three times daily for a further 7 days) did not cause any additional vasopressor effects.

In hypertensive patients with common or classical migraine, small, transient increases in both systolic and diastolic blood pressure (maximum mean increase: 6/6 mmHg) occurred shortly after subcutaneous doses of 6 mg, but resolved within 60 minutes. A dose-related increase of 14 mmHg in systolic blood pressure was found in elderly patients given 200 mg oral sumatriptan.

Sumatriptan had no effect on cardiac function in migraine patients when given as a 64 μ g/kg intravenous infusion. Exercise tests were performed after each infusion showing that sumatriptan had no effect on left ventricular ejection fraction either at rest or after exercise, and no differences were noted between placebo and sumatriptan.

TOXICOLOGY

ACUTE TOXICITY:

Administration of single oral doses of sumatriptan up to 2000 mg/kg in rats and 1200 mg/kg in mice was well tolerated.

Dogs also survived high oral doses of sumatriptan (500 mg/kg).

In subcutaneous studies, a dose of 2 mg/kg to rats was lethal. Dogs received subcutaneous doses of 20 and 100 mg/kg which were non-lethal. The reactions to treatment were similar irrespective of species or route of administration. Apart from local damage at the injection sites, there were no macroscopic or microscopic changes noted in any tissue (Table 7).

TABLE 7: RESULTS FROM ACUTE TOXICITY (LD₅₀) STUDIES IN MICE, RATS AND DOGS

Species/Strain	Route	Approx. LD ₅₀ (mg/kg)	MNLD (mg/kg)	MLD (mg/kg)
Mouse: CRH	Oral	1500	≥ 1200	> 1200
Mouse: CRH	Intravenous	> 15, < 20	≥ 15	≤ 20
Rat: RH	Oral	> 2000	≥ 2000	> 2000
Rat:SD	Oral	> 2000	≥ 2000	> 2000
Rat:RH	Intravenous	> 40	> 20	≤ 32
Rat: SD	Subcutaneous	1200 (M) 1400 (F)	≥ 500	≤ 1000
Dog: Beagle	Oral	> 500	≥ 500	> 500
Dog: Beagle	Subcutaneous	> 100	≥ 100	> 100

Key: MNLD - Maximum non-lethal dose
 MLD - Minimum lethal dose
 (M) - Male
 (F) - Female

LONG TERM STUDIES:

Subacute toxicity studies were conducted for periods up to 6 weeks in RH rats. Sumatriptan was given orally (by gavage) at doses up to 500 mg/kg/day and given subcutaneously at doses up to 81 mg/kg/day.

Clinical signs observed following oral administration were generally minor and transient in nature and occurred predominantly at 500 mg/kg/day. These signs included post-dosing erythema, mydriasis, ataxia, salivation, subdued temperament, postural changes and moist eyes.

Reactions were similar in subcutaneous studies in rats receiving doses of sumatriptan up to 81 mg/kg/day. Local irritation at the injection site was accompanied by a marked inflammatory response, local necrosis, hemorrhage, infiltration, granulation tissue formation and local muscle degeneration and repair. These reactions were dose dependent.

In dogs administered oral sumatriptan (1 to 100 mg/kg/day) in studies up to 6 weeks, clinical signs observed included head shaking, scratching, salivation, trembling, agitated behaviour, vocalization, mydriasis and vasodilation. These effects were dose-related. The dogs also developed tachycardia lasting for several hours, often followed by bradycardia. No changes in ECG were detected.

Subcutaneous administration of sumatriptan (1 to 16 mg/kg/day) up to 6 weeks in dogs caused injection site reactions similar to the reactions described in rats.

Chronic toxicity studies were carried out for 24 weeks and 72 weeks in rats and 26 and 60 weeks in dogs.

In both the 24 week and 72 week study in rats receiving sumatriptan doses of 5, 50 and 500 mg/kg/day orally, clinical signs were similar to those seen in previous oral toxicity studies in rats and were mild and transient in nature.

Animals of each sex receiving 50 and 500 mg/kg/day gained weight more rapidly than controls. This was considered to be related to increased food consumption.

Small reductions in cholesterol levels were frequently noted at 500 mg/kg/day. As well, dose related increases in urine specific gravity were seen throughout the 72 week study at 500 mg/kg/day. These increases were of no toxicological significance. Cessation of treatment showed good evidence of recovery.

There were no macroscopic or histological treatment related findings in any of the organs in either study.

A long term repeat dose subcutaneous toxicity study of 24 weeks duration was performed in RH rats receiving sumatriptan at doses of 1, 8 and 64 mg/kg/day.

There was occasional temporary appearance of masses at the injection sites in the animals receiving the highest dose of sumatriptan. Evidence of injection site injury was also apparent in the recovery animals. Rats in this group showed signs of neutrophilia and lymphocytosis.

Injection site reactions in animals in the high dose group were similar to those reported during previous toxicity studies.

