



Antimigraine Agents

Therapeutic Class Review (TCR)

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FDA-APPROVED INDICATIONS

Drug	Manufacturer	Indication(s)
almotriptan (Axert®) ¹	OMJPI	Acute treatment of migraine attacks with or without aura in adults and in adolescents 12-17 years of age whose attacks usually last four hours or more
diclofenac (Cambia™) ²	Nautilus Neurosciences	Acute treatment of migraine attacks with or without aura in adults
eletriptan (Relpax™) ³	Pfizer	
frovatriptan (Frova™) ⁴	Endo	
naratriptan (Amerge®) ⁵	generic	
rizatriptan (Maxalt®) ⁶	Merck	
sumatriptan (Imitrex®) ⁷	generic	Acute treatment of migraine attacks with or without aura in adults (all formulations) Injection: Acute treatment of cluster headache episodes in adults
sumatriptan (Alsuma™) ⁸	US WorldMeds	Acute treatment of migraine attacks with or without aura in adults
sumatriptan (Sumavel™ DosePro™) ⁹	Zogenix	Acute treatment of cluster headache episodes in adults
sumatriptan/naproxen (Treximet™) ¹⁰	GlaxoSmithKline	Acute treatment of migraine attacks with or without aura in adults
zolmitriptan (Zomig®) ^{11,12}	AstraZeneca	Acute treatment of migraine attacks with or without aura in adults (all formulations)

OVERVIEW

Headache is one of the most common complaints by patients when presenting to a physician. Migraine accounts for 10 to 20 percent of all headaches in adults.¹³ The American Migraine Study 2 showed that there are 27.9 million Americans who suffer from migraines.¹⁴ Migraine causes decreased productivity and absenteeism from work for many patients, which creates a large economic impact for the United States. Sixty-four percent of physician-diagnosed patients who experience migraines, and 41 percent of undiagnosed migraine sufferers reported severe impairment or the need for bed rest due to their migraine symptoms. In addition, a recent count showed 17.2 percent of females and six percent of males to be migraine sufferers, an epidemiologic profile that has remained stable over many years.¹⁵ Approximately 85 percent of patients with migraine headaches suffer less than three to four attacks per month.¹⁶ The median frequency of migraine attacks among migraine sufferers is one and one-half per month.¹⁷

Migraine headache must be differentiated from tension-type headache. Criteria for the diagnosis of migraine headache includes an episodic headache lasting from four to 72 hours with at least two of the following symptoms: unilateral pain, throbbing, aggravation of pain upon moving, pain of moderate to severe intensity accompanied by nausea, vomiting, photophobia, or phonophobia.¹⁸ Treatment of

acute migraine attacks includes acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), and the ergot alkaloids. NSAIDs, or combinations such as aspirin plus acetaminophen plus caffeine, are recommended as first-line therapy for those patients with mild to moderate migraine pain. Migraine-specific agents (triptans, dihydroergotamine [DHE]) should be used in patients whose migraine attacks do not respond to NSAIDs. Due to well-established efficacy, the triptans have become the drugs of choice for treating actual migraine attacks.

The US Headache Consortium, the American Academy of Family Physicians, and the American College of Physicians – American Society of Internal Medicine have recognized that the triptans are effective agents for the acute treatment of migraine.^{19,20} Data reviewed for the guidelines did not demonstrate that any one triptan was superior. Sumatriptan/naproxen (Treximet), frovatriptan (Frova), and eletriptan (Relpax) were not available at the time of publication of the guidelines. These groups indicated that therapy with any triptan for a patient with moderate to severe migraine pain in whom no contraindications exist is appropriate. If a patient does not experience adequate relief or experiences intolerable adverse reactions with one triptan, treatment with another agent in the class may be effective.^{21,22,23,24}

PHARMACOLOGY OF TRIPTANS^{25,26,27,28,29,30,31,32,33,34,35,36,37,38}

Drug	High Binding Affinity	Weak Binding Affinity
almotriptan (Axert)	5-HT _{1B} , 5-HT _{1D} , 5-HT _{1F}	5-HT _{1A} , 5-HT ₇
eletriptan (Relpax)	5-HT _{1B} , 5-HT _{1D} , 5-HT _{1F}	5-HT _{1A} , 5-HT _{1E} , 5-HT _{2B} , 5-HT ₇
frovatriptan (Frova)	5-HT _{1B} , 5-HT _{1D}	--
naratriptan (Amerge)	5-HT _{1B} , 5-HT _{1D}	--
rizatriptan (Maxalt)	5-HT _{1B} , 5-HT _{1D}	5-HT _{1A} , 5-HT _{1E} , 5-HT _{1F} , 5-HT ₇
sumatriptan (Alsuma, Imitrex, Sumavel DosePro, Treximet)	5-HT _{1D}	5-HT _{1A} , 5-HT _{5A} , 5-HT ₇
zolmitriptan (Zomig)	5-HT _{1B} , 5-HT _{1D}	5-HT _{1A}

Migraine pain is believed to result from activity within the trigeminovascular system. This activity results in a release of vasoactive neuropeptides with subsequent vasodilation, dural plasma extravasation, and perivascular inflammation.³⁹ The therapeutic activity of the triptan derivatives can be attributed to agonist effects on the vascular and neuronal serotonin (5-hydroxytryptamine, 5-HT₁) receptor subtypes in the trigeminal system. Relief of migraine headache may result from (1) intracranial vessel constriction via stimulation of vascular 5-HT_{1B} receptors; (2) inhibition of vasoactive neuropeptide release through stimulation of presynaptic 5-HT_{1D} receptors; and (3) interruption of pain signal transmission within the brainstem through stimulation of 5-HT_{1D} receptors.

All serotonin agonists in this class are selective 5-HT₁ receptor agonists, acting at subset 5-HT_{1D} and most also at 5-HT_{1B}. When activated, these receptors are believed to mediate the symptoms associated with a migraine attack.^{40,41}

Diclofenac and naproxen are non-steroidal anti-inflammatory drugs (NSAIDs) that inhibit the synthesis of inflammatory mediators and have analgesic properties.