Studies of 26 and 60 weeks at oral doses of 2, 10 and 50 mg/kg/day were performed in Beagle dogs.

A moderate increase in heart rate was observed in the intermediate (10 mg/kg/day) dose group (60 week study) and in the high (50 mg/kg/day) dose group (26 and 60 week studies). The increase lasted for up to 7 hours after dosing and a dose related decrease in heart rate was evident 24 hours after dosing, at 10 and 50 mg/kg/day. There were no changes in rhythm. Animals of either sex receiving 50 mg/kg/day showed slight reductions in body weight gain in both studies.

In the 60 week study, a dose related incidence of transient changes was noted on the surface of the cornea. However, these changes were not considered to be treatment related as evidenced by microscopic examination.

Organ weight analyses revealed significantly increased heart weights in all groups of treated females in the 26 week study. There were no treatment- related effects on organ weights in the 60 week study.

A long term repeat dose subcutaneous study of 24 weeks duration was performed in the Beagle dog at doses of 1, 3.5 and 12 mg/kg/day. Injection site reactions included oedema, marked hemorrhage, moderate/chronic inflammation and minimal arteritis. Some minimal injection site changes were also seen in treated animals after a 5 week recovery period.

Transient dose related changes in the precorneal tear film of treated dogs were observed. There was, however, no histological evidence of damage to the cornea or surrounding tissues.

Analysis of hematological parameters revealed a slight lowering of some red cell parameters in the high dose (12 mg/kg/day) group. No reticulocyte response was evident. Although no effect on total leucocyte count was observed, lymphocyte numbers were generally lower and neutrophils were generally slightly higher at this dose level. The only change observed during the recovery period was a statistically significantly reduced hemoglobin level in the males.

CARCINOGENICITY:

The carcinogenic potential of sumatriptan was evaluated in a 78-week oncogenicity study conducted in mice given oral doses of 10, 60 and 160 mg(base)/kg/day. There were two groups (102 mice each) given the vehicle only.

Tumours were found in more than half of the male mice and in less than half of the females across all groups. There was a statistically significant increase in the incidence of non-fatal hemolymphoreticular tumours observed in males at the dose of 60 mg/kg/day group only when compared with controls. Since there was no dose relationship, this increase was considered to be of no toxicological significance. There was no evidence that administration of sumatriptan at any of the dose levels caused any alteration in the incidence of any specific tumours or non-neoplastic lesions.

A 104-week study was conducted in the Sprague-Dawley rat given oral doses of 10, 60 and 360 mg(base)/kg/day. Two control groups of 100 animals each were given vehicle control only.

There was a significant increase in the incidence of non-fatal adrenal medullary tumours (benign and

malignant pheochromocytomas) in males given doses of 10 and 60 mg/kg/day and in males dosed at 360 mg/kg/day. A significant increase in the incidence of benign testicular interstitial (Leydig) cell tumours occurred when compared with controls. Adrenal medullary tumours also increased significantly in females dosed at 60 and 360 mg/kg/day. Comparison of both types of tumours with historical control data indicated that the observations were within the expected background range for the species and that long-term exposure to sumatriptan does not induce any treatment-related increases in the incidences of any tumours for the species tested.

MUTAGENICITY:

Sumatriptan produced no detectable or reproducible mutagenic potential above that seen in controls, in studies conducted *in vitro* with mutant strains of *Salmonella typhimurium*, *Escherichia coli*, or *Saccharomyces cerevisiae* with or without a rat hepatic drug metabolizing enzyme system. In addition, no statistically significant clastogenic effects were seen *in vitro* using cultured human peripheral lymphocytes at a maximum dose of 1000 µg/mL in the presence of the rat hepatic drug metabolism enzyme system or *in vivo* in a rat micronucleus test, at a maximum dosage of 1000 mg/kg.

Sumatriptan showed only weak cytotoxic activity at the highest concentration of 5000 µg/mL tested *in vitro* with V-79 mammalian cells.

REPRODUCTION AND TERATOLOGY:

In organogenesis studies, oral doses of up to 500 mg/kg/day in the rat were without adverse effects upon fetal parameters measured, but an oral dose of 1000 mg/kg/day in the rat, proved toxic to both dams and embryos.

Two oral organogenesis studies were conducted in rabbits, one using daily oral doses of 5, 25 or 100 mg/kg/day and the other using 5, 15 or 50 mg/kg/day. Sumatriptan was administered from days 8 to 20 of pregnancy.

In the first study, there were no adverse effects at the two lower doses. At the highest dose (100 mg/kg), there was a severe decrease in maternal body weight gain indicating that this dose is maternally toxic. A non-significant increase in post-implantation intra-uterine death from 8.3% in the untreated control group to 21.2% in the high dose (background range in untreated control animals 1.7% to 15.2%) was observed.