PHARMACOKINETICS

Drug	Bioavailability (%)	Half-Life (hrs)	Tmax (hrs)	Active Metabolites	Excretion (%)
almotriptan (Axert) ⁴²	70	3-4	1-3	None	Urine: 75 Feces: 13
diclofenac (Cambia) ⁴³	50	2	0.25	One with weak activity	Urine: 65 Bile: 35
eletriptan (Relpax) ⁴⁴	50	4	1.5-2	N-demethylated metabolite	Predominantly non-renal
frovatriptan (Frova) ⁴⁵	20 in men 30 in women	26	2-4	One with minor activity	Urine: 32 Feces: 62
naratriptan (Amerge) ⁴⁶	70	6	3-4	None active	Urine: 80
rizatriptan (Maxalt) ⁴⁷	45	2-3	1-1.5* 1.6-2.5**	N-monodesmethyl-rizatriptan (activity similar to parent)	Urine: 82 Feces: 12
sumatriptan oral (Imitrex) ⁴⁸	15	2.5	1.5	None	Urine: 60 Feces: 40
sumatriptan injection (Alsuma, Imitrex, Sumavel DosePro) ^{49,50,51}	97	1.9	12 minutes	None	Urine: 60
sumatriptan nasal spray (Imitrex) ⁵²	17	2	--	None	Urine: 45
sumatriptan	15	2	1	None	Urine: 60 Feces: 40
naproxen (Treximet) ⁵³	95	12-19	6	6-O-desmethyl naproxen	Urine: 95
zolmitriptan (Zomig) ⁵⁴	40	3	1.5* 3**	N-desmethyl metabolite (potency is two to six times that of the parent)	Urine: 65 Feces: 30
zolmitriptan nasal spray (Zomig) ⁵⁵	102 versus oral tablet	3	3		Predominantly renal

*Regular tablets **Orally disintegrating tablets

CONTRAINDICATIONS/WARNINGS^{56,57,58,59,60,61,62,63,64,65,66,67,68,69}

While the incidence is rare, the triptans have been associated with angina (including Prinzmetal's variant angina), myocardial infarction, cardiac arrhythmias, hypertension, or stroke, particularly when they were used in patients with vascular risk factors. Triptans should be used with extreme caution in these patients or those with a suspected history of coronary artery disease. Triptans should not be used in patients with uncontrolled hypertension, ischemic heart disease, peripheral vascular disease, or cerebrovascular disease. Patients with other significant underlying cardiovascular diseases should not receive sumatriptan/naproxen (Treximet), nor should patients who have undergone coronary artery bypass graft surgery.

Triptans should not be used in patients with severe hepatic impairment or diseases that impair absorption, metabolism, and excretion of these products. Naratriptan (Amerge) and sumatriptan/naproxen are contraindicated in patients with severe renal impairment (CrCl < 15 mL/min). Rizatriptan (Maxalt) should be used with caution in patients with moderate hepatic insufficiency.

In a Public Health Advisory, the FDA cautioned that serotonin syndrome could occur if triptans are used in combination with selective serotonin reuptake inhibitor or selective serotonin-norepinephrine reuptake inhibitor antidepressants.⁷⁰ All triptan-containing products include this warning in their labeling.

Diclofenac (Cambia) and sumatriptan/naproxen contain boxed warnings regarding the increased risk of serious gastrointestinal inflammation, bleeding, ulceration, and perforation associated with NSAIDs. A boxed warning is also included for cardiovascular effects such as increased risk of thrombotic events, myocardial infarction, and stroke. NSAID-containing products are contraindicated in the treatment of peri-operative pain in the setting of coronary artery bypass graft surgery. Diclofenac is also contraindicated in patients who have experienced asthma, urticaria, or allergic-type reactions after taking aspirin or other NSAIDs. Long-term administration of NSAIDs can also lead to hepatic and/or renal dysfunction, skin reactions such as Stevens-Johnson syndrome, and premature closure of the ductus arteriosus in late pregnancy.

Overuse of ergotamines, triptans and opioids has been associated with the exacerbation of headache (medication overuse headache) in susceptible patients. Medication overuse headache may present as migraine-like daily headaches or as a marked increase in frequency of migraine attacks. Withdrawal of the treatment may be necessary.

Risk Evaluation and Mitigation Strategies (REMS) are required for diclofenac. REMS for Cambia and Treximet are no longer required.

DRUG INTERACTIONS^{71,72,73,74,75,76,77,78,79,80,81,82,83,84}

All agents from this class should not be given within 24 hours of ergot alkaloids or another triptan.

Rizatriptan (Maxalt), sumatriptan (Alsuma, Imitrex, Sumavel DosePro, Treximet), and zolmitriptan (Zomig) should not be given within two weeks of a monoamine oxidase inhibitor (MAOI).

Eletriptan (Relpax) should not be used within 72 hours of the following CYP450 3A4 inhibitors: ketoconazole (Nizoral[®]), itraconazole (Sporanox[®]), nefazodone, clarithromycin (Biaxin[®]), ritonavir (Norvir[®]), nelfinavir (Viracept[®]), or any other known potent CYP450 3A4 inhibitor.⁸⁵

Rizatriptan dose must not exceed 5 mg (up to a maximum of three doses in any 24-hour period) when administered concurrently with propranolol (Inderal[®], Innopran XL[®]).⁸⁶

NSAIDs may diminish the antihypertensive effect of ACE inhibitors. Concomitant use of aspirin or bisphosphonates and NSAIDs is not generally recommended because of the potential for GI ulceration. The effects of warfarin and NSAIDs on GI bleeding are synergistic, thereby increasing the risk of serious GI bleeding when used together. There is an increased bleeding risk when NSAIDs are given with SSRIs, as well. The effects of NSAIDs on renal prostaglandin synthesis may alter the effects of cyclosporine, lithium, and various diuretics.

ADVERSE EFFECTS

Drug	Paresthesia	Pain and pressure sensations	Flushing/ Palpitations	Nausea	Dizzi- ness	Somnolence	Unusual taste/ Nasal irritation
almotriptan (Axert) ⁸⁷	1	< 1	< 1	1-2	< 1	< 1	nr
diclofenac (Cambia) ⁸⁸	1-10*	nr	nr	3	2	1-10*	nr
eletriptan (Relpax) ⁸⁹	3-4	1-2	2 / <2	4-8	3-7	3-7	nr
frovatriptan (Frova) ⁹⁰	4	2-3	4 / nr	> 2	8	> 2	nr
naratriptan (Amerge) ⁹¹	1-2	2-4	nr/ < 1	4-5	1-2	1-2	nr
rizatriptan tablet (Maxalt) ⁹²	3-4	6-9	> 1 / > 1	4-6	4-9	4-8	nr
sumatriptan tablet (Imitrex) ⁹³	3-5	6-8	> 1	> 1	> 1	> 1	nr
sumatriptan injection (Alsuma, Imitrex, Sumavel DosePro) ^{94,95,96}	5-14	7	7 / < 1	< 1	12	3	nr
sumatriptan nasal spray (Imitrex) ⁹⁷	0.4-1.4	< 1	< 1	11-13.5	1-1.4	< 1	13.5-24.5 / 2.5-3.8
sumatriptan/ naproxen (Treximet) ⁹⁸	2	3	>1	3	4	3	nr
zolmitriptan tablet (Zomig) ⁹⁹	5-9	13-22	nr/ 0-2	4-9	6-10	5-8	nr
zolmitriptan nasal spray (Zomig) ¹⁰⁰	10	10	nr/ >1 - 2	4	3	4	21 / 3

Adverse effects are reported as a percentage. Adverse effects data are obtained from package inserts and are not meant to be comparative or all-inclusive.

nr = not reported.

*Reported from diclofenac and other NSAID trials; not specifically from Cambia trials.

SPECIAL POPULATIONS^{101,102,103,104,105,106,107,108,109,110,111,112,113,114}

Pediatrics

Almotriptan (Axert) is approved for adolescents 12-17 years of age whose attacks usually last four hours or more. The other products in this class have not been approved for use in pediatric populations (<18 years of age).

There are data to suggest that other agents may be effective in the treatment of migraine headaches in adolescents; all measure triptan efficacy against placebo. In general, even if statistical significant differences are demonstrated, the response rates for placebo are high. This is true for almotriptan, as well.¹¹⁵ One study in patients ages six to 17 years using rizatriptan (Maxalt) showed possible efficacy.¹¹⁶ Several studies in patients ages 12 to 17 years showed efficacy for sumatriptan (Imitrex) nasal spray.^{117,118,119}

Pregnancy

All products in this review are Pregnancy Category C. Products containing NSAIDs should not be used in pregnant women after 30 weeks gestation (Category D).

Nursing Mothers

Eletriptan (Relpax) and sumatriptan are excreted in human breast milk. Infant exposure can be minimized by avoiding breast-feeding for twelve hours after treatment with sumatriptan tablets. Caution should be exercised when administering eletriptan to nursing women.

It is not certain whether almotriptan, frovatriptan (Frova), naratriptan (Amerge), rizatriptan, and zolmitriptan (Zomig) are excreted in human milk. Caution should be employed when the products in this class are administered to women who are breast-feeding.

Renal Impairment

Although no significant change in clearance of eletriptan was observed, blood pressure elevations were reported in those with mild to severe renal impairment. Rizatriptan should be used with caution in dialysis patients due to a decrease in the clearance of rizatriptan.

Dose adjustments are recommended for patients taking almotriptan with severe renal impairment and patients taking naratriptan with mild to moderate impairment. Naratriptan is contraindicated in patients with severe renal impairment (CrCl < 15 mL/min).

Little clinical effect on sumatriptan or frovatriptan is expected in those with renal impairment since it is largely metabolized to an inactive substance. Elimination of naproxen is decreased in patients with severe renal impairment. Sumatriptan/naproxen (Treximet) is contraindicated in patients with creatinine clearance less than 30 mL/min.

In studies, clearance of zolmitriptan was decreased by 25 percent in those with severe renal impairment.

Diclofenac (Cambia) and sumatriptan/naproxen (Treximet) should not be used in patients with advanced renal disease.

Hepatic Impairment

Triptans should not be used in patients with severe hepatic impairment or diseases that impair absorption, metabolism, and excretion of these products. Rizatriptan should be used with caution in patients with moderate hepatic insufficiency. Dosage adjustments are required for almotriptan, naratriptan, and sumatriptan for those with mild to moderate impairment. Use of lower dosages of zolmitriptan is recommended in patients with moderate to severe hepatic impairment.

Diclofenac should not be used in patients with hepatic insufficiency.

DOSAGES^{120,121,122,123,124,125,126,127,128,129,130,131,132,133}

Drug	Availability	Single Initial Dose	Minimum Time Before Repeat Dose (hr)	Maximum Dose in 24 Hours (mg)	Package Size
almotriptan (Axert)	6.25, 12.5 mg tablets	6.25 mg or 12.5 mg	2	25	6, 12 (12.5 mg only)
diclofenac (Cambia)	50 mg powder packet	50 mg mixed in one to two ounces of water	Not established	Not established	9
eletriptan (Relpax)	20, 40 mg tablets	20 mg or 40 mg	2	80	6, 12 (40 mg only)
frovatriptan (Frova)	2.5 mg tablet	2.5 mg	2	7.5	9
naratriptan (Amerge)	1, 2.5 mg tablets	1 mg or 2.5 mg	4	5	9
rizatriptan (Maxalt, MLT)	5, 10 mg tablets	5 mg or 10 mg	2	30	Tablets: 3 (10 mg only), 6, 9, 12, 18 MLTs: 3, 6 (10 mg only), 9 (5 mg only), 12 (10 mg only)
sumatriptan (Imitrex)	25, 50, 100 mg tablets	25 mg to 100 mg	2	200	9
sumatriptan injectable (Imitrex)	4 mg or 6mg injection	4, 6 mg SC	1	12	Prefilled cartridge: 2 Vials: 5-vial cartons (6 mg injections only)
sumatriptan (Alsuma)	6 mg injection	6 mg SC	1	12	2
sumatriptan injectable (Sumavel DosePro)	6 mg injection (needle-free system)	6 mg SC	1	12	6
sumatriptan nasal spray (Imitrex)	5, 20 mg per spray	5 or 10 mg (1-2 sprays) or 20 mg (1 spray)	2	40	6
sumatriptan/naproxen (Treximet)	85 mg/500 mg tablets	one tablet	2	two tablets	9, 12
zolmitriptan (Zomig, ZMT)	2.5, 5 mg tablets	2.5 mg or 5 mg	2	10	3 (5 mg tablet, ZMT) 6 (2.5, 5 mg tablet, 2.5 mg ZMT)
zolmitriptan nasal spray (Zomig)	5 mg per spray	5 mg	2	10	6

MLT = Maxalt Orally Disintegrating Tablet; ZMT = Zomig Orally Disintegrating Tablet

Dosing Considerations

Renal impairment: The recommended starting dose of almotriptan in patients with severe renal impairment is 6.25 mg. The maximum daily dose should not exceed 12.5 mg over a 24-hour period. In patients with mild to moderate renal impairment, the maximum daily dose of naratriptan should not exceed 2.5 mg over a 24-hour period and a lower starting dose should be considered. Naratriptan should not be used in patients with severe renal impairment.