In addition there was an increased incidence of subtle variations in the position of certain blood vessels emanating from the aortic arch. In the untreated control these were present at 5.5% of foetuses (3 out of 10 litters affected). At the maternally toxic dose of 100 mg/kg, 23.1% of foetuses had these variations (4 out of 5 litters affected). This type of change is commonly found in untreated control animals (historical control incidence 17.5%; proportion of litters affected 44 out of 91), and does not compromise either health or survival.

In the second oral study, the findings were similar to those seen in the first study. There were no adverse effects at the two lower doses. At the highest dose (50 mg/kg), there was a severe decrease in maternal bodyweight gain. There were also various fetal effects ascribed to maternal toxicity. There was a slight reduction in mean fetal weight (37.7 g in control, 35.3 g at 50 mg/kg); small increases in the incidence of common skeletal variants (control incidence 8.8%; at 50 mg/kg 20.8%; Background mean 6.2%; Background range 1.3% - 13.3%) and again an increased incidence of positional changes of certain aortic arch blood vessels; (control incidence 12.8%, 3 out of 20 litters affected; at 50 mg/kg 25%, 10 out of 14 litters affected).

Placental transfer studies in pregnant rabbits have shown that sumatriptan can cross the placental barrier in small amounts. After a 5 mg/kg oral dose, 71.2 ng sumatriptan per gram of foetus was detected. The blood levels at this dose were 172 - 269 ng/mL. At the maternally toxic dose of 50 mg/kg in rabbits, blood levels reached 3180-6750 ng/mL.

Organogenesis studies conducted using intravenous doses of up to 12.5 mg/kg/day in rats revealed fused ribs at a dose of 2.5 mg/kg/day and rudimentary tail and dilatation of the renal pelvis at a dose of 12.5 mg/kg/day. The treatment had no adverse effects on either the dams or the fetuses and the malformations were considered unrelated to treatment since they are known to occur spontaneously in the control groups of the rat strain employed.

Rabbits were also studied using intravenous doses of up to 8.0 mg/kg/day which revealed no teratological response. However, in the first study a statistically significant dose related increasing trend in prenatal mortality was seen due to apparent maternal toxicity. In the second study, using intravenous doses up to 2.0 mg/kg/day, no maternal toxicity or increased prenatal mortality were observed.

Fertility studies conducted in rats with oral doses of up to 500 mg/kg/day and subcutaneous doses of up to 60 mg/kg/day indicated that there were no adverse effects upon the reproductive performance of the treated, parental generation, or upon the growth and development of two successive untreated generations.

In peri- and post-natal studies conducted in rats given oral doses of up to 1000 mg/kg/day and subcutaneous doses of up to 81 mg/kg/day, no toxicological adverse effects that may have been relevant to the peri- and post-natal development of their offspring was seen. However, oral administration of 1000 mg/kg/day during periods of pregnancy and lactation resulted in a decrease in maternal and fetal bodyweight.

A comprehensive evaluation of the effects of sumatriptan on reproduction indicate that the compound is devoid of teratogenic potential in the rat. In addition, there were no adverse effects on fertility or postnatal development. In rabbit oral reproduction studies, there were increased incidences of variations in cervico-thoracic blood vessel configuration in the foetuses, but these were only seen at maternally toxic doses in which blood levels were in excess of 50 times those seen after therapeutic doses in humans. A direct association with sumatriptan treatment is considered unlikely but cannot be excluded. The relevance to humans is unknown.

LOCAL TOLERANCE:

The subcutaneous and intramuscular administration of 1 mL of a solution of sumatriptan (50 mg/mL) to rabbits produced no overt signs of irritancy and caused only slight necrotic changes in the deepest layers of the subcuticular muscle. While the subcutaneous lesions healed in a rapid and uncomplicated manner, the intramuscular lesions were moderately slow to heal.

At a lower concentration (2.5 mg/mL) no signs of subcutaneous or intramuscular irritancy were apparent.

In inhalation toxicity studies (dog, monkey), no irritants of the nasal passages or respiratory tract tissues was identified after intranasal administration of sumatriptan.

SKIN AND EYE IRRITANCY:

Sumatriptan produced little or no irritant reaction when applied topically to the skin of guinea-pigs and was a non-irritant in the rabbit eye.

Sumatriptan was shown to be devoid of detectable skin sensitizing potential in guinea-pigs; subjected to a 12-day induction period (0.05 mL of a 10% solution, applied epicutaneously) prior to challenge with sumatriptan.

DEPENDENCE LIABILITY:

The physical dependence liability of sumatriptan was assessed in Cynomolgus monkeys at an oral dose of 5 mg/kg, the lowest tolerable dose causing mild to moderate CNS effects.

The behavioral changes observed upon withdrawal of sumatriptan were limited in their number, sporadic, unsustained and were not observed in all animals. It would appear that sumatriptan does not share with compounds such as opiates and benzodiazepines, the ability to cause physical dependence.

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