Hepatic Impairment: The recommended starting dose of almotriptan in patients with hepatic impairment is 6.25 mg. The maximum daily dose should not exceed 12.5 mg over a 24-hour period. In patients with mild or moderate hepatic impairment, the maximum daily dose of naratriptan should not exceed 2.5 mg over a 24-hour period and a lower starting dose should be considered. The use of naratriptan is contraindicated in patients with severe hepatic impairment (Child-Pugh grade C). Use of sumatriptan is not recommended, but if treatment is deemed advisable in the presence of liver disease, the maximum single oral dose should in general not exceed 50 mg. Patients with moderate or severe hepatic impairment have decreased clearance of zolmitriptan, and significant elevation in blood pressure has been observed in some patients. Use of zolmitriptan doses < 2.5 mg of an alternate formulation with blood pressure monitoring is recommended.

The safety of treating, on average, more than three headaches in a 30-day period has not been established for eletriptan tablets and zolmitriptan tablets and orally disintegrating tablets; more than four headaches in a 30-day period for almotriptan, frovatriptan, naratriptan, rizatriptan, sumatriptan tablets and nasal spray, and zolmitriptan nasal spray; and more than five headaches in a 30-day period for sumatriptan/naproxen. For diclofenac, the safety and effectiveness of a second dose have not been established. Different formulations of diclofenac are not interchangeable with Cambia as they may not be bioequivalent.

CLINICAL TRIALS

Search Strategies

Articles were identified through searches performed on PubMed and review of information sent by manufacturers. Search strategy included the use of all drugs in this class. Randomized, controlled, comparative trials for FDA-approved indications are considered the most relevant in this category. Randomized, controlled comparative trials are considered the most relevant in this category. Studies included for analysis in the review were published in English, performed with human participants, and randomly allocated participants to comparison groups. In addition, studies must contain clearly stated, predetermined outcome measure(s) of known or probable clinical importance, use data analysis techniques consistent with the study question, and include follow-up (endpoint assessment) of at least 80 percent of participants entering the investigation. Despite some inherent bias found in all studies including those sponsored and/or funded by pharmaceutical manufacturers, the studies in this therapeutic class review were determined to have results or conclusions that do not suggest systematic error in their experimental study design. While the potential influence of manufacturer sponsorship/funding must be considered, the studies in this review have also been evaluated for validity and importance.

almotriptan (Axert) and sumatriptan (Imitrex)

A randomized, double-blind trial comparing the efficacy and safety of almotriptan 12.5 mg and oral sumatriptan 50 mg enrolled 1,173 patients with migraine.¹³⁴ Efficacy was evaluated at two hours for headache relief (decrease in pain to little or no pain), headache freedom (decrease to no pain), use of rescue medications, and headache recurrence. At two hours, almotriptan and sumatriptan provided headache relief in 58 percent and 57.3 percent of patients, respectively. Almotriptan provided headache freedom in 17.9 percent of patients, and 24.6 percent of the sumatriptan group reported headache freedom ($p=0.005$). All other efficacy variables were similar for both treatment groups. Adverse effects were reported less frequently in the almotriptan group (15.2 percent) compared to the sumatriptan group (19.4 percent, $p=0.06$) although the difference was not statistically significant.

In a study to evaluate patient satisfaction with antimigraine therapy, 1,173 patients were randomized to almotriptan 12.5 mg or sumatriptan 50 mg oral in a double-blind manner.¹³⁵ Diaries were evaluated for satisfaction of pain relief, side effects, functional status, and health-related quality of life (HRQOL). No difference was seen between the groups for satisfaction with pain relief, functional status, or HRQOL results. Almotriptan patients reported being less bothered by side effects.

In a randomized, single-dose, placebo-controlled, double-blind study, almotriptan and sumatriptan were compared for efficacy and safety in the treatment of migraine.¹³⁶ Patients ($n=668$) were randomized to almotriptan 12.5 or 25 mg, sumatriptan 100 mg, or placebo and evaluated for pain relief at two hours following dosing. All active therapies had equivalent response rates that were significantly superior to placebo. Almotriptan was tolerated best and similar to placebo. Almotriptan 25 mg and sumatriptan 100 mg had similar incidence of adverse effects.

almotriptan (Axert) and zolmitriptan (Zomig)

In a multicenter, double-blind, randomized trial, 532 adult migraineurs received almotriptan 12.5 mg and 530 adult migraineurs received zolmitriptan 2.5 mg for the treatment of a single migraine attack.¹³⁷ For blinding purposes, both drugs were encapsulated. The primary endpoint was sustained pain-free patients with no adverse events. Other endpoints included pain relief, and pain-free at several time points, sustained pain free, headache recurrence, use of rescue medication, functional impairment, time lost because of migraine, treatment acceptability, and overall treatment satisfaction. No significant differences were seen in the percentage of patients that were sustained pain-free with no adverse events (almotriptan 29.2 percent and zolmitriptan 31.8 percent, $p=0.357$) or the other efficacy endpoints measured including pain-relief and pain-free at two hours. The incidence of triptan-associated adverse events and triptan-associated central nervous system adverse events was significantly lower for patients receiving almotriptan compared to zolmitriptan ($p=0.03$).

diclofenac (Cambia)

In a randomized, double-blind, parallel-group, placebo-controlled study included adult sufferers with an established migraine diagnosis treated one moderate or severe attack with diclofenac 50 mg for oral solution ($n=343$) or matching placebo ($n=347$).¹³⁸ The four co-primary endpoints included the percentage of subjects who, at two hours post-treatment, reported no headache pain, no nausea, no photophobia and/or no phonophobia. Significantly more subjects treated with diclofenac achieved a two-hour pain-free response (25 versus 10 percent, $p<0.001$), no nausea (65 versus 53 percent; $p=0.002$), no photophobia (41 versus 27 percent; $p<0.001$), and no phonophobia (44 versus 27 percent; $p<0.001$) compared to placebo. Pain intensity differences between treatments were significantly lower

in the diclofenac group, starting at 30 minutes post-treatment ($p=0.013$) with significant differences at all time points thereafter ($p<0.001$). Twenty-four-hour sustained pain-free response favored diclofenac versus placebo (19 versus seven percent, $p<0.0001$). The most common adverse event was nausea (diclofenac potassium for oral solution [4.6 percent]; placebo [4.3 percent]).

Other formulations of diclofenac have been studied in the treatment of migraine headaches. Both tablet and sachet formulations of diclofenac have been found to be more effective than placebo.^{139,140} One study found the diclofenac sachet to be more effective than placebo as well as sumatriptan 100 mg; another demonstrated that the sachet was significantly more effective than diclofenac tablets.^{141,142}

eletriptan (Relpax) and sumatriptan (Imitrex)

In a randomized, double-blind, parallel-group trial, eletriptan and sumatriptan were compared for efficacy, safety, and tolerability in the acute treatment of migraine in 692 patients.¹⁴³ Patients were randomized to placebo, sumatriptan 100 mg, eletriptan 20 mg, 40 mg, or 80 mg. At two hours, headache response rates were 24 percent for placebo, 55 percent for sumatriptan, 54 percent for eletriptan 20 mg, 65 percent for eletriptan 40 mg, and 77 percent for eletriptan 80 mg. At two hours, there was a difference between sumatriptan 100 mg and eletriptan 80 mg in headache response rate ($p<0.001$). All doses of eletriptan were significantly different from placebo for headache response rate ($p<0.001$). Headache-free rates at two hours for eletriptan 80 mg were superior to sumatriptan 100 mg (37 versus 23 percent; $p<0.05$). All therapies were well tolerated. Eletriptan 80 mg is not currently available in the US, nor is the 80 mg dose FDA-approved.

Eletriptan and sumatriptan were compared in a single migraine attack study enrolling 2,113 patients.¹⁴⁴ Patients were randomized to eletriptan 40 mg, sumatriptan 100 mg, or placebo in the double-blind, parallel-group trial involving patients with moderate migraine headaches. After two hours, the headache response rate was 67 percent for eletriptan, 59 percent for sumatriptan, and 26 percent for placebo, both statistically significant differences in favor of eletriptan ($p<0.001$, $p<0.0001$). Eletriptan patients also reported less nausea, photophobia, and phonophobia compared with sumatriptan after two hours. Overall, the incidence of adverse effects was low for the two active treatment groups, with nausea being the most commonly reported in all groups.

Eletriptan and sumatriptan were compared for efficacy in the acute treatment of migraine in 1,008 patients.¹⁴⁵ Patients were randomized in a double-blind manner to placebo, eletriptan 40 mg or 80 mg, or sumatriptan 50 mg or 100 mg to treat up to three attacks. The sumatriptan doses were encapsulated in the study. The primary endpoint of the study was the one-hour headache response which was 12 percent for placebo, 24 percent for sumatriptan 50 mg, 27 percent for sumatriptan 100 mg, and 30 and 37 percent for eletriptan 40 and 80 mg, respectively. Two-hour response rates were 31 percent for placebo, 50 percent for sumatriptan 50 mg, 53 percent for sumatriptan 100 mg, 64 percent for eletriptan 40 mg, and 67 percent for eletriptan 80 mg. For the two-hour response rate, all doses of eletriptan were superior to sumatriptan for headache response and complete pain relief ($p<0.05$). All treatments were well tolerated.

eletriptan (Relpax) and naratriptan (Amerge)

In a randomized, double-blind, placebo-controlled study, migraine patients ($n=548$) were randomized to treat a single migraine attack with eletriptan 40 mg, naratriptan 2.5 mg, or placebo.¹⁴⁶ Headache response rates at two hours and four hours, respectively, were 56 and 80 percent for eletriptan, 42 and

67 percent for naratriptan ($p < 0.01$ for both time-points), and 31 and 44 percent for placebo ($p < 0.0001$ versus both active drugs at both time-points). Eletriptan showed a greater pain-free response at two hours (35 versus 18 percent; $p < 0.001$) as well as lower use of rescue medication (15 versus 27 percent; $p < 0.01$) and higher sustained headache response at 24 hours (38 versus 27 percent; $p < 0.05$) compared with naratriptan.

eletriptan (Relpax) and zolmitriptan (Zomig)

In a multicenter, double-blind, double-dummy, parallel-groups trial, 1,587 outpatients with migraine were randomized in a 3:3:3:1 ratio to eletriptan 80 mg, eletriptan 40 mg, zolmitriptan 2.5 mg, or placebo.¹⁴⁷ Of these, 1,312 treated a single migraine attack and were included in the intention-to-treat population. For the primary efficacy endpoint of headache response at two hours, rates were 74 percent for eletriptan 80 mg, 64 percent for eletriptan 40 mg, 60 percent for zolmitriptan ($p < 0.0001$ versus eletriptan 80 mg), and 22 percent on placebo ($p < 0.0001$ versus all active treatments). Eletriptan 40 mg had similar efficacy to zolmitriptan 2.5 mg and significantly ($p < 0.05$) lower recurrence rate and need for rescue medication past 24 hours. All treatments were well tolerated, and on patients' global ratings of treatment, both eletriptan doses scored significantly better than zolmitriptan.

frovatriptan (Frova)

Three randomized, placebo-controlled, double-blind, parallel-group trials enrolling 2,676 patients were performed to confirm the clinical efficacy of frovatriptan 2.5 mg for the acute treatment of migraines.¹⁴⁸ Headache response two hours after frovatriptan dosing was significantly greater than placebo in all three trials ($p < 0.001$). There was approximately a two-fold measure of effect over placebo for headache response at both the two- and four-hour measurement. The incidence of 24-hour headache recurrence was low (10 to 25 percent). In patients with migraine-associated nausea, photophobia, and phonophobia at baseline, there was a decreased incidence of these symptoms in frovatriptan-treated patients.

There are currently no peer-reviewed comparative trials evaluating efficacy of other triptans with frovatriptan. Tolerability and safety of frovatriptan 2.5 mg and sumatriptan 100 mg were compared in a trial with a 12-month open-label extension that enrolled 1,554 patients.¹⁴⁹ Fewer adverse events were observed with frovatriptan compared to sumatriptan (36 versus 43 percent, $p = 0.03$).

naratriptan (Amerge) and rizatriptan (Maxalt)

In a randomized, double-blind, placebo-controlled study, 522 patients treating a single migraine attack were given either rizatriptan 10 mg, naratriptan 2.5 mg, or placebo.¹⁵⁰ Rizatriptan provided earlier headache relief ($p < 0.001$), acting as early as 30 minutes following a dose. More patients were pain-free at two hours versus naratriptan (44.8 versus 20.7 percent, $p < 0.001$). Both treatments were effective compared to placebo.

naratriptan (Amerge) and sumatriptan (Imitrex)

A randomized, double-blind, placebo-controlled trial compared naratriptan and sumatriptan for the acute treatment of migraine.¹⁵¹ Patients ($n = 643$) were randomized to naratriptan 1, 2.5, 5, 7.5, or 10 mg or sumatriptan 100 mg or placebo per attack. Efficacy was determined at two hours post-dose for headache relief. Naratriptan response (52 to 69 percent) and sumatriptan response (60 percent) were superior to placebo (31 percent, $p < 0.05$). Over the course of 24 hours, efficacy as determined by

sustained headache relief without need for rescue medication or recurrence was reported more frequently with naratriptan and sumatriptan than placebo. Adverse effects were similar among naratriptan 1, 2.5, or 5 mg doses and placebo. Naratriptan 5, 7.5, and 10 mg doses and sumatriptan had a similar incidence of adverse effects.

A randomized, double-blind study evaluated headache recurrence between naratriptan 2.5 mg and sumatriptan 100 mg in 253 patients with known history of recurrent migraine headaches.¹⁵² Recurrence was defined as recurrence of headache following a pain-free interval of at least 24 hours between attacks. No difference was observed in the incidence of recurrent headache pain during four to 24 hours after treatment for naratriptan (45 percent) and sumatriptan (57 percent, $p=NS$). Pain relief after the second attack was achieved more frequently with sumatriptan (57 percent) than naratriptan (41 percent, $p=0.005$). Side effects were similar in both treatments with no difference in incidence following the second dose.

rizatriptan (Maxalt) and sumatriptan (Imitrex)

Patients who had migraine with or without aura were randomized to receive 10, 20, or 40 mg doses of rizatriptan or sumatriptan 100 mg or placebo.¹⁵³ The trial was a double-blind outpatient trial enrolling 449 patients. The proportion of patients with headache relief at two hours was 18 percent for placebo, 46 percent for sumatriptan, 52 percent for rizatriptan 10 mg, 56 percent for rizatriptan 20 mg, and 67 percent for rizatriptan 40 mg. All differences with placebo were statistically significant ($p<0.001$). Rizatriptan 40 mg was superior to sumatriptan ($p=0.001$). The recurrence of headache within 24 hours was found to be equal across all treatment groups at approximately 40 percent. Adverse events occurred more frequently after rizatriptan 40 mg compared to other treatments. Rizatriptan doses of 20 and 40 mg exceed the current FDA approved labeling.

Rizatriptan 5 and 10 mg and sumatriptan 25 and 50 mg were compared in a double-blind, placebo-controlled, crossover study for efficacy and safety in two migraine attacks.¹⁵⁴ Patients ($n=1,329$) were randomized to rizatriptan 5 mg/sumatriptan 25 mg; sumatriptan 25 mg/rizatriptan 5 mg; rizatriptan 10 mg/sumatriptan 50 mg; sumatriptan 50 mg/rizatriptan 10 mg; or placebo/placebo. At two hours, more patients had pain relief with rizatriptan 5 mg than sumatriptan 25 mg (68 versus 62 percent, $p<0.05$), and more patients were pain free (33 versus 28 percent, respectively; $p<0.05$). With the higher doses, rates of pain relief (72 versus 68 percent) and pain-free status (41 versus 37 percent) were similar between rizatriptan 10 mg and sumatriptan 50 mg. Safety was similar among all groups.

In a double-blind single migraine attack study, 1,268 patients were randomized to rizatriptan 5 or 10 mg, sumatriptan 100 mg, or placebo and evaluated after two hours for headache relief.¹⁵⁵ Headache relief at one hour with rizatriptan 10 mg (37 percent) was significantly higher than with sumatriptan (28 percent, $p=0.01$). At two hours, all groups had similar rates of headache relief (60 percent for rizatriptan 5 mg, 67 percent for rizatriptan 10 mg, and 63 percent for sumatriptan 100 mg) and were superior to placebo ($p\leq 0.001$). Significantly fewer adverse events were reported with rizatriptan 10 mg (33 percent) compared to sumatriptan 100 mg (41 percent, $p=0.014$).

rizatriptan (Maxalt) and zolmitriptan (Zomig)

Rizatriptan 10 mg and zolmitriptan 2.5 mg were compared in a randomized, double-blind, placebo-controlled, single migraine attack study with 766 patients.¹⁵⁶ Both drugs had a similar pain relief response at two hours (70.5 versus 66.8 percent) although pain-free response (43.2 versus 35.6

percent, $p=0.041$) and return to normal function (45.4 versus 37 percent, $p<0.05$) were greater with rizatriptan. Headache recurrence was similar between the groups. All therapies were well tolerated.

sumatriptan (Imitrex) 4 mg injection

In the randomized, double-blind, placebo-controlled study, 577 subjects received either sumatriptan 4 mg SC or placebo SC for a migraine attack with headache pain of moderate to severe intensity.¹⁵⁷ The primary efficacy measurement was pain relief, reported by way of questioning and observation of subjects at two hours. At two hours post-administration, sumatriptan 4 mg SC was associated with a greater proportion of patients experiencing pain relief (70 versus 22 percent; $p<0.001$) or who were pain free (50 versus 11 percent; $p<0.001$). There were statistically significant differences in favor of sumatriptan 4 mg SC compared to placebo for multiple secondary end points, including pain relief as early as 10 and 30 minutes post-administration.

sumatriptan injection (Alsuma, Sumavel DosePro)

The prescribing information for these products contain the same approval studies included in the prescribing information for sumatriptan injection (Imitrex).^{158,159} No randomized, controlled studies are available.

sumatriptan/naproxen (Treximet) and sumatriptan (Imitrex)

Two randomized, double-blind, single-attack, parallel-group studies were conducted among 1,461 and 1,495 patients who were diagnosed as having migraine and received treatment for a moderate or severe migraine attack.¹⁶⁰ Patients were randomized to receive a sumatriptan/naproxen tablet, sumatriptan 85 mg, naproxen 500 mg, or placebo after onset of a migraine with moderate to severe pain. Primary outcome measures included the percentages of patients with headache relief two hours after dosing, absence of photophobia, absence of phonophobia, absence of nausea for the comparison between sumatriptan/naproxen and placebo, and the percentages of patients with sustained pain-free response for the comparison between sumatriptan/naproxen and each monotherapy. Sumatriptan/naproxen was more effective than placebo for headache relief at two hours after dosing (study one, 65 versus 28 percent; $p<0.001$ and study two, 57 versus 29 percent; $p<0.001$), absence of photophobia at two hours (58 versus 26 percent; 50 versus 32 percent; both $p<0.001$), and absence of phonophobia at two hours (61 versus 38 percent; 56 versus 34 percent; both $p<0.001$). The absence of nausea two hours after dosing was higher with sumatriptan/naproxen than placebo in study one (71 versus 65 percent; $p=0.007$), but not in study two (65 versus 64 percent; $p=0.71$). For two- to 24-hour sustained pain-free response, sumatriptan/naproxen was superior (25 and 23 percent in studies one and two, respectively; all $p<0.01$) to sumatriptan (16, 14 percent), naproxen (10, 10 percent), and placebo (8, 7 percent). The incidence of adverse events was similar between sumatriptan/naproxen and sumatriptan.

zolmitriptan (Zomig) and sumatriptan (Imitrex)

A total of 1,522 patients were randomized in a double-blind trial to receive zolmitriptan 2.5 mg or 5 mg or sumatriptan 50 mg for the treatment of up to six moderate to severe migraine attacks.¹⁶¹ The two-hour headache response was 62.9, 65.7, and 66.6 percent, respectively. No significant differences were seen with the percentage of patients achieving headache response at one or two hours throughout the six attacks. All treatments were well tolerated.

Zolmitriptan and sumatriptan were compared for efficacy in the treatment of migraine headaches in 1,445 patients over six months.¹⁶² In the double-blind study, patients were randomized to zolmitriptan 2.5 or 5 mg, sumatriptan 25 or 50 mg, and were permitted to administer a second dose of study medication for recurrent headache at least four hours after the first dose. Headache response was determined at two hours after dosing and was 67.1 percent for zolmitriptan 2.5 mg, 64.8 percent for zolmitriptan 5 mg, 59.6 percent for sumatriptan 25 mg, and 63.8 percent for sumatriptan 50 mg. Statistically significant differences were observed at two hours between zolmitriptan 2.5 mg and 5 mg and sumatriptan 25 mg (odds ratio=1.47 and 1.54; both $p < 0.001$) and 50 mg doses (odds ratio=1.17, $p = 0.021$; odds ratio=1.22, $p = 0.005$). Similar headache response rates at two hours were seen with zolmitriptan 5 mg and sumatriptan 50 mg. All therapies were well tolerated.

In a triptan-naïve patient population of 1,058, zolmitriptan 5 mg and sumatriptan 100 mg were compared in a multicenter, double-blind, placebo-controlled trial for efficacy in a single migraine attack.¹⁶³ Patients were randomized and evaluated for headache response at one and two hours after dosing. Zolmitriptan and sumatriptan had similar rates of response at one and two hours; pain-free (complete) responses at two hours were 39 percent for zolmitriptan, 38 percent for sumatriptan, and 32 percent for placebo. Adverse effects were similar between the triptan groups.

zolmitriptan (Zomig) nasal spray

In a randomized, double-blind study, zolmitriptan nasal spray was evaluated for efficacy and safety over a one-year period.¹⁶⁴ Patients ($n = 1,093$) were randomized to zolmitriptan 0.5, 1, 2.5, or 5 mg dose or placebo with the availability of a second dose at least two hours after the first. The first portion of the study identified that zolmitriptan 5 mg was the most effective dose in reducing migraine headache pain at two hours post-dose (73.2 percent response rate). Over the one-year period, the response rate at two hours for zolmitriptan nasal spray remained 72 to 74.6 percent. The second portion of the study focused on adverse effects and tolerability, and all patients received zolmitriptan 5 mg for up to one year. Zolmitriptan nasal spray was well tolerated with only 1.9 percent of patients discontinuing therapy due to adverse effects. Adverse effects, which were mostly mild and transient, were reported in 22.1 percent of treated attacks.

A randomized, double-blind, placebo controlled, parallel-group study evaluated the efficacy and tolerability of zolmitriptan nasal spray in patients with moderate or severe migraine headaches.¹⁶⁵ The study included 1,547 patients aged 18-65 years with an established diagnosis of migraine headache or at least a one-year history of migraine symptoms with or without aura. Treatment groups included placebo, zolmitriptan (Zomig) 2.5 mg tablets, and zolmitriptan nasal spray at 0.5, 1, 2.5, and 5 mg. Response was evaluated at 15, 30, and 45 minutes, and 1, 2 and 4 hours post-dose. The primary endpoint was headache response 2 hours post-dose. Other migraine treatments were restricted (e.g., triptans, opiate or ergot derivatives). Headache response at 2 hours was statistically significant for all doses of zolmitriptan nasal spray ($p < 0.001$), with 70.3 percent, 58.6 percent, 54.8 percent, 41.5 percent of attacks responding to zolmitriptan nasal spray 5 mg, 2.5 mg, 1 mg, 0.5 mg, respectively, compared to 61.3 percent for zolmitriptan 2.5 mg oral tablet and 30.6 percent for placebo. Headache response rate to zolmitriptan nasal spray 5 mg and 2.5 mg at 15 minutes was statistically significant compared to placebo (10.6 percent and 8.1 percent versus 5.1 percent, respectively, $p = 0.0115$).

A randomized, double-blind, parallel group, multicenter study evaluated the early efficacy and tolerability of zolmitriptan nasal spray 5 mg versus placebo in the treatment of acute migraine in adults.¹⁶⁶ Patients with an IHS diagnosis of migraine with or without aura were randomized to receive

zolmitriptan nasal spray 5 mg (n=935) or placebo (n=934). Subjects treated up to two migraine attacks within 15 minutes of headache pain becoming moderate or severe in the ten weeks following randomization. The primary efficacy endpoint was headache response (improvement in pain intensity from severe or moderate to mild or none) at 2 hours, 1 hour, 30 minutes, and 15 minutes following treatment. Significantly higher headache response rates, $p < 0.001$, were produced with zolmitriptan nasal spray 5 mg than placebo at 15 minutes (17 percent versus 9.6 percent), 30 minutes (36 percent versus 20.1 percent), 1 hour (53.2 percent versus 30.6 percent), 2 hours (66.2 percent versus 35 percent), and 4 hours (72.9 percent versus 42.3 percent). Pain-free rates were also significantly higher with zolmitriptan nasal spray than with placebo at 15 minutes (1.4 percent versus 0.4 percent; $p = 0.004$), 30 minutes (8.1 percent versus 2.7 percent), 1 hour (21.3 percent versus 7.9 percent), 2 hours (35.6 percent versus 13.7 percent), and 4 hours (52.9 percent versus 21.1 percent; $p < 0.001$ for all comparisons beyond 15 minutes). The sustained headache response rate at 24 hours (52.6 percent versus 24.4 percent); and the sustained pain-free rate at 24 hours (29.8 percent versus 11.5 percent) were significantly higher ($p < 0.0001$) with zolmitriptan nasal spray compared to placebo.

rizatriptan (Maxalt)

In a randomized, placebo-controlled, double-blind study, rizatriptan orally disintegrating tablet was evaluated for efficacy and tolerability in patients who were non-responders to sumatriptan.¹⁶⁷ In the baseline phase, participants treated a single moderate/severe migraine attack with open-label generic sumatriptan 100 mg. Those who continued to experience moderate/severe pain at two hours post-dose were eligible to enter the double-blind treatment phase, during which participants treated three migraine attacks in crossover fashion (two with rizatriptan 10 mg ODT, one with placebo) after being randomly assigned to one of three treatment sequences (1 : 1 : 1 ratio). The primary endpoint was two-hour pain relief. A total of 102 (94 percent) acute migraine participants treated at least one study migraine. Pain relief at two hours was significantly greater with rizatriptan compared with placebo (51 percent versus 20 percent, $p < 0.001$). Response rates also favored rizatriptan on two-hour pain freedom (22 percent versus 12 percent, $p = 0.013$) as well as 24-hour sustained pain relief (38 percent versus 14 percent, $p < 0.001$) and sustained pain freedom (20 percent versus 11 percent, $p = 0.036$). Treatment was generally well tolerated. Rizatriptan 10 mg ODT was superior to placebo at providing two hour pain relief and two hour pain freedom in the treatment of acute migraine in those who do not respond to sumatriptan 100 mg. Rizatriptan was generally well tolerated in this population.

META-ANALYSIS

Pharmaceutical companies and the principal investigators of company-independent trials were asked for raw patient data of all double-blind, randomized, controlled, clinical trials of oral triptans in migraine.¹⁶⁸ There were 53 clinical trials (12 unpublished), involving 24,089 patients, meeting the criteria for inclusion. Mean results for sumatriptan 100 mg were 59 percent (95% CI, 57 to 60) for two-hour headache response; 29 percent (95% CI, 27 to 30) for being pain-free at two hours; 20 percent (95% CI, 18 to 21) for sustained pain-free response; and 67 percent (95% CI, 63 to 70) for consistency of effect when administered for separate headaches. Placebo-subtracted adverse event rates were 13 percent (95% CI, 8 to 18) for patients with at least one adverse event, six percent (95% CI, 3 to 9) for at least one central nervous system adverse event, and 1.9 percent (95% CI, 1 to 2.7) for at least one chest adverse event. Compared with these data, rizatriptan 10 mg showed better efficacy and consistency as well as similar tolerability, and almotriptan 12.5 mg showed similar efficacy at two hours and better results at other time points. Studies with other triptans resulted in no significant differences

compared to sumatriptan. The results of the 22 trials that directly compared triptans show the same overall pattern. Frovatriptan and sumatriptan/naproxen were not available at the time of this analysis. Eletriptan 80 mg showed increased efficacy compared to sumatriptan, but it is not currently available in the US, nor is the 80 mg dose FDA-approved.

SUMMARY

The US Headache Consortium, the American Academy of Family Physicians, and the American College of Physicians – American Society of Internal Medicine have recognized that the triptans are effective agents for the acute treatment of migraine. NSAIDs, or combinations such as aspirin plus acetaminophen plus caffeine, are recommended as first-line therapy for those patients with mild to moderate migraine pain. Professional guidelines have not established a superior NSAID. There are many choices available as generics.

Migraine-specific agents such as the triptans should be used in patients whose migraine attacks do not respond to NSAIDs. Sumatriptan (Imitrex) is regarded as the standard by which the other agents in the triptan class are measured. By comparison, there is no other triptan that has been shown to be consistently more effective or safer; however, most triptans can be as effective as sumatriptan. If any, almotriptan (Axert) and rizatriptan (Maxalt), by virtue of meta-analysis, may be able to claim greater effectiveness. However, the triptans appear to be equally safe.

There may be advantages to certain products. Frovatriptan (Frova) has the longest half-life of the products. Theoretically, patients should not need to redose as frequently with this product; however, it may take longer for the product to begin to work. The other triptans have similar half-lives and durations of action, but naratriptan (Amerge) may have a slower onset of relief compared to the other triptans. Almotriptan is FDA-approved for use in adolescents. A non-oral route of administration is available when nausea or vomiting present as significant components of migraine attacks. Rizatriptan is available as an oral tablet and a rapidly disintegrating oral tablet; sumatriptan is available as an oral tablet, nasal spray, and injection; and zolmitriptan (Zomig) is available as an oral tablet, rapidly disintegrating oral tablet, and nasal spray. Nasal irritation can occur and unpleasant taste is common with nasal administration. Both often begin to produce relief in 15 minutes. Subcutaneous administration of sumatriptan (Alsuma, Imitrex, Sumavel DosePro) can have an onset of pain relief as soon as 10 minutes following a dose.

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